

# FROM BIOMASS TO BIOGAS: PRESENT DAY STATUS & FUTURE REQUIREMENTS



# **FROM BIOMASS TO BIOGAS: PRESENT DAY STATUS & FUTURE REQUIREMENTS**

---

Monitor and Evaluate the Currently  
Employed Marketing Efforts by the  
Tanzania Domestic Biogas Programme.

*&*

Assess the Application of Social  
Marketing Techniques and Principles in  
Promoting Biogas in Tanzania.

## PERSONAL DATA

---

Title of thesis: From Biomass to Biogas: Present Day Status & Future Requirements

Author: Paul Wilhelm Gerardus Warnars

Student number: 3691144

E-mail address: p.w.g.warnars@gmail.com

University: Utrecht University

Faculty: Faculty of Geosciences

Programme: MSc International Development Studies

Number of ECTS: 15

Supervisor: Dr. Henk Huisman

Place and date: Utrecht, October 2012

## EXECUTIVE SUMMARY

---

A reliable supply of energy is the catalyst for any country's economy. However, energy recourses are becoming increasingly scarce and subsequently expensive. This has a substantial impact on the socio-economic progress of developing countries that lack financial, physical and human capital to secure their supply of energy. In Africa, the situation is marked by an insufficient generation capacity, unreliable supplies, high prices and a poorly performing energy infrastructure. Not surprisingly, energy provision is characterized by a high reliance on traditional biomass fuels. Especially in Tanzania. Only 6 per cent of all Tanzanians has access to the electricity grid. More than 90 per cent of the country's energy consumption derives from the energetic value of biomass fuels such as firewood and charcoal. This dependency hampers social and economic progress, leads to deforestation and land degradation, and causes many health problems because of indoor air pollution. Since the government is incapable to deliver a reliable energy network in the foreseeable future, improvement seems unlikely without private sector initiatives. The Tanzania Domestic Biogas Programme is such an initiative that fosters socio-economic development by stimulating the use of biogas. Biogas is produced from excreta in small scale digesters for domestic use. The technology is simple, affordable, uncomplicated to operate and easy in maintenance. This makes it an ideal renewable energy source for smallholder farmers with a few cattle.

The objective of the biogas programme is to improve the livelihood and quality of life for rural households by developing a commercial viable biogas sector. This study has a focus on the commercial aspects. The exercise is to provide the programme with insights about the performance of the employed marketing activities and to contribute to the application of social marketing in dissemination strategies. Currently, there is no coherent marketing strategy in place and there are no tools to evaluate promotion interventions. This study is constructed around various models and approaches that discuss consumer behaviour, market potential, promotion efficiency and new diffusion strategies. The primary data for this study is obtained through qualitative field research. Quantitative data plays a secondary role and is used to evaluate and complement the gathered field data in this exploratory study. A total of 116 respondents are interviewed, ranging from potential clients to implementing partners.

The results show that the programme is experiencing many barriers and challenges that hinders a successful dissemination of the technology. The sector is not performing according to expectations. There is little support from the government, poor access to feasible credit facilities, much poverty, a lack of entrepreneurial skills, a limited energy use in rural areas, freely available firewood, a low level of awareness, poorly performing partners and disproportionately high costs for constructing plants in remote localities. Moreover, biogas is often not seen as a fully fledged solution because it does not provide electricity to charge a cell phone. All in all, this makes it difficult for the programme to reach a high level of penetration. Consequently, the penetration rate of biogas is approximately 3.03 per cent. Even though the technology is still in an early stage of diffusion, the demand for biogas among potential customers is low because the technology is perceived too expensive. The programme is inadequately communicating the costs of applying biogas. Hence, potential clients are poorly informed about the costs and develop a wrong cost perception. Also masons are poorly aware of the costs and rely on their implementing partner to make pre-calculations for them. Marketing can change this wrong perception by promoting the actual costs of applying biogas. In reality, an average smallholder farmer in Tanzania is able to pay back its digester within 22 months due to savings on energy expenditures and higher crop revenues from applying bio slurry. This, however, is not known by potential customer nor mason. It shows that marketing fails to communicate the most appealing benefit of biogas: financial prosperity.

The programme is the main promoter of the technology and responsible for the design and implementation of the marketing-communication strategy. Promotion is employed on a national, local and regional level. The programme itself is concerned with promotion on a national level. This is primarily done through mass media exposures in newspapers or on television. Ironically, potential biogas clients in rural areas rarely read newspapers and do not have televisions. National mass activities are thus highly ineffective and inefficient. Regional promotion activities are more efficient. This consist of promotion at livestock markets and farmers exhibitions, but also through ineffective mass media exposures. This is performed by the programme with its implementing partners. Local promotion activities are proven to be most effective and efficient, especially the demonstration of a working digester is very convincing to potential customers. Social pressure is a strong motivation, individuals with a high social status in their community are good ambassadors for the technology. Masons and biogas enterprises are accountable for local promotion activities. Other partners such as local government officers, promoters and loan companies play a minor role in the promotion of biogas. Even though local promotion activities are successful, the amount of constructed digesters is lacking behind target, the demand for biogas remains low and potential clients perceive too many barriers to invest in biogas. There are various reasons for not fully utilizing the local promotion potential; Masons are not motivated enough to promote digesters because the construction of digesters is not their primary source of income. The geographical spread of localities, poor infrastructure and lack of transport limits the area a mason can cover. Masons lack commercial skills, knowledge and promotion material to 'sell' their digester. And there is

a strong dependence on the efforts of the implementing partners. Hence, the programme need to reorganize its marketing-communication strategy for a more successful dissemination of the technology. Marketing insights may contribute to new approaches and initiatives.

This thesis discusses a mixture of marketing models, principles and approaches. These views argue that the programme should change its marketing approach by promoting those benefits that appeal to individuals that currently use biogas. Current users are interested in technologies that sets them a step higher on the development ladder and gives them an advantage over their peers. They calculate the overall benefits of applying biogas by subtracting the costs of adopting it. This is natural behaviour, all human relationships are formed by the this subjective cost-benefit analysis. Also for the biogas sector, financial consequences are the most dominant motives for potential customers to invest, or not, in biogas. Consequently, the programme must be clear and transparent in communicating the costs of applying biogas. Which is done most effective and efficient by local masons. The role of the programme should be supportive instead of leading. Masons need to be supported by the programme with promotion materials and receive trainings to develop commercial skills. The programme can also enable a feasible environment to invest in biogas and learn people about the benefits of renewable energy from a young age, encourage biogas through feasible credit facilities, and foster an information network for stakeholders. Furthermore, the programme should have a focus on growth in geographically selected core areas and invest selectively in expansion to other areas. Consequently, the programme should only have a focus on households with an interest and proven potential for biogas.

This study also provides a range of recommendations and ideas that might contribute to a higher biogas demand and viable sector; Since the price of a digester is a major barrier for potential clients, the programme must be clear, straightforward and transparent in communicating the costs. In reality, it appears that most households can afford a digester. The available subsidies can be used in providing low interest and long term loans that coincide with the payback time of a digester. Reach a high penetration degree in the localities where the programme is currently active and focus on individuals with a high status in their community. Design promotion material that is customized to a specific locality and include contact details of the mason there. Limit the programme to masons that perform well and do not let bad performing masons spoil localities. Start learning people about biogas from a young age by providing school material concerning the importance of the environment. And, cooperate with other energy projects and -possibly- offer hybrid forms of energy delivery.

All in all, even though the programme is not performing very well, biogas is still in an early stage of diffusion and there is plenty of market potential undiscovered. Local promotion activities are most effective, not only now, but also in the future of the programme.

**Keywords:** biogas, energy provision, social marketing, rural development, Tanzania

## PREFACE

---

The thesis is written for my Master degree International Development Studies at Utrecht University. My internship assignment at the domestic biogas programme in Tanzania forms the basis for this study.

The exercise of this study is to provide the biogas sector in Tanzania with information about the performance of the employed marketing interventions together with providing views for a more successful diffusion of the technology. This assignment has thus a focus on the dissemination of biogas in rural Tanzania to substitute the reliance on traditional biomass fuels, which also explains the title of this study: ‘From Biomass to Biogas’. The purpose is to provide the biogas programme with insights about the functioning of the marketing activities employed by the programme and to contribute to the application of social marketing in the dissemination process, which relates to the second part in this study’s title: ‘Present Day Status & Future Requirements’. The diffusion of biogas will be explained by applying (social-) marketing models and principles.

During my Master I had a particular interest in the topics of economic progress and (renewable) energy for development. In my modest employment I worked as a project manager and marketer for two companies that initiate renewable energy projects in the Netherlands. Prior to my Master, I studied a Bachelor in Commercial Economics and Entrepreneurship. The internship at the biogas programme in Tanzania is thus in line with my personal interests and career.

This study is divided into two parts. The first part includes the introduction, various views on the dissemination of biogas for development and the methodology. The second part contains the results of my internship, analytical marketing results, a synthesis and conclusion with recommendations. This thesis will traditionally end with a reflection, literature list and appendices.

## ACKNOWLEDGEMENT

---

My adventure in Tanzania and the begin of my research started in February 2012. SNV Arusha gave me the opportunity to conduct my research and fulfil my internship at the domestic biogas programme. In this section I would like to thank everybody that has contributed to realization of this study in one way or another.

In the first place I thank the Dutch development organization SVN that facilitated my research. I also like to thank the biogas programme itself, TDBP. TDBP gave me insight in their organization and helped me with transport and translators. I am very thankful for the assistance of these two organisations and a few people in particular; Tom ole Sikar and Peter Bos from SNV Arusha, mama Elda and mister Shila from TDBP, and my translator John. Furthermore I am very thankful to all respondents that made time available and were willing to share their story with me. Without your help this research would not be possible.

Alex, I am thankful I shared this experience with you. Our discussions, movie nights and evenings spend in the ViaVia were very enjoyable. During my visit I had the opportunity to meet many people and make new friendships, you all made this experience unforgettable and motivate me to go back to Tanzania. My good friend Quirijn, the three weeks we spend at the national parks and Zanzibar are memorable. This is considered to be the best holiday I ever had, I am glad I shared this with you.

Then, of course, my family and friends back home. I was always delighted to receive Facebook messages and emails from the home front. The Skype conversations I had with my sister Lisa always made my day and were very motivational. I like to thank Alphonse who shared his Tanzania experiences with me and brought me in contact with helpful people in Arusha. Chris Hennessy, your support is very much appreciated and I am very thankful for your help. Mom and dad, this all would not be possible without your help. I will always be grateful for your support throughout my studies.

Last but not least, my supervisor Doctor Henk Huisman. I would like to thank you very much for your supervision throughout this research and your valuable input. Your visit to Arusha was really refreshing and very much appreciated. Your experiences, interesting stories, enthusiasm and straightforward views on development have been very inspirational.



---

# TABLE OF CONTENTS

---

<b>PERSONAL DATA</b> .....	<b>iii</b>
<b>EXECUTIVE SUMMARY</b> .....	<b>ii</b>
<b>PREFACE</b> .....	<b>v</b>
<b>ACKNOWLEDGEMENT</b> .....	<b>vi</b>
<b>TABLE OF CONTENTS</b> .....	<b>vii</b>
<b>LIST OF TABLES, MAPS AND FIGURES</b> .....	<b>xi</b>
<b>ABBREVIATIONS</b> .....	<b>xiii</b>
<b>CONVERSIONS</b> .....	<b>xiv</b>
<b>PROLOGUE   FROM POWER DEMAND TO DEMANDING POWERS</b> .....	<b>xv</b>
Energy Demand in a Globalized Economy.....	xvi
The Energy Economy.....	xvi
The Driving Force of an Increasing Energy Demand.....	xvi
Energy for the Developing World.....	xvi
Underpowered: The Power Sector in Sub-Saharan Africa.....	xvii
Energy in Tanzania.....	xviii
<b>PART I</b> .....	<b>1</b>
<b>1   INTRODUCTION: FROM BIOMASS TO BIOGAS</b> .....	<b>2</b>
1.1 Renewable Energy in Tanzania.....	3
1.2 A Focus on Biogas.....	4
1.2.1 Today's Biogas Programme.....	4
1.2.2 Contemporary Challenges in Promoting Biogas.....	5
1.2.3 Drivers & Barriers for Biogas Penetration in Tanzania.....	5
1.3 Marketing Biogas: Present Day Status and Future Requirements.....	7
1.3.1 Social Marketing.....	7
1.3.2 Community-Based Social Marketing.....	7
1.3 Conclusion & Structure of this Study.....	8
<b>2   VIEWS ON BIOGAS DIFFUSION FOR DEVELOPMENT</b> .....	<b>10</b>
2.1 A Framework for Analysis.....	11
2.1.1 Layout Theoretical Framework.....	11

2.2	Drivers & Barriers for Promoting Renewable Energy in Tanzania.....	13
2.2.1	Drivers in Promoting Renewable Energy .....	13
2.2.2	Barriers for Renewable Energy Penetration .....	13
2.2.3	Conquering Barriers for Successful Renewable Energy Penetration.....	15
2.3	Renewable Energy: a Driving Force for Development .....	16
2.3.1	Challenges for Developing Countries.....	16
2.3.2	Climbing the Energy Ladder .....	17
2.3.3	What goes First... Income Growth or Economic Growth?.....	17
2.3.4	A Centralized or Decentralized Renewable Energy Approach? .....	18
2.4	Behaviour Change Theories .....	19
2.4.1	Cause Related Marketing.....	19
2.4.2	The Theory of Reasoned Action & Planned Behaviour .....	19
2.5	Economic Feasibility Biogas.....	20
2.5.1	The (Social-) Exchange Theory.....	20
2.5.2	Financial Cost / Benefit Analysis .....	20
2.6	Illustrating the Market Potential for Biogas in Tanzania.....	21
2.6.1	Biogas Market Potential in Geographical Perspective.....	21
2.6.2	Potential Diffusion Biogas Technology.....	23
2.7	Promotion Dimensions .....	24
2.7.1	Promotion Efficiency and Effectiveness.....	24
2.7.2	The AIDA Model .....	25
2.8	Marketing Analysis .....	25
2.8.1	The 4 E's .....	25
2.8.2	The Market and Business Attractiveness (MABA) .....	26
2.9	Conclusion.....	27
<b>3</b>	<b>  ASSESSING THE BIOGAS SECTOR: METHODS APPLIED .....</b>	<b>28</b>
3.1	Research Questions and Assumptions.....	29
3.1.1	The Starting Point.....	29
3.1.2	Research Questions .....	29
3.1.3	Assumptions .....	30
3.2	Conceptual Model .....	31
3.3	Exploratory Research .....	32
3.4	Gathering Primary Data .....	33
3.5	Research Limitations.....	34
3.6	Conclusion.....	35

<b>PART II</b> .....	<b>36</b>
<b>4   ASSESSING THE BIOGAS SECTOR</b> .....	<b>37</b>
4.1 Biogas Potential .....	38
4.1.1 Calculating the Highest potential Biogas Regions.....	38
4.1.2 Demand Potential per District .....	42
4.2 Biogas Perceptions .....	43
4.2.1 Awareness .....	44
4.2.2 Knowledge.....	45
4.2.3 Perceived Barriers .....	47
4.2.4 Perceived Benefits .....	48
4.2.5 Attitude.....	50
4.2.6 Biogas Demand .....	51
4.3 The Costs of Adopting Biogas .....	52
4.4 Biogas Promotion Efficiency and Effectiveness .....	54
4.4.1 Effectiveness Promotion Activities Employed by the Programme.....	54
4.4.2 Efficiency Promotion Activities Employed by the Programme.....	56
4.4.3 Promotion Effectiveness Versus Efficiency .....	61
4.5 Summary .....	62
<b>5   STRATEGIC BIOGAS MARKETING</b> .....	<b>63</b>
5.1 The Market and Business Attractiveness (MABA) of Biogas.....	64
5.1.1 Business Attractiveness .....	64
5.1.2 Market Attractiveness.....	64
5.1.3 Determine the Market & Business Attractiveness for the Biogas Programme .....	65
5.1.4 MABA's Strategic Matrix Evaluation .....	66
5.2 Potential Diffusion of the Biogas Technology in Tanzania.....	67
5.2.1 Intrinsic Characteristics .....	67
5.2.2 Importance of Peer Networks .....	68
5.2.3 Understanding the Needs of User Segments.....	69
5.2.4 Illustrating the Potential Diffusion of the Biogas Technology in Tanzania.....	69
5.3 Biogas Promotion Scales.....	70
5.3.1 The AIDA Model for the Biogas Sector.....	70
5.3.2 The Biogas Promotion Pyramid .....	72
5.4 Stimulating Change: from Biomass to Biogas .....	72
5.5 Economic Feasibility Biogas.....	74

5.5.1	Break Even Point .....	74
5.5.2	Return On Investment.....	77
5.6	Summary .....	78
<b>6</b>	<b>  SYNTHESIS, DISCUSSING BIOGAS DISSEMINATION .....</b>	<b>79</b>
6.1	Getting the Answers .....	80
6.1.1	Sub Questions Considering Potential Biogas Customers .....	80
6.1.2	Sub Questions Considering the Biogas Programme .....	83
6.2	Are the Assumptions Valid, or Not? .....	86
6.2.1	Contextual Dimensions .....	86
6.2.2	Potential Biogas Customers.....	87
6.2.3	The Tanzania Domestic Biogas Programme .....	88
6.3	Conclusion.....	89
<b>7</b>	<b>  LOOKING BACK &amp; LOOKING FORWARD.....</b>	<b>90</b>
7.1	Looking Back .....	91
7.2	Looking Forward.....	92
7.3	Recommendations .....	93
	<b>FINAL REFLECTIONS.....</b>	<b>95</b>
	<b>BIBLIOGRAPHY .....</b>	<b>97</b>
	<b>APPENDICES .....</b>	<b>104</b>
	APPENDIX A: Table to determine most potential biogas areas .....	105
	APPENDIX B: Maps to determine most potential biogas areas .....	106
	APPENDIX C: Employed promotion activities per scale and stakeholder .....	108
	APPENDIX D: Return on investment table .....	109
	APPENDIX E: Map Tanzania with programme and implementing partners .....	110

---

## LIST OF TABLES, MAPS AND FIGURES

---

### Tables

Table 1	Framework for elaborating on each marketing P	p. 12
Table 2	Interviews conducted	p. 33
Table 3	Table to calculate most potential biogas areas	p. 105
Table 4	Level of awareness	p. 44
Table 5	Level of awareness per district	p. 45
Table 6	Level of potential clients <i>not exposed</i> to local promotion activities	p. 46
Table 7	Level of potential clients <i>exposed</i> to local promotion activities	p. 46
Table 8	Barriers for investing in biogas	p. 47
Table 9	Drivers for investing in biogas	p. 49
Table 10	Attitude towards biogas	p. 50
Table 11	Biogas demand	p. 51
Table 12	Perceived versus actual costs	p. 53
Table 13	Impact promotion activities	p. 54
Table 14	Promotion costs versus impact	p. 57
Table 15	Promotion costs, waste and synergy	p. 60
Table 16	Promotion effectiveness and efficiency	p. 61
Table 17	Business attractiveness biogas programme	p. 66
Table 18	Market attractiveness biogas programme	p. 66
Table 19	Intrinsic deterrents for biogas dissemination	p. 68
Table 20	Breakeven point for biogas investment	p. 77

### Maps

Map 1	Population density Tanzania 2007	p. xviii
Map 2	Research area in Tanzania	p. 33

Map 3	Mean distance to collect firewood (in km.)	p. 39
Map 4	Average annual precipitation (in mm.)	p. 106
Map 5	Improved water access per district	p. 106
Map 6	Livestock per square kilometre	p. 40
Map 7	Percentage of people below the basic need poverty line	p. 106
Map 8	Poverty headcount per district	p. 106
Map 9	Average annual temperature (in Celsius)	p. 41
Map 10	Environmental conditions	p. 107
Map 11	Potential biogas demand (in points)	p. 42
Map 12	Potential biogas demand (points categorized)	p. 43

## Figures

Figure 1	Logo TDBP	p. 4
Figure 2	The four marketing P's	p. 12
Figure 3	Determine the highest potential biogas areas	p. 22
Figure 4	Diffusion of innovations model	p. 23
Figure 5	The AIDA model	p. 25
Figure 6	The market and business attractiveness analysis	p. 26
Figure 7	Conceptual framework	p. 31
Figure 8	Determine the highest potential biogas areas	p. 38
Figure 9	SACCOS company that facilitates credit for the construction of digesters	p. 48
Figure 10	Mixing manure with water for the digester to operate	p. 48
Figure 11	Promotion activities per geographical scale	p. 55
Figure 12	Market and business attractiveness biogas	p. 67
Figure 13	Biogas promotion scales	p. 72
Figure 14	Four E's framework for the biogas programme	p. 73

---

## ABBREVIATIONS

---

<b>AIDA</b>	Awareness, Interest, Desire, Action
<b>BCE</b>	Biogas Construction Enterprise
<b>BEP</b>	Break Even Point
<b>CAMARTEC</b>	Centre for Agricultural Mechanization and Rural Technology
<b>GDP</b>	Gross Domestic Product
<b>GoT</b>	Government of Tanzania
<b>GW</b>	Giga Watt
<b>IP</b>	Implementing Partner
<b>MABA</b>	Market Attractiveness and Business Attractiveness
<b>NGO</b>	Non-Governmental Organization
<b>ROI</b>	Return On Investment
<b>SACCOS</b>	Savings and Credit Cooperative Society
<b>SNV</b>	Netherlands Development Organization
<b>TANESCO</b>	Tanzania Electricity Supply Company
<b>TDBP</b>	Tanzania Domestic Biogas Programme
<b>TZS</b>	Tanzanian Schilling

## CONVERSIONS

---

Conversions are based upon the currency rates from 8 October 2012 (XE, 2012).

1.00 United States Dollar (USD)	=	1,575.00 Tanzanian Shilling (TZS)
1.00 Tanzanian Shilling (TZS)	=	0.000634921 United States Dollar (USD)
1.00 Euro (EUR)	=	2,027.70 Tanzanian Shilling (TZS)
1.00 Tanzanian Shilling (TZS)	=	0.000493170 Euro (EUR)



# **PROLOGUE** | **FROM POWER DEMAND TO DEMANDING POWERS**

---

Energy is a hot topic in today's academic and political debate. A growing world population together with a greater uses of modern conveniences is accompanied by an increase in energy demand. Energy, and especially a reliable supply of energy, plays a significant role in today's world economy and is perceived to be the catalyst for any country's economy. The available fossil energy resources are becoming increasingly scarce. Mounting energy prices because of the scarcity is a major burden for developing nations. Especially for these countries there is a strong need to reform their supply of energy. The run on energy resources will change the current geopolitical relations considerably. Countries put pressure on the energy sector and other nations to secure their supply (Broadhead & Kilmann, 2008; Thorp, 2011; Mihaele, 2008). Therefore the title of this prologue is 'from Power Demand to Demanding Powers'.

## **Energy Demand in a Globalized Economy**

### The Energy Economy

There is a direct correlation between the degree of integration in the world economy and the increase in a country's energy demand. It is evident that the demand for energy is rapidly growing, not only in the presently developed economies, but in developing countries as well. Economic progress is impossible without a reliable supply of energy. It is thus important to recognize the role of energy in obtaining the benefits of globalization for development. This expanding world economy will create an unprecedented demand for energy (Thorp, 2011, p. 83).

Fossil fuels (oil, natural gas and coal) continue to remain the dominant source of energy in the following decades, accounting for 84 per cent of the overall increase in energy demand between 2005 and 2030. It is estimated that a 22 trillion US dollars investment is needed in this time span to improve on the global supply infrastructure (Mihaela, 2008, p. 171). The competition over energy resources will grow intense as key resources dwindle, prices rise, and supplies shrink (*ibid.* p. 84). It is inevitable that a new global energy economy is emerging, in which energy demand and supply makes countries and regions in the world much more interdependent (Mihaela, 2008, p. 170). As globalization continues, free markets should ensure an efficient movement of investment capital and fossil fuels. However, rather than free markets, anxious governments might decide how capital and energy supplies are allocated (Thorp, 2011, pp. 83). A 2005 report from the United States National Intelligence Council claims that this new global energy economy will have substantial impacts on geopolitical relations (*ibid.* p. 79).

### The Driving Force of an Increasing Energy Demand

The process of shifting labour patterns is seen all over the globe, it is not limited to the western world. Economies make a transition from low-wage agricultural labour activities to manufacturing to higher-paid office and service employment (Thorp, 2011, pp. 78-79). Many people experience remarkable shifts in lifestyle as economies change from a subsistence to an industrial or service based economy. Economic progress together with a high population growth and an increasing amount of modern conveniences is accompanied by a fast growing energy demand (Broadhead & Killmann, 2008, p. 5). The World Energy Outlook 2009 calculated that energy demand grew with 66 per cent from 1980 to 2007, it also projects that this demand will increase with another 40 per cent from 2007 to 2030 (EIA, 2009).

### Energy for the Developing World

More and more countries tap into the global economy to modernize their economies and societies. Developing nations increased their energy consumption rapidly, from 22 per cent of the world's total energy consumption in 1970 to 46 per cent in 2004. Projections indicate that energy consumption will become dominated by developing economies in 2030, with a share of 57 per cent of all consumed energy (Mihaela, 2008, p. 171). Energy consumption in developing countries is growing with 3 per cent annually contrary to 0.9 per cent in already industrialized

countries. The lion share of this increase in demand will derive from rapid economic growth in Asia, especially in India and China. Asia will more than double its energy consumption in the next 20 years and is responsible for approximately 65 per cent of the total increase in energy demand. High investments are essential to keep up with this growing energy demand. Economic progress will lack behind if investments in production capacity and infrastructure are insufficient (Broadhead & Killmann, 2008, p. 9).

### **Underpowered: The Power Sector in Sub-Saharan Africa**

The energy infrastructure in Sub-Saharan Africa (hereafter Africa) is considered to be the poorest in the world. Approximately 74 per cent of all Africans lack access to electricity, compared to 28 per cent of the population in all developing countries combined (Kahsai et al., 2011). With 68 gigawatts (GW), the total generation capacity of the 48 countries of Sub-Saharan Africa combined is less than Spain's generation capacity. Excluding the relatively developed South-Africa, this result in a total production capacity of 28 GW. There is little progress in Africa's energy sector. The gap between Africa and other developing regions is growing (AICD, 2008, p. 5). A study from the International Energy Agency (IEA, 2004) claims that energy consumption correlates with wealth. Since a lack of stock is evident in Africa, it is no surprise that many households lack access to proper energy facilities. Unless efforts to improve its energy network are made, energy poverty will continue to hamper economic development and poverty alleviation in Africa (Kahsai et al., 2011).

Africa's power crisis is marked by insufficient generation capacity, unreliable supplies, high prices and a poorly performing energy infrastructure. The average price of a unit energy is twice as high as compared to other developing regions, whilst the supply of energy is extremely unreliable. Power outages in Africa are 56 days per year on average. This poor functioning power network is accountable for significant losses in turnover for both formal and informal enterprises, 6 and 16 per cent annually respectively. The amount of new households connected to the electricity grid is not keeping up with the population growth, the electrification rate is thus declining (AICD, 2008, pp. 5-6). Not surprisingly, in most parts of Africa energy provision is characterized by a high reliance on traditional biomass. Unfortunately this form of energy provision is unsuited to encourage economic progress, it puts a heavy burden on the environment and causes many health problems (Kahsai et al., 2011, p. 739).

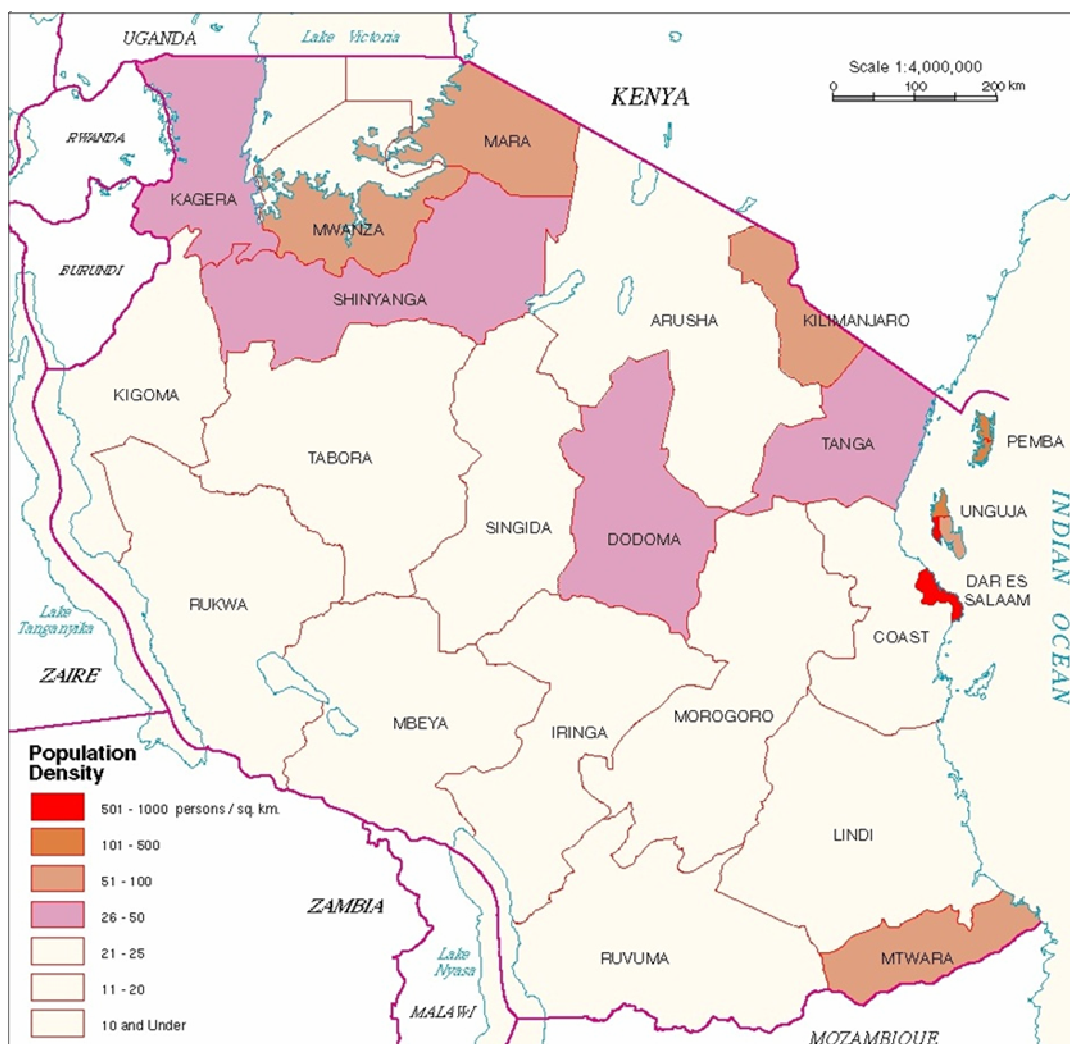
Africa has much potential to produce sustainable and high quality energy from solar, wind, hydro and geothermal sources. Together with the proven oil and gas reserves, there should be enough energy for adequate economic progress of the African economy. The lack of financial, physical and human capital is a major obstacle for all nations in Africa. Promoting the continent as an unity may enhance sustainable progress, increase competitiveness and improve integration with the global economy (ibid. 745).

## Energy in Tanzania

### *Population, urbanization and energy demands*

Tanzania has a population of 43,600,000 (CIA, 2012), a vast majority (74 per cent) lives in rural areas. Due to a high population growth and an emerging city migration, the rate of urbanization is dramatically increasing over the last decades. (Katyega & Marandu, 2001, p. 34). It is estimated that the rate of urbanization is growing with 4.7 per cent from 2010 to 2015 (CIA, 2012). This high urbanization rate together with increased economic activities translates itself into growing energy demands. Only 6 per cent of the population in Tanzania has access to the electricity grid (Katyega & Marandu, 2001, pp. 34-35). The electricity demand is 900 megawatt (MW) annually while the production capacity is only 700 MW (Mwema & Shabbir, 2011). This causes the electricity grid to be extremely unreliable, the average power outage is 63 days a year (AICD, 2008, p. 10). It is estimated that the demand for electrical energy in Tanzania is currently growing with 9 to 10 per cent a year (Mwema & Shabbir, 2011).

**Map 1: Population Density Tanzania 2007**



Source: Website Digital National Atlas, 08-10-2012

### *Country size in relation to energy provision*

With 947,000 square kilometres in size (CIA Factbook, 2012), Tanzania is a large country. With 26 per cent of the people living in cities, the majority of the population is living in peripheral areas. The central part of Tanzania is sparsely populated. Due to large distances it is perceived to be economically unattractive to construct an energy network that covers the majority of the sparsely populated rural areas (Katyega & Marandu, 2001, p. 34).

### *Income versus energy consumption*

Tanzania is classified among the poorest countries in the world, its annually per capita income is estimated at 1,500 US dollars in 2011 (CIA, 2012). The low per capita income relate to a low electricity consumption and lead to a greater use of cheap but unsustainable biomass resources. This, in turn, creates a severe limit on the development of the power sector. It demonstrates that there is a causal relationship between poverty levels and power sector developments (Katyega, M., Marandu, M., 2001, p. 35).

### *The energy balance of Tanzania*

Over 90 per cent of Tanzania's energy consumption derives from the energetic value of traditional biomass fuels such as firewood and charcoal. Petroleum and electricity account for 8 and 1.2 per cent respectively. Charcoal and firewood is Tanzania's primary source of energy, 94 per cent of the people use it either alone or mixed with other fuels. Kerosene is the most widely used fuel for lighting, but increasing kerosene prices pose an additional burden on many households. In 1990, the total biomass recourse potential from natural forests was the equivalent of 27 million tonnes of oil. Using biomass is preferred because electricity is too expensive for the majority, unreliable due to power outages and poorly available since the electricity grid is limited to urban areas. Unreliability and poor availability can be overcome by the use of decentralized energy units in isolated grids. However, decentralized and small scale energy networks are perceived too expensive, this is because of the high initial investment price and future maintenance costs. Contrary to electrical energy, biomass is free, reliable and widely available (Mwema & Shabbir, 2011).

### *Consequences of using biomass*

The main energy sources in Tanzania are charcoal, firewood, dung and other traditional biomass fuels. Its use is growing in absolute terms because of the fast population growth. Many people suffer with difficulty in breathing, stinging eyes and chronic respiratory diseases. Young children and mothers die frequently because of indoor air pollution from the use of charcoal and firewood inside their homes. It also leads to an overexploitation of natural forests and severe soil and land degradation. With an average charcoal consumption of 750,000 tonnes in 2000, the amount of consumed wood in Tanzania was 22.27 million m<sup>3</sup>. This means that the average consumption of charcoal and firewood per person was 30.05 m<sup>3</sup> and 7.5 m<sup>3</sup> respectively. Many people are unaware of the ecological consequences of the disproportionate use of traditional biomass fuels. Firewood collection is the most important

cause of deforestation and land degradation, accounting for approximately 91,000 hectares of land annually. The land covered with forest decreased from 46 per cent in 1990 to 41 per cent in 2000 and 37.5 per cent in 2005 (*Mwema & Shabbir, 2011*).

### *Renewable energy*

Electricity accounts only for 1.2 per cent of the total energy consumption, around 73 per cent of this electricity is generated with hydropower turbines. Approximately 0.8 per cent of Tanzania's energy consumption derives from other renewable energy resources such as solar panels, bio fuels and biogas. There is still much potential development of renewable energy in Tanzania (*Gwang'ombe, 2004, p. 2*).

All in all, the global demand for energy is rapidly growing. Competition over energy resources will grow intense as resources dwindle, prices rise and supply shrink. Countries and regions in the world are more and more depending upon each other for a steady supply of energy. Countries that lack access to proper energy resources are incapable to modernize their economies. This is also true for Africa, Africa's power crisis is marked by insufficient generating capacity, unreliable supplies, high prices and a poor performing infrastructure. The average price of an unit of energy is twice as high compared to other developing regions in the world. Unless efforts to improve the current energy network are made, energy poverty may continue to hamper economic development and poverty alleviation. The development of a reliable and independent supply of energy is thus essential for social and economic progress in Africa. Especially for Tanzania, where only 6 per cent of the population has access to electricity. The majority of the population applies traditional biomass fuels such as firewood and charcoal to heat their homes and cook their meals. This high dependence on firewood together with a growing energy demand leads to fast deforestation and land degradation. Currently less than 2 per cent of Tanzania's energy demand is utilized from renewable energy recourses. Fortunately, there is much potential for renewable energy in Tanzania. The introduction of this study will elaborate on the applicability of biogas in Tanzania.

## **PART I**

---

This study is roughly divided into two parts. Part I will introduce the programme together with the challenges it is currently facing. It will also introduce the concept of social marketing and its potential contribution to the biogas programme in Tanzania. The second chapter, views on biogas dissemination, is presenting various views that relate to the dissemination of biogas in Tanzania and its impact on development. This second chapter is also introducing a range of marketing principles that are used to assess and contribute to marketing strategies in part II of this study. The third and last chapter in the first part is the methodology. The methodology will present the central questions in this study together with the assumptions. Furthermore, this chapter is illustrating the approach of this study.

# 1 | INTRODUCTION: FROM BIOMASS TO BIOGAS

---

Tanzania is experiencing an unstable and unbalanced supply of energy. The majority of the population is living in rural areas without access to modern sources of energy. These households are highly depending on traditional biomass fuels, approximately 90 per cent of all consumed energy derives from traditional sources. This dependency will lead to a fast deforestation and land degradation, health problems due to indoor air pollution, and it hampers social and economic development. Tangible developments in Tanzania's electricity grid are perceived to be unlikely in the foreseeable future. Private initiatives can contribute to the development of decentralized and renewable energy networks to stimulate social and economic progress in Tanzania. The Tanzania Domestic Biogas Programme is aiming to foster the development in rural Tanzania by stimulating the use of biogas. Biogas is produced from excreta and is thus a potential source of energy in rural areas because many smallholder farmers own cattle that produce the necessary amount of dung to operate a biogas digester.

This introduction is presenting the current status of renewable energy dissemination in Tanzania, the challenges the biogas programme is facing in its marketing activities and the concept of social marketing techniques.



## 1.1 Renewable Energy in Tanzania

The energy sector in Tanzania is characterized by a low per capita consumption of commercial energy and largely depends on non-commercial energy resources, primarily firewood and charcoal. Although firewood is often considered as a renewable energy resource, it is not a feasible nor sustainable form of energy consumption. This is because the extraction of firewood in Tanzania for energy purposes is much higher than the proliferation of new trees and leads to fast deforestation. The combustion of firewood and charcoal causes much indoor and outdoor air pollution, and causes many health problems among households using firewood and charcoal. And, collecting firewood costs much time, especially for woman and children (Gwang'ombe, 2004, p. 2). Hence better (renewable) energy alternatives are preferred. Biomass accounts for approximately 90 per cent of the total energy consumption in Tanzania, while petroleum accounts for 8 per cent and electricity only for 1.2 per cent. The remaining 0.8 per cent share in the total energy consumption derives from private and decentralized renewable energy projects such as solar panels, biogas, wind energy and small hydropower turbines (*ibid.*).

TANESCO (Tanzania Electric Supply Company) is a government owned company that is responsible for constructing and maintaining the national electricity grid together with the transport of electricity over the grid. Although there are a few minor electricity suppliers connected to the grid, TANESCO's Generation division is the key electrical energy producer in Tanzania with a market share of 98 per cent (Lymio, 2007, p. 15). Over the years the power sector of Tanzania has been dominated by hydropower. Presently 73 per cent of the electricity over the grid derives from hydro turbines. Traditional gas and fossil oil driven thermal plants contribute to the remaining 27 per cent of all electricity generated (TanESCO, website, retrieved at 21 June 2012) in Tanzania. Tanzania is thus -strictly speaking- very advanced in applying renewable energy resources already. Even though the lion share of electricity is generated by hydro turbines, hydro power is losing ground to an increasing number of power plants that function on coal, gas and oil. This is because there is not much room left for large scale hydro turbines, and because the water levels in rivers and dams is declining due to severe droughts and a growing number of irrigation systems (Lymio, 2007, p. 16). As such, Tanzania have to rely on an a mix of renewable and non-renewable energy sources to ensure the availability of power for the economy (GTZ, 2007).

Solar power, wind energy, geothermal resources, anaerobic biogas, liquid bio-fuels and other means of modern biomass energy resources are still in an undeveloped stage. Only 0.8 per cent of the total energy consumption derives from these renewable resources. Since coal is also calculated in this 0.8 per cent, the share of sustainable energy resources (excluding hydropower) is thus estimated to be even lower (Gwang'ombe, 2004; Lymio, 2007).

## 1.2 A Focus on Biogas.

Small scale biogas digesters for domestic use is a simple, low-cost and easy in maintenance technology for the relatively poorer households in Tanzania. The primary benefit of biogas is the production of gas for cooking and lighting purposes. Biogas is produced from human and/or animal excreta. Since it applies waste which is already there, it requires a minimum amount of resources to operate. The only necessary resource which has to be extracted from the environment is water for the fermentation process. Modern solid-state biogas plants are proven to be durable for at least 20 years. The combustion of biogas is less harmful for the environment than the combustion of solid biomass and has a almost zero negative impact on the health of households. The ‘waste’ of the digester itself is bio slurry, which is very useful as a good and environmental friendly fertilizer. And, the amount of work to operate a biogas digester is far less than an average household spend on collecting firewood (SNV, 2009).

### 1.2.1 Today’s Biogas Programme

The objective of the Tanzania Domestic Biogas Programme (hereafter TDBP) is to improve the livelihood and quality of life for rural households in Tanzania through developing a commercial viable domestic biogas sector. By promoting the use of biogas, the programme intends to contribute to health improvements and economic development. Smallholder farmers in rural areas are the potential target group for the programme. During the first 5 year phase (2009-2013), the programme will support the construction of 12,000 domestic biogas installations of a fixed-dome design. The over-arching goal of the domestic biogas programme is focused on private sector involvement in delivering high quality biogas digesters through the most efficient means available. The programme invests in marketing-communication activities to boost the demand of biogas among potential users To respond to an increase in biogas demand, hundreds of local masons have been trained in constructing digesters over the last 3½ years (Bos, 2011).

In 2007 the Tanzania Domestic Biogas Programme was initiated by the Centre for Agricultural Mechanization and Rural Technology (CAMARTEC) and supported by various national and international (donor-) institutions. Stichting Nederlandse Vrijwilligers (hereafter SNV) is a Dutch NGO that supports the programme through capacity building. The programme cooperates with implementing partners (hereafter IPs) for a dissemination of the biogas technology on a regional level. These IPs are already existing development organisations in Tanzania.

Figure 1: Logo TDBP



Source: Website TDBP

### 1.2.2 Contemporary Challenges in Promoting Biogas

The biogas sector is performing poorly, not even 5,000 digesters are constructed in the first 3½ year of the programme. The goal is the construction of 12,000 digesters during the first phase of the programme, it is unlikely this objective is going to be achieved.

Experience is showing that promotion activities to foster the demand for biogas remain limited and need more attention. There is a need for social marketing approaches to increase the awareness and demand for biogas in Tanzania on a national, regional and household level. New social marketing approaches must fit within the present Promotion & Marketing Strategy applied by TDBP and its partner organizations. Masons cooperatives and biogas construction enterprises (hereafter BCEs) lack marketing skills, knowledge and tools to find their own clients. Currently they rely too much on the efforts from the programme.

The second 5 year phase of the programme starts in 2014. SNV will probably not be involved in the second phase of the programme. This will mean that there is no more capacity support from SNV. For a viable and a self supporting biogas market, it is important that there are fundamental marketing strategies in place for the second phase of the programme to rely on.

The most important (marketing) challenges the programme is currently facing are (Bos, 2011):

<b>Institutional Challenges:</b>	<b>Market Challenges:</b>
<ul style="list-style-type: none"> <li>• Present marketing activities is confused in doing marketing, there is no coherent marketing strategy in place. Nobody knows exactly which marketing activities are employed and what their impact is.</li> <li>• Masons and BCEs lack knowledge, skills and tools to promote biogas and generate their own clients. Currently they rely too much on the programme and its partners.</li> </ul>	<ul style="list-style-type: none"> <li>• The programme has too little knowledge about their potential target group, which areas are highest potential and how well the biogas technology has penetrated the potential biogas market.</li> <li>• There is a low demand for biogas among potential customers. This might be because potential biogas users are not aware of the technology or do not perceive biogas is to be beneficial for their household.</li> </ul>

### 1.2.3 Drivers & Barriers for Biogas Penetration in Tanzania

Even though the biogas programme experienced some windfalls in the dissemination of the technology, it seems that the amount of setbacks and obstacles are far greater. Painuly (2001), Wilkins (2002) and Ahlborg and Hammar (2010) wrote much literature about the penetration of renewable energy sources in developing countries and Tanzania in specific. In their articles they examined the most dominant drivers and barriers for introducing renewable energy technologies. The drivers and barriers for the biogas programme are evaluated by applying the

indicators as described in the literature. The most dominant drivers and barriers in the dissemination of the biogas technology in Tanzania are elaborated prior to defining the theoretical framework for this study. These insights form the basis for further research about assessing and improving the marketing activities from the biogas programme.

The driving forces for promoting biogas are scarce and only relate to the motivation potential biogas users have to invest in biogas. The direct benefits include improved living standards by gas for cooking and lighting, no more indoor air pollution, increased income from savings on energy expenditures, higher productivity and workload reduction for women and children. In the long term biogas users profit from a longer life expectancy. The programme is only very limitedly profiting from the involvement of governmental institutions and partner NGOs. There is a range of renewable energy projects in Tanzania, but there is only very little cooperation and synergy among the different projects. Hence the biogas programme in Tanzania is insufficiently profiting from the potential drivers for a better dissemination of the technology.

The amount of barriers the biogas programme experiences are far greater than the amount of drivers. The barriers are categorized in: institutions and stakeholder performance, economy and finance, social dimensions, technical management, diffusion and adaptation, and infrastructure. Institutions and stakeholder performance: There is a lack of strategy within the biogas programme and its implementing partners. There is no coherent promotion strategy and protocol in place to target localities and approach potential biogas customers. Marketing interventions are not examined by the programme nor its IPs. There is only top-down management in the biogas programme, the masons and BCEs take very little initiative to execute their own promotion activities. There is thus a high level of dependency on TDBP and IPs. There is very little government involvement and cooperation with other energy technologies and strategies. The programme with its partners do not cover the whole country, nationwide promotion activities are thus perceived to be inefficient. Economy and finance: The loans for biogas digesters are too expensive with total rates of 25 per cent and the payback time is usually 6 to 8 months. Social dimensions: Biogas is not affordable for many households. Many people are sceptical about the technology. Even though women are the key energy users in the household, men make most important financial decisions. There is also a lack of entrepreneurial mindset among masons and BCEs. Technical management: Knowledge about the technology is very much concentrated at TDBP, masons are trained to construct digesters but lack expertise. In some areas there are many poorly functioning digesters, this is because the digesters are not constructed well or there is essential connecting material missing. Diffusion and adaptation of the technology: the technology is poorly aware among potential biogas users, people are stuck in their habit and do not see a need to change convenient firewood and charcoal with biogas. Rural infrastructure: There is a low population density in remote areas in Tanzania and limited basic infrastructure. Many villages are hard to reach, especially with construction material (Field Work 2012).

### 1.3 Marketing Biogas: Present Day Status and Future Requirements

As the title indicates, the purpose of marketing in the biogas sector is twofold in this study. Marketing models and principles can contribute to assess the 'present day' status of the programme in terms of biogas perceptions among (potential) customers and stakeholders, market potential, the potential diffusion of biogas, economic feasibility of biogas for households, and the efficiency and effectiveness of promotion activities employed by the programme. Secondly, the findings provide insights in the 'future requirements' of the programme, such as for designing new marketing strategies that might contribute to a better diffusion of biogas in Tanzania.

Marketing techniques to promote biogas are used for the purpose of societal benefit instead of commercial profit, this form of marketing is commonly referred to as social marketing. Social marketing involves behaviour change, changing a bad behaviour into a good behaviour. For the biogas programme this means changing the use of traditional biomass fuels into the use of biogas.

#### 1.3.1 Social Marketing

Social marketing can create a positive social change in Tanzania by changing people's old behaviour of using traditional biomass fuels, towards the use of biogas. To become successful it must increase the audience's perception that the benefits of biogas outweigh the costs of installing a plant. Social marketing assessments help to grasp the seemingly intractable behaviours in complex circumstances (Serrat, 2010). The data from the behaviour analysis is useful in designing new social marketing strategies and promotion tools for masons and BCEs for a more successful approach of potential clients. Not only biogas users are profiting from their digester, non users also profit because biogas has a positive effect on the environment and prevents fast deforestation. Masons and BCEs profit from a viable biogas market where they can construct digesters to make a living for their family. Social marketing should be applied to change people's behaviour towards the adoption of biogas installations and change the current behaviour of masons into entrepreneurs. The role of social marketing in TDBP is to increase the demand of biogas among potential customers and provide masons with valuable marketing tools to generate their own clients in rural areas (Hasting, 2003).

#### 1.3.2 Community-Based Social Marketing

Research in the field of social science have demonstrated that behaviour change is most effective when initiatives are delivered at local level. Community-based social marketing attempts to make psychological knowledge visible and relevant to programme planners. Both generic and social marketing techniques are used to promote a social benefit and change people behaviour (McKenzie-Mohr, 2000). Central to the development of a community based social marketing strategy are three question: 1) What behaviour should be promoted? 2) Who should the programme target? 3) What barriers will an individual face in deciding to adopt a new behaviour? (Pickens, 2002).

Social marketing is flourishing when behaviour of the target group is successfully changed. For TDBP this would mean that there is a positive attitude towards biogas and many people (are willing to) adopt a biogas digester. Community-based social marketing involves four steps: identifying barriers and selecting behaviour, designing strategies, piloting the strategy and evaluating the strategy. This study will have a focus on the first two steps of community-based social marketing: 1) identifying barriers and selecting behaviours to assess the present day status of the employed marketing activities, and 2) designing strategies for addressing the future marketing requirements of the programme.

#### *Present Day Status:*

Identify the barriers and attitude potential biogas customers have towards the technology together with their awareness and the amount of knowledge. Both the negative and positive perceptions about the technology is essential information to in- and exclude potential biogas customers in marketing exposures from the programme. The highest potential areas for biogas should be examined and compared with the areas where the programme is currently active. Since biogas is perceived to be too expensive for most households, pre-calculating the economic consequences of investing in the technology will evaluate the price perceptions potential customers have. Identifying barriers and selecting behaviours must take place at the lowest levels possible, for TDBP this is the local and household level.

#### *Future Requirements:*

Designing strategies is the primary purpose for doing marketing research and assessing the potential benefits and barriers. A good marketing strategy for TDBP is not solely focussed on the promotional aspects of marketing (communicating the core message) but also on price setting, geographical context, distribution strategy, logistics and product features for each identified potential market segment. Designing a successful marketing strategy is based upon both rational/academic data, models and approaches, and on creative insights. Without understanding the local culture, a good and creative campaign which is appealing to the potential customer is hard to achieve.

### **1.3 Conclusion & Structure of this Study**

The energy sector in Tanzania is characterized by a low per capita energy consumption and largely depends on traditional biomass resources. The large scale combustion of biomass causes much health problems due to indoor air pollution and deforestation. It also hampers socio-economic growth because households rely too much on biomass and are thus stuck in their energy consumption patterns. The objective of the biogas programme is to improve the livelihood and quality of life for smallholder farmers in rural Tanzania and to develop a commercial viable biogas sector. Currently the programme is confused in doing marketing, there is no coherent strategy in place and there are no tools to assess the currently employed

efforts. This study is particularly designed around the concept of social marketing and behaviour change.

Next chapter will present a range of marketing approaches to evaluate the currently employed activities. It will also discuss models that can be applied to design new marketing strategies. Chapter three presents the methodology of this research. This chapter will include a conceptual framework, the justification of primary data collection methods and the limitations. It will also present the research questions and assumptions.

The second part of this document includes four chapters. Chapter four will make an inventory of the gathered research data. Chapter five is applying marketing tools to evaluate the gathered data to come up with strategic insights. The sixth chapter is the synthesis, here the research questions and assumptions are discussed. The last chapter will conclude this study and make an attempt to answer the central question. This chapter will also make founded recommendations for the program and future research.

## **2 | VIEWS ON BIOGAS DIFFUSION FOR DEVELOPMENT**

---

Marketing models and approaches are valuable tools for assessing the performance of the marketing and promotion activities employed by the programme. This chapter will present a range of views that can be applied to evaluate the diffusion potential of the biogas technology in Tanzania. Behaviour change theories are useful to understand the mindset of potential clients in terms of attitude and biogas adoption behaviour. The majority of the views are constructed around the concepts of marketing. Moreover, also the contextual drivers and barriers for renewable energy dissemination are inventoried. These are used in the final chapter evaluates to what extent these theoretical views are relevant for the present day programme.



## 2.1 A Framework for Analysis

This study is designed around the marketing challenges the biogas programme in Tanzania is currently facing. There is no clear and coherent marketing strategy in place and the presently employed activities are not evaluated. The design of new marketing strategies should boost the demand of biogas among potential clients. However, in the field of marketing there are no overarching theories in place to assess the marketing performance of a product, service or programme. Different models and approaches may lead to similar outcomes and all contribute to useful marketing data. The applied marketing techniques and principles is very much depending on the product itself and its context, the purpose of the research, the expected results and the choice in strategy of the marketer. As already mentioned in the introduction, the foci of this study is behaviour change within the context of social marketing methods.

Community-based social marketing techniques attempt to make psychological knowledge visible and relevant to programme planners. The elaborated theories have a focus on the first two steps of community-based social marketing: 1) identifying barriers and selecting behaviours to assess the present day status of the employed marketing activities, and 2) designing strategies for addressing the future marketing requirements of the programme.

The purpose of system thinking is to grasp the relationship between energy supply and rural development. System thinking is a science based on understanding the connections and relations between (often seemingly isolated) variables.

### 2.1.1 Layout Theoretical Framework

The second section of this chapter, section 2.2, is an overview of the drivers and barriers for renewable energy dissemination in Tanzania. This is vital information to understand what stimulates and hampers the diffusion of the biogas technology. Painuly (2001) also provides methods and ideas to conquer the presently aware barriers. The discussion of this study will elaborate to what extent the drivers and barriers, as described in this section (section 2.2), relate to and influence the diffusion of the biogas technology in Tanzania.

Section 2.3 focuses on the preconditions for development through renewable energy networks. It illustrates the challenges developing countries face in implementing renewable energy networks, the socio-economic 'energy ladder' attempts to explain the relation between energy consumption and income together with opposing views on the relation between economic growth and energy consumption. It also illustrate arguments why a centralized or decentralized energy network is feasible, or not, for socio-economic progress. System thinking contributes to understanding the relationships between energy and development.

Four sections (section 2.4 to 2.7) are assessing marketing models and theories within the most primitive and effective marketing framework known, the four marketing P's. The four P's of marketing are: product, price, place and promotion. The order of assessing each P is irrelevant. The four P's are the most basic dimensions to examine the marketing performance and to design approaches. In the field of marketing it is argued that a balanced

mix of representation of every P is essential for a successful adoption of the product, this is known as the marketing mix (Kotler & Zaltman, 1971, pp. 3–12). The following table and figure illustrate the four marketing Ps together with the section that elaborates on theories for that P.

**Table 1: Framework for elaborating on each marketing P**

<b>Marketing P</b>	<b>§</b>	<b>Theory / Approach</b>
Product	2.4	Behaviour Change Theories
Price	2.5	Cost Exchange Theory & Cost/Benefit Analysis
Place	2.6	Market Potential & Diffusion Theory
Promotion	2.7	Promotion Efficiency and Effectiveness & AIDA

**Figure 2: The four marketing P's**



Source: Website Notedesk.com

**Product:** Section 2.4 explains the theories considering behaviour change. This relates to ‘product’ because it is about the behaviour individuals have in regard to biogas as a product. **Price:** The cost exchange theory and the cost/benefit analysis, in section 2.5, is about the costs of using biogas. Costs are subjective and range from the financial price of a constructing a biogas plant to the time people daily spend on operating a digester. **Place:** The market potential in a geographical perspective together with the diffusion of technology theory are elaborated in section 2.6. These relate to ‘place’ because it concerns potential people and geographical areas. **Promotion:** In section 2.7 the approach to evaluate the most effective and efficient promotion activities is formulated. The AIDA model indicates four promotion scales and suggests there are four stages a potential customer goes through in the purchase of a product.

In section 2.8, marketing analysis, two commonly used strategic models are examined. The four E’s framework and the market- and business- attractiveness analysis (MABA). The four E’s framework is designed as a pure social marketing model that intends to provide fruitful insights for new approaches. The MABA analysis is model that provides strategic advice considering the business and market attractiveness for the biogas programme. The MABA analysis should be applied prior to designing new marketing policies.

The last section, section 2.9, is concluding this chapter.

## 2.2 Drivers & Barriers for Promoting Renewable Energy in Tanzania

### 2.2.1 Drivers in Promoting Renewable Energy

In their article about drivers and barriers for renewable energy in Tanzania (and Mozambique) Ahlborg and Hammar (2010) argue that the primary goal and motivation for rural energy dissemination is related to individual and social development. Ahlborg and Hammar divide some of the most important drivers of renewable energy into direct, potential and long term benefits for rural households in Tanzania with poor access to energy. Direct benefits for households include improved living standards by lighting, a healthier environment and better conditions for education. Potential benefits include increased income generation from productive activities, reducing workload of woman and children and reduced household expenditures on energy. The long term benefits are the returns from improved education, health and production efficiency (Ahlborg & Hammar, 2010).

In a more recent article of Ahlborg and Hammar (2011) the authors identified some additional drivers and barriers for promoting renewable energy technologies in Tanzania (and Mozambique). Some specific drivers for Tanzania are: involvement of churches in stimulating energy projects is successful, a growing number of donors and individuals in governmental agencies are pushing to introduce renewable energy projects, and promotion activities in many localities create a growing demand for renewable energy projects.

### 2.2.2 Barriers for Renewable Energy Penetration

Much literature is written on the barriers renewable energy technologies face in penetrating the market. It is widely acknowledged that a switch to clean and durable energy resources is a way forward and a necessity in today's increasingly polluting world with its growing energy demand. Painuly (2001) identifies the barriers for renewable energy penetration in a world-wide (Western) perspective. Wilkins (2002) identifies these barriers for developing countries in specific, while Ahlborg and Hammar (2010) zoom in on Tanzania in their research.

A comprehensive study by Painuly (2001) shows a number of barriers renewable energy technologies face for effective market penetration. The barriers are categorized as: *Market failure/imperfection*: highly controlled energy sector, lack of information and awareness, restricted access to technology, lack of competition, high transaction costs, missing market infrastructure, and the high investment requirements. *Market distortions*: favouring (e.g. by subsidies) conventional energy, taxes on renewable energy technologies, non-consideration of externalities, and trade barriers. *Economic and financial*: economically not viable, necessity of high discount rates, long payback period, small market size, high cost of capital, lack of access to capital, lack of access to credit facilities for consumers, high up-front capital costs for investors, and a lack of financial institutions that support renewable energy technologies. *Institutional*: lack of institutions to disseminate information, lack of a legal/regulatory framework, problems in realizing financial incentives, unstable macro-economic environment, lack of involvement of stakeholders in decision making, lack of

research and development, lack of private sector participation, and a lack of professional institutions. *Technical*: lack of standards and certification, lack of skilled personnel and training facilities, lack of operation and maintenance facilities, lack of entrepreneurship, and unproven product reliability. *Social, Cultural and Behavioural*: poor consumer acceptance of the product and lack of social acceptance for some renewable technologies. *Other barriers*: uncertainty governmental policies, environmental damage, high (financial) risk perception for new technologies, and a lack of infrastructure (Painuly, 2001, p. 81).

Wilkins (2002) identifies barriers developing countries in specific face in promoting renewable energy projects in rural (remote) areas: *Politics, institutions and legislation*: absence of clear government plans and targets, lack of appropriate support mechanisms, and poor communication between involved institutions. *Intellectual property and standards*: lack of supporting legal institutions, unclear law on intellectual property rights, and a lack of technical standards and quality control. *Local capacity*: poor access to information, lack of exchange in experiences and ideas, and a lack of skilled local labour. *Finance*: too little investments, poor access to capital, ineffective subsidies, and the dispersed nature of many projects. *Social*: superstition towards new technologies, local culture, religion, gender aspects, and low community involvement in planning might lead to low social acceptance of renewable energy resources (Wilkins, 2002).

The most important barriers for successful penetration of renewable energy in Tanzania, according to Ahlborg and Hammar (2010), are: *Institutions and stakeholder performance*: inadequate planning, poor institutional quality, inadequate strategies and organizational structures, lack of co-investment and private sector involvement. *Economy and finance*: poor rural finance institutions, high capital costs compared to a rural setting, fees and tariff system, subsidies, underdeveloped markets and limited energy use, disproportionately high administrative costs for decentralized systems. *Social dimensions*: low affordability renewable energy, poverty among potential customers, local resistance and problems of local participation, theft of materials, and gender issues since woman are the key energy users. *Technical management*: poor maintenance, low capacity of some renewable energy systems, and lack of knowledgeable personnel. *Diffusion and adaption of the technology*: unwillingness of behavioural change, inappropriate technology, and weak awareness of technology usefulness. *Rural infrastructure*: low population density in remote areas and limited basic infrastructure. In a their latest article on renewable energy penetration in Tanzania and Mozambique, the newly identified barriers for Tanzania are: problems that arise because of top-down management in the energy sector, incompatible donor policies, lack of consistency between various projects, donor dependency of many projects, lack of local engagement and entrepreneurship, long distances of transmission in combination with low generation capacity, and the protection of the environment in various projects (Ahlborg & Hammar, 2011).

### 2.2.3 Conquering Barriers for Successful Renewable Energy Penetration

Painuly (2001) argues that government interventions is not solely desirable but a must for successful promotion of renewable energy technologies. The role of the government includes generic actions such as a positive mindset towards clean and renewable energy, removing barriers, building human and institutional capacity, organizing research and development infrastructures, enable a feasible investment environment, and providing mechanisms and clear information to promote this technology transfer. More specific policy approaches can be the removal of barriers by creating conditions whereby the market is forced to act towards renewable energy solutions.

Painuly summarizes the most common and effective means in conquering barriers for successful renewable energy penetration (Painuly, 2001, pp. 84-87): *Energy sector liberalisation*: The purpose of liberalisation is to increase efficiency in the energy sector through facilitating market competition and increase the competitiveness of renewable energy technologies. Some specific policy examples are; create separate entities for energy distribution and generation services, foster private sector developments through easier market access, removal of energy control mechanisms (price controls, fuel use, energy import, capacity expansion). For success of these policy actions institutional measures such as independent regulatory bodies may be needed. *Guaranteed markets*: Renewable energy is often not able to compete in the energy market due to existing barriers. Government policies can require from energy suppliers that a share of the energy distribution derives from renewable resources. *Economic incentives*: Capital subsidies for stimulating the dissemination of renewable energy technologies can be very effective. However, subsidies must have a defines phase out time frame to ensure efficiency improvements in the sector and prevent subsidy dependency. Other effective measures are tax discounts on renewable energy products and feasible (micro) credit facilities. *Government investments*: In countries where the government is a major player in the energy sector (such as Tanzania), national plans and strategies can foster the dissemination of renewable energy technologies. Government investments can spurt the development of the technologies through specialized agencies/bodies. *Information and awareness campaigns*: Educating the benefits and importance of renewable energy techniques are proven to be effective. National promotion campaigns with the support of the government have a greater impact than commercial campaigns. *Institutional measures*: Manage and stimulate the set up of specialized agencies and (commercial) companies to plan and promote the dissemination of renewable energy techniques, such as installation and construction companies, service and information companies that promote the use and awareness of renewable energy, specialized credit agencies that provide loans with feasible conditions, and technical knowledge and assistance facilities. *Research and development*: High cost is a major barrier for renewable energy penetration. Research and development programmes increase product competitiveness. Market and product research may lead to a higher demand for renewable energy and improved technologies for less costs. *Facilitating measures*: Financing feasibility studies, planning and targets for renewable energy contribution, resource assessments, technology demonstrations, and skill and capacity development through training are several

facilitating measures governments can make in promoting the use of renewable energy technologies. *Moral and ethical considerations*: Most households in developing countries do not have much money to spend on energy, moral and ethical considerations are therefore subordinate to economical and financial considerations. Moral justification to voluntarily pay a higher price for green renewable energy is therefore a less effective strategy for Tanzania. Health improvements for children and better forest conservation in the surroundings are moral and ethical arguments to promote clean energy use in Tanzania.

## **2.3 Renewable Energy: a Driving Force for Development**

### 2.3.1 Challenges for Developing Countries

A melting Kilimajaro, the degeneration of the ozone layer and a rising sea level are hot topics in the media and politics nowadays. Renewable energy is the buzzword of the 21<sup>st</sup> century and everyone wants to be involved. Also NGOs found out that renewable energy is not only contributing to a better climate, but to many other aspects in developing countries. Renewable energy deals with environmental problems as deforestation, land degradation and CO<sub>2</sub> emissions. It fosters a sustained growth of the economy, creates new jobs, improve people's livelihood and alleviate poverty for many households. Furthermore it makes the country less depending on the import of fossil fuels from other countries and thus less vulnerable for geopolitical developments. (Kahsai et al., 2011, pp. 739-741).

But transition to a renewable energy network comes with many challenges and will cost too much money for developing countries according to Stern (2003). As he explains; Because there is a direct correlation between household income and energy demand, it is economically unfeasible to invest in high quality energy networks while potential users earn too less money to consume the produced energy. A low population density and the geographical spread of villages and cities causes a great loss of synergy and efficiency, this will result in different price settings and high operation costs. Decentralized energy networks are too expensive. And there is a lack of knowledge in developing countries to install, but especially to operate and maintain, renewable energy networks. To conclude his explanation: It is economically unfeasible to invest in high quality fuel systems in poor countries with a low energy demand (Stern, 2003, pp. 3-7). Also the Worldwatch Institute argues that a full penetration of renewable energy in developing countries is unrealistic. They argue there are additional barriers Stern not reveals in his article, these are; Governments are inexperienced and do not know how to promote new technologies. There is uncertainty about the functioning of new technologies and their durability. And, a dynamic energy market with changing techniques and methods make it hard to decide what the right investment is (in a few month a cheaper and more efficient mean of generating energy might be available). Furthermore, many households in developing countries do not feel a need for renewable energy or simply cannot afford it (The Worldwatch Institute, date unknown, pp. 10-11).

### 2.3.2 Climbing the Energy Ladder

Theoretical energy literature on domestic energy use in developing countries has been dominated by transition theory, also known as ‘energy ladder’ (Malti & Mnenwa, 2012, p. 3). This theory claims that households choose for more modern sources of energy as their income increases. The bottom steps of the energy ladder represent traditional biomass energy sources (firewood and charcoal) while the last step is electrical energy from the grid. The steps in between are commercial energy sources such as kerosene, diesel, LPG, solar panels, wind turbines and biogas. This perception is based on physical characteristics of the energy source such as cleanliness, ease of use, efficiency and application (Akabah, 1990). Climbing up the ladder to more ideal forms of energy is a natural behaviour of individuals when their income is increasing, in return, people also climb down the ladder when their income is decreasing (Marfufu et al., 1997).

Various studies found out the reality to be more complex than suggested by the transition theory. They found out that the theory ignores energy-use patterns and wrongly dismissed the importance of structural factors such as the relative costs per unit of energy (Hiemstra-van der Horst & Hovorka, 2008). The theory does not acknowledge that households already rely on a range of energy sources that typically encompass at least to steps on the energy ladder (Hossier, 1993). There are two major explanations for this behaviour. Firstly, the unreliability of energy supply require households to rely on various sources of energy. And secondly, it depends on the cost-effectiveness of the energy source, for example: using kerosene for lighting and charcoal for cooking is much cost effective than using firewood for light and kerosene for cooking (Barns & Qian, 1992).

Even though there is some critique on the energy ladder, many studies revealed a positive correlation between rising incomes, the use of modern fuels and an increase in energy consumption (Hosier & Dowd, 1987). Along with economic growth and rising incomes, households purchase more modern equipment such as televisions, computers and mobile phones that need electricity. Households thus change their energy demand and automatically climb up the energy ladder. Leach (1988) argues that replacing traditional biomass energy in Sub-Saharan Africa is a basic feature of economic growth (*Leach, 1988*).

### 2.3.3 What goes First... Income Growth or Economic Growth?

There are different views on the relation between economic growth, income level, and energy consumption. Toman and Jemelkova (2003) argue that access to energy is a precondition for economic growth and rising incomes because energy is a direct input in the production process. Mehrara (2007) argues the other way around and claims that energy consumption derives from economic growth and higher incomes. Other authors, such as Jumbe (2004), argue that there is no causality between energy consumption, income level nor economic growth. In a more recent view, there is a bidirectional relation between energy consumption and economic growth or income. This implicates that energy consumption and economic growth are complementary. Thus, an increase in energy consumption will stimulate economic

growth and income rise, and conversely, an increase in income will stimulate energy consumption (Kahsai et al., 2011, p. 740).

The energy situation of a household is closely related to social development. According to Bang (2009), the dependence on polluting and inefficient fuels is both a cause and result of poverty. Many poor households do not have the resources to obtain clean and efficient fuels or improved appliances. Conversely, reliance on traditional biomass fuels and inefficient appliances limit the opportunities for social and economic development, which results in a continuing vicious cycle of poverty and reliance on polluting and inefficient fuels (Bang, 2009, pp. 1-3)

#### 2.3.4 A Centralized or Decentralized Renewable Energy Approach?

Centralized and decentralized energy approaches both have its advantageous and disadvantageous. A decentralized energy system is characterized by many small energy conversion units situated close to its consumers, a centralized energy system is based upon a few large energy production facilities which are often far situated from its consumers. Alanne and Saari (2004) argue that it is more feasible for developing economies to have a decentralized and renewable energy system. Decentralized energy initiatives can be pinpoint on those communities with sufficient means to afford and consume the locally produced energy. Since energy is locally produced, converted, transferred, distributed and consumed, there is a minimum amount of energy conversion losses. Production capacity can be optimized for the amount of users and locally available resources such as geothermic heat, solar, wind, hydro and biomass is environmental friendly. The applied system can be customized to the environment and the type of energy which is required by the (potential) customers.

The proponents of centralized energy systems have a different view. They argue there is little doubt that centralization of renewable energy production is more efficient than decentralization. It enables location optimization, settling at the best possible location for generating energy (for example: windy places for wind energy or sunny places for sun energy). They claim a single energy plant is much more cost efficient than many small installations because it profits from economies of scale in designing energy infrastructure networks. And, there are less management and industrial costs in relation the amount of produced energy (Martin, 2009, pp. 8 – 10). Other authors argue that a mix of centralized and decentralized renewable energy production facilities is the most feasible solution for most developing countries. Centralized energy plants in urban areas and a decentralized energy units in remote areas (Orgerie et al., 2011, pp. 1 - 5). The choice for a centralized or decentralized energy network is thus very much depending on the amount of household served together with the relative costs of implementing renewable energy facilities.



## 2.4 Behaviour Change Theories

When identifying and selecting behaviours of potential biogas clients, several models and theories help to assess how receptive the market will be to biogas installations and what benefits are most appealing to the target group. The following theories will be used to assess the current marketing efforts by the biogas programme and to grasp the motives and intentions for people to change their behaviour.

### 2.4.1 Cause Related Marketing

A primary function of consumer marketing is to grasp people's behaviour by assessing perceptions (potential) customers and stakeholders have towards the usability of a product. This technique is also known as cause-related marketing because it attempts to explain the relation between consumer and product. Through questionnaires and semi-structured interviews the perceptions of (potential) customers and stakeholders can be identified and evaluated. The perceptions current users have are important to grasp their purchase motives, for potential customers it is important to understand the barriers they perceive, but also the motives and barriers stakeholders have are vital to understand the dynamics of the market (Alcheva et al., 2009, p. II). To grasp potential people's buying behaviour and the perceptions stakeholders have towards biogas, this study will assess the level of biogas awareness, the amount of knowledge about the technology, the attitude people have towards biogas, the motives and barriers both potential customers and current users have towards biogas, and the motives and barriers among stakeholders which are related to the dissemination of the biogas technology.

### 2.4.2 The Theory of Reasoned Action & Planned Behaviour

The theory of reasoned action organizes itself around the constructs of behavioural and normative beliefs, attitudes, intentions and behaviour. The most important predictor for someone's behaviour is one's intention to act. This intention is influenced by one's attitude toward engaging in the behaviour and the subjective norms about the behaviour. Attitude, in turn, is determined by the believe in the outcomes and attributes which are associated with this behaviour. Subjective norms are based on normative beliefs that reflect how referent people apprise the behaviour (both positive or negative). Referents can be e.g. an individual, a family or a peer group. The theory of reasoned action is an useful model for social marketers to grasp people's intention to act. Insights gained through in-depth interviews with respondents may help to identify negative attitudes, which is useful for social marketing planners to develop materials that can counter these attitudes (Lefebvre, 2000, pp. 4-6).

The theory of reasoned action is a useful models to grasp people's behaviour and intention to invest in biogas. The theory may help to uncover the attitude and beliefs on biogas, and why people are willing or not to adopt a biogas digester. Even though the basic theory is quite logic and often taken for granted, illustrating the steps people take in engaging in a certain behaviour gives useful information to social marketers. By in-depth interviews all

the individual elements and factors that create the attitude and one's behaviour on biogas can be identified.

## **2.5 Economic Feasibility Biogas**

### 2.5.1 The (Social-) Exchange Theory

With its foundation in psychology, sociology and economics, the exchange theory assumes that we are need-directed beings with a natural tendency to try and improve our conditions. It claims that all human relationships are formed by the use of a subjective cost-benefit analysis and the comparison of alternatives (in marketing terms: substitutes), thus people calculate the overall worth of a particular relationship by subtracting its costs from the rewards it provides. Inhere relations can be both personal and institutional. Costs can be time, money and effort, but also sacrifices of time and lost opportunities. Costs are the elements of a relational life that has a negative value for a person. Benefits include things such as material or financial gains, social status, and emotional comforts. Even though all humans are seen as rational and punishment avoiding beings, individuals have different expectations of relationships and the standards that humans use to evaluate costs and rewards vary over time and from person to person. The social exchange theory is often referred to as 'perceived costs versus actual costs' because there is a knowledge gap between reality and perception. Through interviews the perceived cost can be identified (Hasting, 2003).

This theory also applies for the relation between the potential customer and biogas. Other sources of energy are good alternatives for biogas, if the costs (such as: time spend in collecting firewood, financial costs per unit energy, health due to indoor pollution) of an alternative energy source is lower than the benefits of a biogas installation, potential customers will most likely not purchase a biogas installation. This can mean two things for biogas installations: 1) the benefits of a biogas installation are not as prosperous as initially thought and the project is deemed to fail, or 2) the perceived costs are higher than the actual costs. Since costs are subjective, the standards that humans use to evaluate costs and rewards vary over time and from person to person.

### 2.5.2 Financial Cost / Benefit Analysis

Assessing the financial consequences is an important step for potential customers to get insight in the costs and benefits of applying biogas. The break-even point (BEP) calculation and return-on-investment (ROI) are two methods that derived from the field of traditional business economics but can be used to pre-calculate the economic feasibility of biogas for potential households.

#### *Break Even Point*

The break-even formula is designed to calculate at what point in time sales revenues equals the investment and production costs. For (potential) biogas customers the break-even analysis is the point (break-even point) where the financial gains of using a digester start to exceed the

investment costs. By calculating the savings on traditional biomass fuel expenditures together with the extra income per hectare from higher crop revenues minus the operation and maintenance costs, it is possible to estimate the point in time (in weeks, months or years) when the investment in a biogas digester has paid itself back. The formula is both simple and effective.

<b>Break-Even Point</b>	=	Initial Investment Costs Digester	
		$\frac{\text{Monthly Savings on Energy Expenditures + Additional Monthly Income from Higher Crop Revenues} - \text{Monthly Maintenance and Operation Costs}}{\text{Initial Investment Costs Digester}}$	

### *Return On Investment*

The return on investment calculation is used complementary to the break-even analysis. Potential biogas customers can use the return on investment tool to calculate the financial gains of using biogas over a certain period. Similar to the break-even analysis, the return on investment calculation for biogas is based upon household savings on energy expenditures and additional income because of bio-slurry benefits. The formula to calculate the return on investment for biogas is: Number of Years \* (Annually Savings on Energy Expenditures + Additional Annual Income from Higher Crop Revenues – Annual Maintenance and Operation Costs) – Initial Investment Costs. The result is a positive or negative amount of TZS over a ‘X’ number of years.

<b>Return On Investment</b>	=	Number of Years	*	Annual Savings on Energy Expenditures + Additional Annual Income from Higher Crop Revenues – Annual Maintenance and Operation Costs		–	Initial Investment Costs Digester

## **2.6 Illustrating the Market Potential for Biogas in Tanzania**

### 2.6.1 Biogas Market Potential in Geographical Perspective

To pinpoint the highest potential regions in Tanzania for biogas dissemination, a range of relevant indicators need to be examined (GTZ, 2007). Various studies have made an attempt to illustrate the highest potential biogas regions in Tanzania (Winrock International, 2007; GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009; Schoot Uiterkamp, 2011). Even though much information is already available from previous studies, no study have made a distinction in the relevant importance of each indicator or combined all available data in an overarching map. Based upon previous biogas assessments (HURDEC/SNV, 2000; GTZ, 2007) it is possible to evaluate the relative importance of each indicator.

The most relevant indicators to examine potential biogas regions in Tanzania are:

*Availability substitutes:* Biogas substitutes, such as charcoal and firewood, are very cheap or freely available. Motives for investing in biogas are subordinate when households have access to economical more feasible substitutes. Areas where the mean distance in collecting firewood is little are therefore less potential than areas where people spend many hours in collecting firewood for cooking or charcoal production (Winrock International, 2007; GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009; Schoot Uiterkamp, 2011).

*Water availability:* Biogas digesters need much water to operate, dry areas with a scarcity of water are therefore unsuited for biogas dissemination. Indicators to determine the potential of areas in terms of water availability are: the annual precipitation in millimetres and the access to improved water points (Winrock International, 2007; GTZ, 2007; Marree & Nijboer, 2007; Schoot Uiterkamp, 2011).

*Livestock:* Manure from livestock is an essential ingredient to produce biogas, the amount of livestock per square kilometre is therefore an important indicator to examine the highest potential areas (SNV, 2000; GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009).

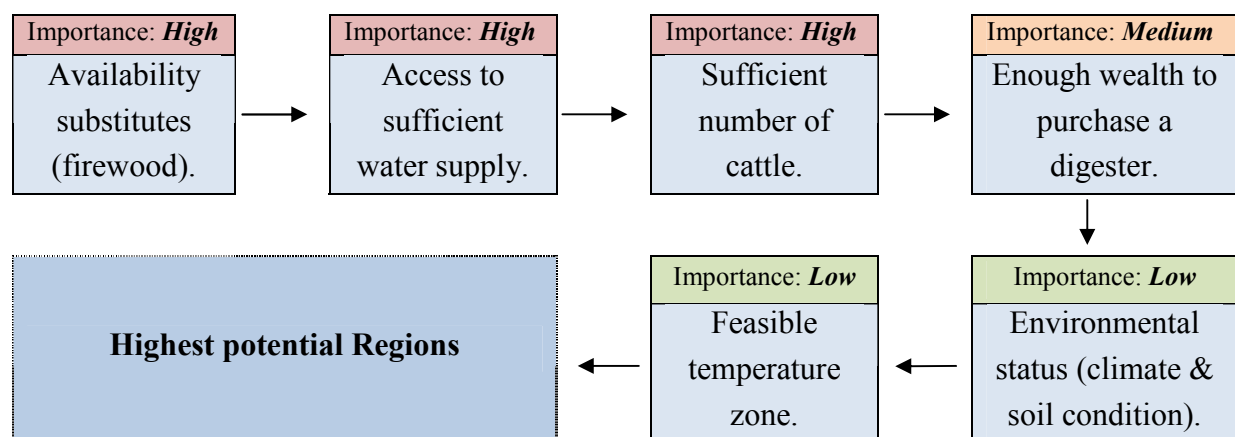
*Wealth:* Biogas digesters in Tanzania are relatively expensive and many people are not able to afford a digester. Combining the results from the poverty headcount per district with the percentage of people living below the basic need poverty line indicates the degree of potential a region has in terms of wealth (SNV, 2000; Winrock International, 2007; GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009).

*Environmental status:* The availability of bio-slurry is an important benefit of biogas. Bio-slurry increases crop production with approximately 25 per cent. Fertile soil and good climatic production potential are therefore preconditions to make full advantage of the available bio-slurry. The environmental status of an area is an indicator to measure the extent of biogas, in specific bio-slurry, usability (Winrock International, 2007; GTZ, 2007; SNV, 2009; Schoot Uiterkamp, 2011).

*Temperature:* The rate of methane formation in a biogas digester increases with rising temperatures. The warmest areas are therefore best suited for biogas production, (GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009).

The following flowchart illustrates the steps to identify the highest potential biogas regions in Tanzania in chronological order of importance.

**Figure 3: Determine the highest potential biogas areas**



Source: Desk Research 2012

### 2.6.2 Potential Diffusion Biogas Technology

A common approach to analyze the diffusion process of a certain technology, such as the biogas technology in Tanzania, is to look at the properties of the technology. A famous and commonly applied theory is the diffusion of innovations theory by Rogers (1995). Rogers defines several intrinsic characteristics of innovations that influence an individual's decision to adopt or reject an innovation.

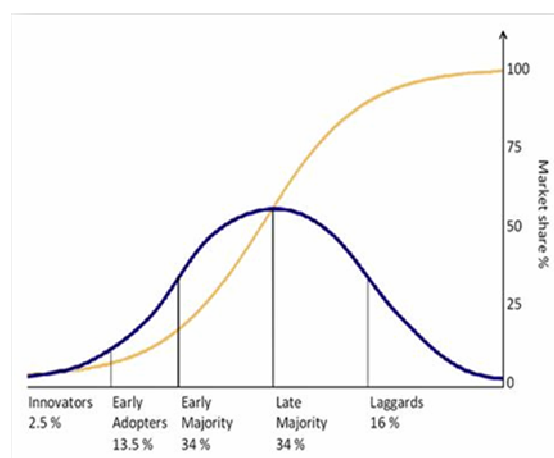
He suggest that an innovation should be analyzed by examining: Its relative advantage compared to other innovations in social and economical terms. Compatibility, how well the innovation fits existing values, past experiences, and current needs. The complexity of the innovation, how difficult it is to understand and use the innovation. Trialability, if there is an opportunity to try the innovation before full-scale adoption. And its observability, how well the results of the innovation can be understood by potential users (Rogers, 1995, pp. 15-16). A combination of these actors help to indicate the rate of diffusion in the market.

Rogers defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. The diffusion of innovations model is a fixed order of different stages, suggesting that different types of adopters accept an innovation at different points in time.

The five different types of adopters with their characteristics are; 1) Innovators who are motivated by a need for novelty and a need to be different. 2) Early adopters which are drawn by the product's intrinsic value. 3) The early majority that perceive the spread of a product and decide to go along with it. 4) The late majority who will join after realizing that most people are having this product. And the 5) laggards that finally follow as the product attains popularity and broad acceptance (Kotler, 2009, pp. 149-150).

The diffusion of innovations theory can help to estimate the degree of technological market potential in Tanzania and indicate in which stage biogas is already adopted by the market. The theory is illustrated as a time curve which is divided in five stages of adoption on the horizontal axis, a second line illustrates the total market share on the vertical axis.

**Figure 4: Diffusion of innovation model**



Source: Website Wikipedia 2012 , retrieved at 20-07-2012

## 2.7 Promotion Dimensions

### 2.7.1 Promotion Efficiency and Effectiveness

Efficiency and effectiveness are two commonly used definitions in the field of marketing. Awareness and knowledge are useful indicators to measure the extent of effectiveness and effectiveness of promotion campaigns in marketing-communication (promotion) evaluations. The first step is to assessing the impact of the promotion activities according to potential biogas customers. The amount of people that become 'aware' of a product existence from a specific source relates to the 'effectiveness' of that communication channel. The second step is to measure the 'efficiency' of the promotion interventions. A promotion activity is perceived to be efficient according to three determents: 1) The costs per reached potential customer are low. 2) As little as possible promotion budget is 'waste' to non potential customers. And, 3) there is synergy between all stakeholders in doing promotion.

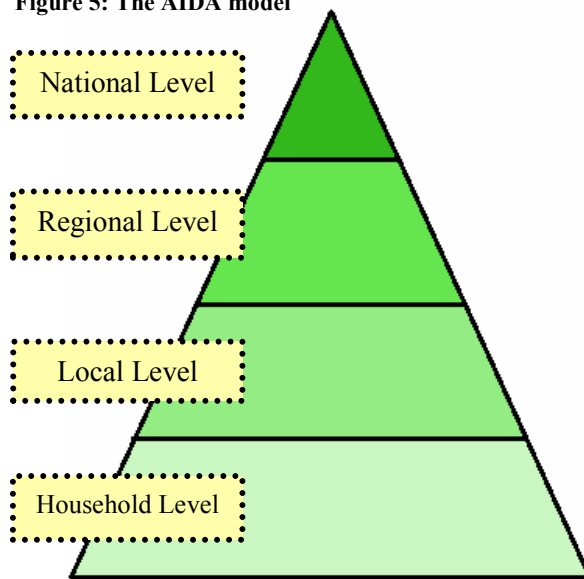
Some communication channels or promotion activities do not have the purpose to transfer much product knowledge but only intent to create brand or product awareness. Mass media campaigns is an example of a strategy to create a high level of awareness, while personal door to door promotion activities is better suited to transfer much product knowledge. Sales promotion activities are proven to be more successful when the targeted potential customer is aware of the product existence before gaining knowledge about the product (such as costs and benefits).

Mass media exposures have the potential to be very efficient when a promotion activity reaches a large population of the potential target group, the costs for each reached potential client is than relatively low. Hence mass media exposures are more suited for conventional products with a large potential customer group. The promotion activity is inefficient when the costs per reached customer is high because the target group is small and only a minor share of the potential target group is reached by the campaign. Individuals tend have a low attendance for commercial mass exposures, mass communication campaigns are therefore better suited to create brand or product awareness without transferring much product knowledge. Local and personal promotion activities targeted on potential customers are proven to be most effective in terms of transferring knowledge about the product, but are less efficient because the costs per reached potential customer is high. Local and personal activities become more efficient when the potential target group is small (Smith & Park, 1992).

The most feasible promotion activities can be traced by identifying the level of biogas awareness and knowledge biogas together with the effectiveness and efficiency of each promotion activity employed by the biogas programme.

## 2.7.2 The AIDA Model

**Figure 5: The AIDA model**



Source: Hague (date unknown) with own modifications

(interest), then form feelings about the product (desire) and finally take action. This order of stages is often called the know-learn-feel-do sequence (Glowa, 2002, pp. 7-8).

The purpose of the model is to think about strategies for each scale and event. There is a range of variations on the AIDA model. The model is often illustrated as a pyramid, the small top of the pyramid relates to the little amount of efforts (time/money) invested in creating product awareness while at the wide bottom of the pyramid much efforts are invested in direct sales activities. The four stages also represent geographical scales, from awareness creation on a national level to direct sales activities on a household level. The model links each geographical scale with an action element (e.g. interest creation at regional level) and the relative promotion investments at that scale (e.g. little investments in top of pyramid and much in bottom). The AIDA model argues that there should be an overarching marketing strategy together with a specific strategy approach for each level. The model stresses the importance of clear and bounded tasks and responsibilities for each geographical scale (Hauge, date unknown).

For the biogas programme this model is useful to illustrate the most feasible marketing-communication dimensions in promoting biogas in Tanzania.

## 2.8 Marketing Analysis

### 2.8.1 The 4 E's

The Four E's is a theoretical framework designed as a pure social marketing theory to change bad behaviour into good and sustainable behaviour. The model has been used in developing countries to stimulate the use of sustainable energy. The four E's in this theory are: enable, encourage, exemplify and engage. The four E's is a very useful framework for policy makers,

it is a systematic process to achieve behavioural goals and encourage people to make sustainable choices. There is no uniform approach to elaborate on each E, this very much depends on the context of the promoted behaviour (such as specific barriers and drivers) and the interpretation of the marketer (Sustainable Consumption Roundtable, 2006, pp. 12-14).

Since the use of biogas is also a sustainable choice, the four E's framework can be applied as a tool for the biogas programme in developing sustainable policies. By giving a meaning to every E, the programme can design durable and sustainable approaches to educate potential customers about the importance of clean biogas. The idea is that people become better aware about the importance of the environment and recognize the role of biogas as a sustainable solution (Lainé, 2011).

### 2.8.2 The Market and Business Attractiveness (MABA)

The MABA analysis compares the market attractiveness (MA) with the business attractiveness (BA). The MABA Analysis is a useful tool in making decisions related to designing a marketing strategy or identifying new business opportunities. The analysis makes use of a nine squares matrix where each square relates to a predetermined strategy. The purpose is to calculate the place of a product, such as biogas, inside this matrix and see which strategy belongs to that square. The market attractiveness indicators relate to the market environment of the product, the business cannot influence these external factors. The business attractiveness relates to the performance of the business with its products, the organisation can influence these internal factors. The first step to decide which indicators are important in determining both dimensions of attractiveness and how important they are (weighting). The outcome of the analysis is a strategic advice for the programme (ten Have et al., 2003, pp.123-126).

A MABA analysis consists of two axels, each divided in three columns that indicate the dimensions of attractiveness. Horizontally the business attractiveness and vertically the market attractiveness. Relevant factors are given a weight and a score to determine the degree of attractiveness for both axels. The strategy that fits the programme belongs to the square where the scores of both axels cross. This strategic matrix illustrates the right action for the biogas programme to follow considering its current status in the market (*ibid.*).

Figure 6: The market and business attractiveness analysis

		Business Attractiveness		
		High	Medium	Low
Market Attractiveness	High	Protect Market Position	Invest	Selective Expansion
	Medium	Selective Investing in Business	Selective Policy & Focus on Revenues	Expand or Limit
	Low	Protect and Reorientation Market	Focus on Revenues	Disinvests & Harvest

Source: ten Have *et al.*, 2003



## 2.9 Conclusion

The second chapter of this study elaborated various models and principles that can be used to assess and evaluate the employed marketing activities of the programme. The two foci of this study are the behaviour of potential biogas customers and the marketing performance of the sector.

The first sections come up with contextual barriers the program might face in their diffusion strategy, the concept of the energy ladder, the relation between the effects of energy consumption and economic growth, and the pro's and con's of decentralized energy networks. The majority of the sections are constructed around marketing concepts and behaviour change theories. The models are used as tools in the second part of this document to analyze and evaluate the gathered data.

Next chapter presents the methodology of this study.

## **3 | ASSESSING THE BIOGAS SECTOR: METHODS APPLIED**

---

This chapter will elaborate the methods applied in this study. The first section is presenting the starting point of this research together with the research questions and assumptions. The second section is visualizing a simplified flowchart that shows the very basic and causal relations in marketing biogas. The process of gathering data is summarized in section three and four. The research limitations are discussed in the fifth section. This chapter will end with a conclusion.

### 3.1 Research Questions and Assumptions

This section presents the research questions and assumptions for this study. The questions and assumptions relate to the contemporary challenges the programme face in its marketing. The research questions were partly formulated prior to visiting the research area, but many research questions occurred during the process of participatory research. The assumptions are formulated with regard to the different views on the dissemination of biogas as illustrated in the previous chapter.

#### 3.1.1 The Starting Point

The objective is to make a survey on the promotion and marketing efforts in the domestic biogas sector and to examine how social marketing can contribute to a further dissemination of the technology. This assignment is translated into the two-fold title of this study: ‘present day status’ and ‘future requirements’.

In collaboration with SNV and TDBP, I divided this assignment into four tangible tasks to fulfil. The first two are about assessing the present day status and the last two relate to future marketing activities of the programme.

- Assess the present status of marketing and promotion activities employed by the programme and its partner organizations.
- Assess the potential biogas market.
- Examine under what conditions masons and BCEs can generate their own clients.
- Examine what social marketing strategies contribute to an increase in demand and further dissemination of the technology.

#### 3.1.2 Research Questions

The research questions have a focus on the programme with its partners, masons and BCEs, and potential biogas customers. The success of the programme is primarily determined by the demand of biogas among potential clients. Consequently, research questions are about the biogas demand among potential customers and how the programme can trigger this through marketing activities.

##### *Central Research Question:*

- What is the status of the marketing activities employed by the biogas sector and how can (social-) marketing methods and principles improve the marketing and promotion strategy as applied by the programme?

The central question consists of two components, it relates to the current status and future marketing implications for the biogas programme. The first step is to assess the current marketing performance. The level of awareness and knowledge potential biogas customers have towards the technology is vital to understand the performance of the marketing activities

employed by the programme. But it is also important to be aware of the most appealing benefits and the costs potential clients perceive for investing in the technology. This leads to the second step, the design of new social marketing strategies. The programme can design new marketing strategies around the most appealing benefits of the biogas technology as perceived by potential clients.

Various sub questions are formulated to answer the central question of this study. The questions relate to the two major actors in this study, potential biogas customers and the biogas programme itself.

*Sub Questions Considering Potential Biogas Customers:*

- Where are the highest potential biogas regions in Tanzania?
- To what extent is the potential target group aware of the technology?
- What are the perceived drivers and barriers for investing in biogas?
- What is the demand for biogas among potential clients?
- Is there a difference between the perceived- and actual- costs for adopting biogas?
- What are the financial benefits of using biogas?

*Sub Questions Considering the Biogas Programme:*

- How are marketing and promotion activities currently organized?
- What is the effectiveness and efficiency of the employed promotion activities?
- In which stage of diffusion is the biogas programme currently, how much diffusion potential remains and what is the best strategy for further dissemination?
- What social marketing strategies and insights can contribute to new ideas for the programme and a higher demand for biogas?

### 3.1.3 Assumptions

The following assumptions have been formulated against the background information and views on biogas diffusion for development. The assumptions include the contextual dimensions for the biogas programme and to the two main parties involved in this study: potential biogas customers and the programme itself.

*Contextual Dimensions:*

- The performance of the programs is shaped by institutional barriers for renewable energy dissemination, the poverty context and the remoteness of localities. These external influences hamper a successful dissemination of the biogas technology.

*Potential Biogas Customers:*

- There is a low demand for biogas in Tanzania because potential clients have a negative attitude towards the technology.
- Potential clients are insufficiently aware about the financial benefits of using biogas.

- Biogas is perceived to be a step on the energy ladder between traditional biomass and electricity. The impact on the livelihood in terms of socio-economic growth is too small for most households, because it does not provide the energy supply needed to use modern conveniences.

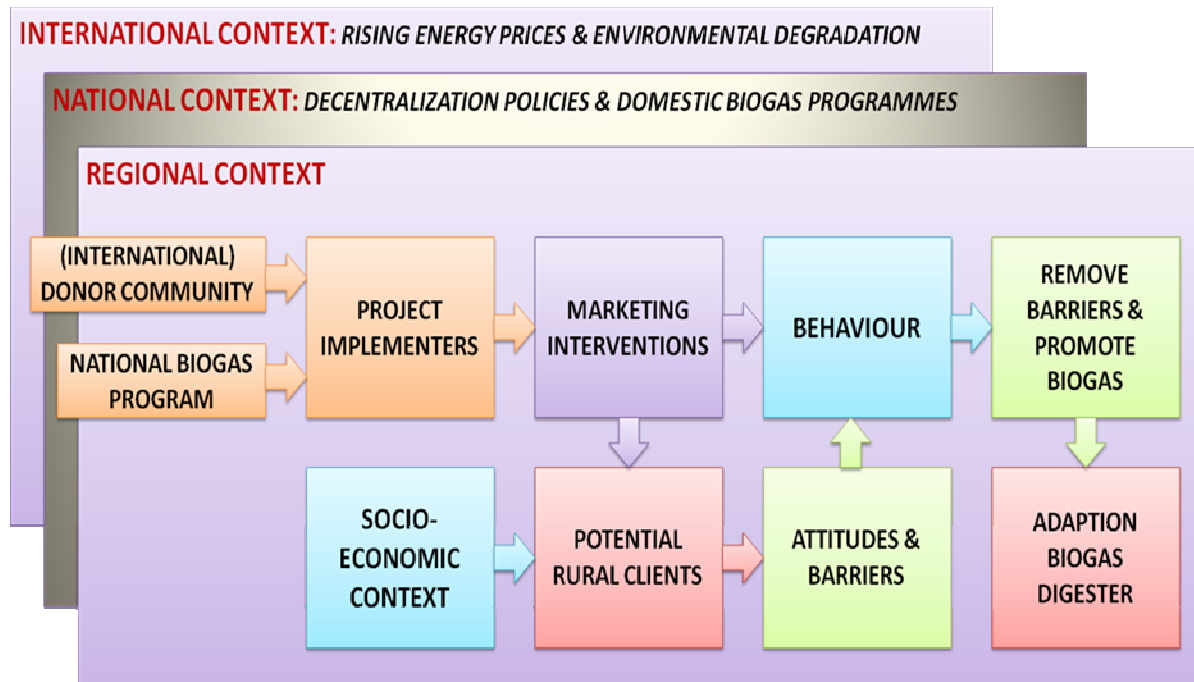
#### *The Tanzania Domestic Biogas Programme:*

- The initial investment costs of biogas are too high for the ‘average’ smallholder farmer. Biogas demand remains low because there are no feasible finance mechanisms in place.
- A lack of coherence in the employed marketing activities has a negative effect on the effectiveness and efficiency of the employed promotion activities.
- There is much market potential undiscovered and the programme is still in an early stage of diffusion.

### 3.2 Conceptual Model

A simplified flowchart (conceptual model) is illustrated to visualize the research intentions of this study (figure 7). This model shows the very basic and causal relations in marketing biogas.

Figure 7: Conceptual framework



Source: Thesis Proposal Paul Warnars 2012

The conceptual framework of this study is based on system thinking. System thinking is a concept based on understanding the connections and relations between (often seemingly isolated) variables. The concept is used to understand the causal relationships of a problem. Causal Loop Diagrams (CLDs) can be used to understand the trend of an issue or a problem in a system, illustrating relations in a CLD makes the problem understandable, transparent and visible for others (Haraldsson, 2000, pp. 2 - 5).

In this study, system thinking has been applied to understand the link between biogas demand and the performance of the employed marketing activities. In specific the relationship between people's attitude and behaviour on one side, and the demand and adoption of biogas on the other side. Understanding these connections may contribute to the design of a coherent social marketing plan.

### 3.3 Exploratory Research

Studies on renewable energy penetration in developing countries are abundant and available (Ahlborg and Hammar, 2010; Stern, 2003; Painuly, 2001; Wilkins, 2002), but all of these researches are very limited in acknowledging the role and concept of consumer behaviour marketing and stop their analysis after identifying the contextual drivers and barriers. Painuly (2001) indicates a number of solutions to conquer barriers on a institutional level.

This study is going a step further by grasping the behaviour, attitude and motives potential customers have in regard to the biogas technology together with the current performance of the programme. Among marketers it is believed that marketing has the ability to change people's behaviour and influence their demand concerning a specific product (*Mas-Colell, 1977*). Even though there are many renewable energy projects in developing countries, research about the applicability of social marketing for promoting renewable energy technologies is an almost unexplored terrain. This study is designed to grasp the intrinsic values individuals grant to the biogas technology and assess the performance of the currently employed marketing activities. Because there is no existing model used in the basis of this study, the research is explorative. The applied literature is supportive and complementary.

Exploratory research is conducted for a problem that has not been clearly defined. This is also true for the biogas programme. Exploratory research helps determine the best research design, data collection method and selection of subjects. It regularly relies on secondary research such as reviewing available literature and/or data, or qualitative approaches such as informal discussions with clients, employees, management or competitors, and more formal approaches through in-depth interviews, focus groups, projective methods, case studies or pilot studies (*Babbie, 1986*). The objective for the biogas programme is to become familiar with social marketing and acquire new insights into the behaviour of potential biogas customers. The type of research applied is mixed qualitative and quantitative. According to Hulme (2007), combining both qualitative and quantitative data is reliable and rich because it can explain the underlying processes in development studies (*Hulme, 2007*).

This method - also known as triangulation, mixed methods, multi-method approach and q-squared data analysis- appears to be very useful to conduct impact assessments at project level and other forms of poverty oriented research. Even though sample surveys are still common, nowadays they are often combined with participatory and other qualitative approaches, each with its own strengths and weaknesses. Triangulation is using different methods to research the same issue, cross-checking the results, and increasing the reliability of the result (Herbert & Shepherd, 2002).

### 3.4 Gathering Primary Data

The primary data for this study is obtained through qualitative field research. Quantitative data plays a secondary role and is used to evaluate and complement field data. The qualitative data is gathered from multiple stakeholders in the northern districts of Tanzania (see table 2 and map 2).

Table 2: Interviews conducted

Stakeholder	Number of Respondents
Potential biogas customers	65
Control Group	20
SNV	4
TDBP	3
Implementing Partners	6
Credit facilitators (SACCOS)	5
Government extension officers	3
BCEs	4
Individual masons	6
<b>Total:</b>	<b>116</b>

Map 2: Research area (in orange) in Tanzania



Potential biogas customers are the foci of attention for this study. The villages for conducting research are selectively targeted to measure the effectiveness of local promotion activities. Hence approximately half of all interviewed potential biogas customers are exposed to local promotion activities (such as village meetings and door to door visits) while the other half is not exposed to local promotion activities. Potential biogas customers are interviewed through different means, the mostly used method was by applying short semi-structured interviews to grasp people's motives and attitude but also to assess how they have heard about the technology and what they already know about biogas. But also during village meetings and in small focus group sessions these data was gathered. A small non potential control group is interviewed to measure the impact of national promotion activities on awareness.

Field data from potential and non potential biogas customers are gathered with the help of John, my translator during the field trips.

Other stakeholders are relevant to assess the marketing features of the programme. The problems they face in their marketing become more and more apparent through in-depth interviews. This also provide the opportunity to discuss improvements on the marketing strategy as currently applied, the views stakeholders have on improving the marketing from their perspective is vital information to design future marketing strategies for the programme.

Quantitative research data on potential biogas customers and current biogas users in Tanzania is sparsely available. Quantitative data plays a secondary role in this study and is used to evaluate and complement field data. Much quantitative data is gathered from the National Budget Survey 2007 (website) as well as from Tanzania's National Bureau of Statistics website. Two useful reports are recently published, a biogas survey report from Kileo (2012) illustrates some shared characteristics of biogas users and their demographic features. And a baseline report published by the University of Minnesota (2011) that examines the future impact of biogas digester adoption on four villages in Tanzania.

### **3.5 Research Limitations**

The major limitation of this study is its methodology, exploratory research is not typically representing the whole country and thus limits representativeness of the study itself (Babbie, 2007). Much of the used quantitative data is not obtained with a focus on energy, hence the applicability of this data is questionable.

The villages for identifying potential customer behaviour are selected prior to engaging them, this form of non-probability sampling is thus biased and might not be representative for the rest of Tanzania. The main disadvantage of qualitative approaches to corpus analysis is that findings cannot be extended to wider populations with the same degree of certainty that quantitative analyses can. This is because the findings of the research are not tested to discover whether they are statistically significant or due to chance. However, in this study qualitative interviews are conducted to grasp people's behaviour about biogas and not to provide a quantitative statistical review. Unfortunately, there is not enough time nor assets to set up a statistically significant nationwide research considering biogas behaviour among potential clients. The exploratory character of this study together with the qualitative data needed for this study justifies the applied research method. Another bias in interviews with potential biogas customers is the possibility of influencing the respondent when the respondent does not understand the question. During focus groups there are occasionally dominant respondents that can influence the other respondents. In this study I found out that especially woman are insecure about their answers and tend to repeat their husband or other males in their direct surroundings. Approximately one quarter of all potential customer respondents are woman. For interviewing potential biogas customers I went to the field together with John, John is recently graduated from ICT studies (Bachelor) and was assisting me as an interpreter with English, Kiswahili and South-African language skills. Especially his



South-African background appeared to be very useful in reporting the answers back to me in a hybrid Afrikaans-English language, which I could understand very well. Although errors can be made during translation, I do not think this has a major impact on the gathered data.

Interviews with SNV, TDBP and IPs were conducted in English and without interpreter. The other stakeholders within the programme are interviewed with the help of an interpreter.

### **3.6 Conclusion**

This chapter, methods applied, illustrates the key aspects of this study. The assignment is to make a survey on the promotion and marketing efforts in the domestic biogas sector and to examine how social marketing can contribute to a further dissemination of the technology. The formulated research questions and assumptions in regard to this assignment will be treated in the last chapter.

The primary data for this study is obtained through qualitative field research. Quantitative data plays a secondary role and is used to evaluate and complement field data. Potential biogas customers are the foci of attention for this study. The villages for conducting research are selectively targeted to measure the effectiveness of local promotion activities. There are 116 individuals interviewed for this study in the Northern and Centre regions of the country.

System thinking has been applied to understand the link between biogas demand and the performance of the employed marketing activities. In specific the relationship between people's attitude and behaviour on one side, and the demand and adoption of biogas on the other side. Because there is no existing model used in the basis of this study, the research is explorative. The applied literature is supportive and complementary. The major limitation is the methodology, because exploratory research is not typically representing the whole country and thus limits the representativeness of the study itself.

The second part of this document will report the result findings of this study. Next chapter, chapter four, is an inventory of the gathered data.

## **PART II**

---

The second part of this document is assessing the research data and discussing the results. Chapter four is summarizing the collected data and visualizes the highest potential biogas regions. Chapter five is evaluating data by applying marketing models and principles. The synthesis is the sixth chapter, here the research questions and assumptions are discussed. Chapter seven is the last chapter and will conclude this study, answer the central question and presents recommendations for the programme.

## **4 | ASSESSING THE BIOGAS SECTOR**

---

The first section in chapter four is calculating the biogas potential of 111 regions in Tanzania. The perceptions potential clients have towards the technology are evaluated in the second section. There is also a distinction made between potential clients exposed and not exposed to local promotion activities to evaluate the impact of the employed marketing activities. The third section is discussing the difference between the perceived and actual costs of adopting biogas. The efficiency and effectiveness of the promotion activities employed are evaluated in the fourth and last section of this chapter.

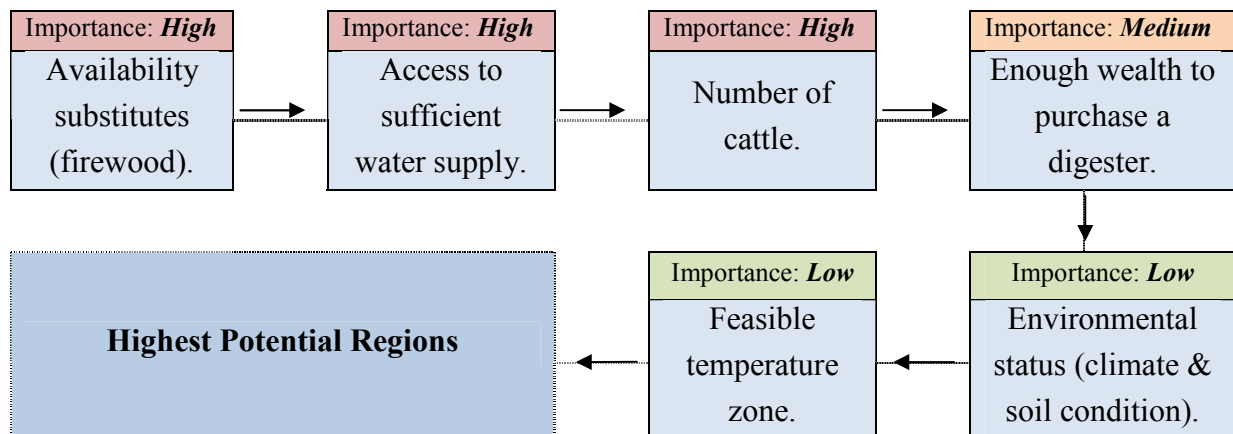
## 4.1 Biogas Potential

Tanzania is a large country and very much fragmented in terms of geographical differences. It is therefore hard to define how some areas are more potential than others. The geographical spread of localities makes it difficult for the programme to be active and fully aware everywhere. The purpose of this section is not only to make an attempt to pinpoint the highest potential areas, but also to exclude the least potential areas. This is done based on existing data from governmental institutions and previous reports (Winrock International, 2007; GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009; Schoot Uiterkamp, 2011; NBS, 2011). Combining various data gives an image of the highest and lowest potential areas.

### 4.1.1 Calculating the Highest potential Biogas Regions.

Relevant indicators are given a value, combined and summarized to make a categorization of the highest potential areas in terms of potential demand for biogas. The following flowchart illustrates the steps (determents) to identify the highest potential biogas regions in Tanzania in chronological order of importance.

Figure 8:



Source: Desk Research 2012

When combining all above mentioned determents it is possible to calculate the highest potential regions for biogas. Not every determent is equally important, each determent is given a value ranging from 1 (low importance) to 3 (high importance). This value is amplified with a given weight for each region. The total number of points each district scores indicates its potential.

For example; *The number of livestock is given an amplifier value of 3 (important), areas with a number of 20 to 49 cattle are given a weight of +2. This means that those areas with a number of cattle ranging from 20 to 49 are getting a score of 6 (3 times +2).* Areas can get a both positive and negative score. A negative score example; *The average annual precipitation is given an amplifier value of 2. Areas with little precipitation (475 – 724 mm.*

annually) are given a weight of -1, this is because these areas are less feasible for biogas. The score of regions with little precipitation are thus getting a score of -4 (2 times -2).

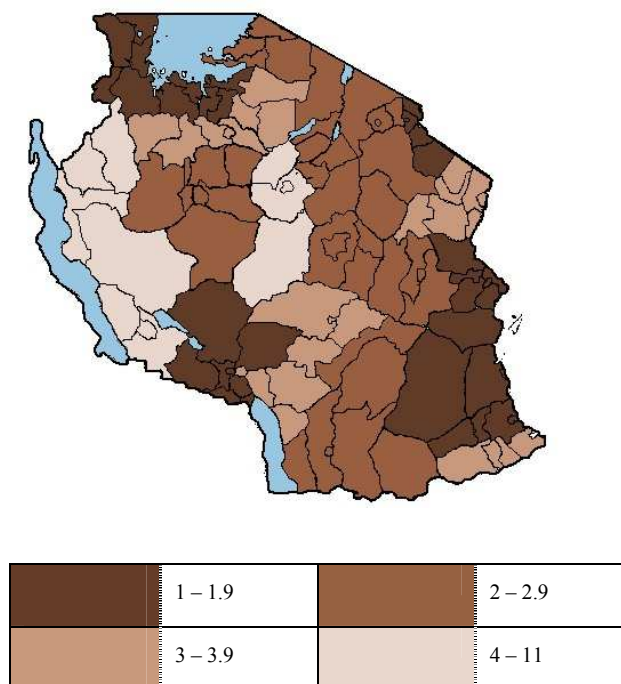
Appendix A will show this table (table 3) with the amplifiers and weight for each indicator. The following sub-sections will elaborate on the indicators.

*Availability Substitutes (Firewood)*

The estimated annual per capita firewood consumption in Tanzania adds up to 1m<sup>3</sup> per year, equals about 7 kg per rural household per day. Solid biomass (which mostly includes fuel wood) account for 93.6 per cent of the total rural household energy consumption in 1999 (Jamting, 2008, pp. 1-2). The collection of firewood is very time-consuming and predominantly carried out by children and woman (Winrock International, 2007). Using biogas substitutes the need to collect firewood (SNV/TDBP, 2009). Since humans are rational economic creatures in nature, the benefits of using biogas should out weight the distance (efforts) in collecting firewood. The further (and longer) people have to walk in collecting firewood, the more potential they are for the biogas programme. Those areas where people do not have to walk far distances to collect firewood are thus less potential for biogas.

**Map 3**

**Mean Distance to Collect Firewood (in Km.)**



**Source: NBS, 2009**

This map shows the mean distance for rural households in collecting firewood. As shown in the map, the mean distance in collecting firewood is very high in the Western as well as some central districts in the country, in these districts people walk an average of 4 to 11 kilometre a day to collect firewood. In many other districts (North, Centre, South), people walk an average of 2 to 3 kilometre in collecting firewood. Everyone who is walking more than 2 kilometres a day (about 30 minutes) can be considered as potential biogas customer for the programme.

### Water

Water is an essential ingredient for a good functioning biogas digester. Every day the digester needs to be feed with manure and an equal amount of water. Depending on the size of a digester an average of 25-30 litre water a day is necessary for the digester to function well (SNV, 2007). Obviously, there is often a lack of water points in areas with high levels of water scarcity. In these areas people have to carry water over long distances, which takes a lot of time and effort. Besides the daily need of water for drinking purposes, people often need water for their land and cattle (Madamombe, 2007). An extra demand of 25-30 litre water on a daily basis to feed the digester is often too much for them to carry (Fieldwork, 2012). Households that live far from a water point are thus less potential contrary to those having access to sufficient amounts of water in their surroundings.

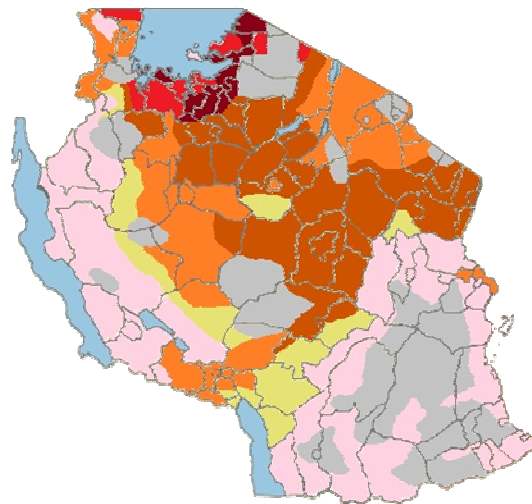
The centre of the country is the driest part in terms of precipitation and thus less potential for the programme. Although there is much precipitation in the South-Eastern part of the country, people lack improved water access and thus experience difficulties in their water supply. The maps that show the average annual precipitation and the access to improved water points are included in appendix B, map 4 and map 5.

### Livestock

Livestock an important deterrent to take into account in examining potential biogas regions in Tanzania (GTZ, 2007). Tanzania is the third country in Africa in terms of cattle size with more than 18,8 million livestock cattle. It is estimated that this cattle population produces more than 40 million tonnes of manure annually. However, much cattle belong to pastoralists who allow their livestock to roam (NABC, 2012, pp. 4 - 7). Many manure is thus scattered over large lands and not concentrated at one place in a village near households. Since no digester can operate without manure, farmers with zero grazing cattle are the foci of the programme. Households need to have at least two full grown cows to be classified as potential, a minimum of three cows is preferred to ensure the necessary amount of manure (SNV, 2007; GTZ, 2007).

Map 6

### Livestock per Square Kilometre



< 1	1 - 4	5 - 9
10 - 19	20 - 49	49 - 99
100 >	<b>Source: FAO, 2011</b>	

As shown on the map, the least potential regions are in the South and coastal regions. The centre part of the country, together with the Northern regions, have a big cattle population and can be considered as very potential for biogas. Especially the districts surrounding Lake Victoria are home of very large cattle populations.

### *Welfare*

The core purpose of the biogas programme is to eradicate poverty by giving rural farmers means to create an income through biogas. It is widely acknowledged that only farmers with a steady level of welfare and income are able to make an investment in biogas. The programme is not suited for the poorest families since they do not have enough resources to purchase, operate and maintain a biogas plant (GTZ, 2007; Marree & Nijboer, 2007; SNV/TDBP, 2009).

The poorest regions are in the middle of the country stretching towards Lake Victoria. The Northern Regions are the regions with the least amount of poverty. The level of welfare is high in many urban areas. The maps 7 and 8 in appendix B show the percentage of people living below the national basic needs poverty line and the poorest and wealthiest districts by poverty headcount.

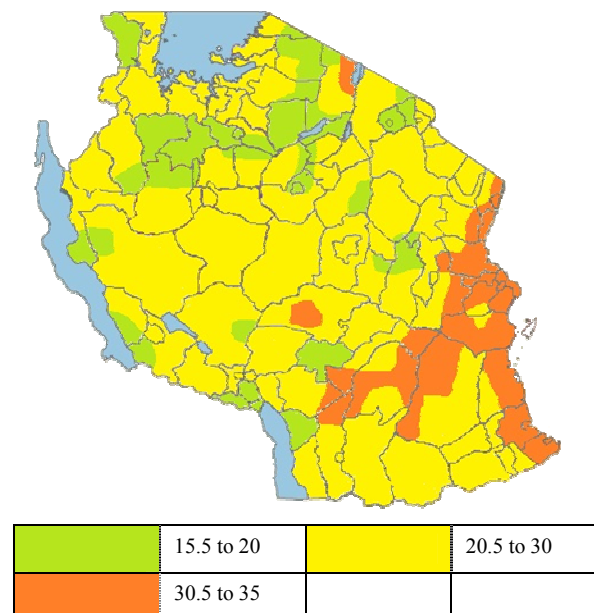
### *Temperature*

The rate of methane formation in biogas digesters increases with rising temperatures. Temperatures around 35 degrees Celsius (32-38 degrees Celsius) are optimal for a maximum amount of gas production. The digester is designed for warm climates such as Tanzania (SNV, 2007).

As shown in the map, the temperature in most areas of Tanzania are (slightly) below the ideal temperature. This does not mean that the country is not suited for biogas digesters. The overall temperature in Tanzania is good enough for sufficient biogas production. The temperatures in the Southern and coastal regions are considered to be optimal.

**Map 9**

### **Average Annual Temperature (in Celcius)**



**Source: FAO, 2011**

*Environmental status*

Agricultural households with access to good soil and climatic conditions can make full advantage of the available bio slurry as a fertilizer. Applying bio slurry results in 25 per cent more crop production per harvest on average. Higher crop revenues contribute to poverty alleviation and improved health conditions since more food can be consumed and sold at local markets. Households that live in a good agricultural environment can benefit most the available bio slurry as a fertilizer (GTZ, 2007; SNV, 2007).

Much land in Tanzania is under a lot of environmental stress and soil degradation. The Southern districts seem to be highest potential and the middle parts least potential. Map 10 in appendix B illustrates the environmental conditions in Tanzania

**4.1.2 Demand Potential per District**

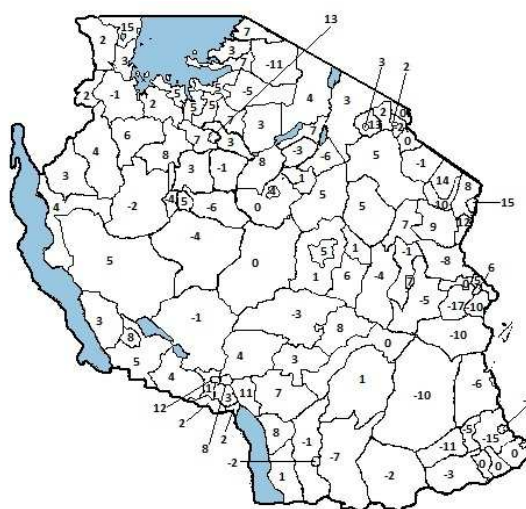
The following two maps are summarizing the results from all elaborated determents. Districts can have a negative or positive score. The higher the score, the more potential a district is. Each score of the 111 examined districts are illustrated in the first map on the right.

As shown in the key of the map, the mean score of all districts combined (both positive and negative scores) is 2.09. The total sum of points is 232 and there are more districts with a positive score than with a negative score. The most prevalent score is 5. The overall score of all districts indicates a fairly positive biogas potential in Tanzania. The best scoring district is Bukoba (+15 points), which is North-West of Lake Victoria. The district with the lowest score is Kisar (-17 points), located near the coast and close to Dar-es-Salaam.

A categorization of points in colour is a good method to illustrate the highest and lowest potential biogas districts in Tanzania. Green is the most dominant colour, which confirms the positive score for biogas of all districts combined in Tanzania. There is much biogas potential in the Northern, Western and Southern regions of the country. In the North-East and around Lake Victoria in the North-West is a concentration of highly potential districts. The red coloured districts are very much concentrated. There are roughly three not potential, red coloured, biogas zones. In the North-West are two bordering districts which are not potential. The second zone is the central part of the country while the biggest and lowest potential biogas region is located in the South-East.

**Map 11**

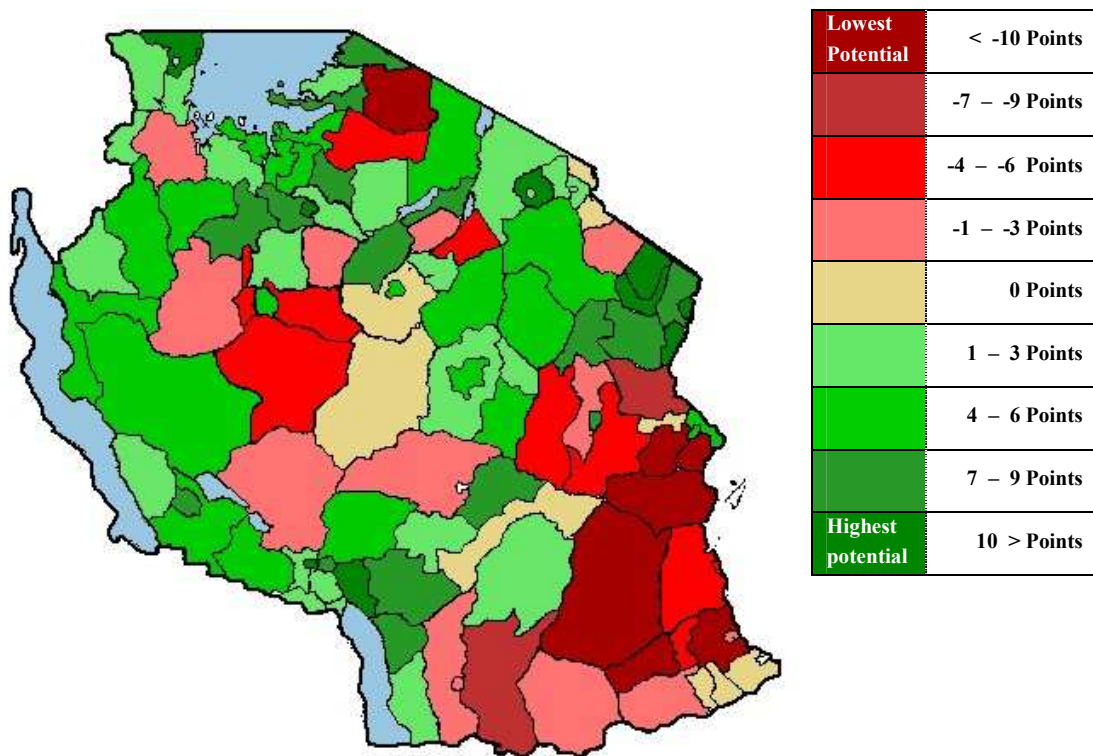
**Potential Demand (in points)**



<b>Districts</b>	<b>111</b>
<b>Highest score</b>	<b>15</b>
<b>Lowest score</b>	<b>-17</b>

<b>Sum points</b>	<b>232</b>
<b>Mean</b>	<b>2.09</b>
<b>Median</b>	<b>3</b>
<b>Mode</b>	<b>5</b>



**Potential Demand (points categorized)****Map 12****4.2 Biogas Perceptions**

Biogas perceptions are a collective term for various indicators to assess the relation people have with the biogas technology. This data is essential to understand the opinions and behaviour potential customers have towards biogas. It is also a good indication for the current penetration of the technology in Tanzania. Interviews with smallholder farmers in rural Tanzania provide valuable insights for improving future marketing interventions.

This section begins by evaluating the awareness of the biogas technology in Tanzania among potential biogas customers exposed and not exposed to local promotion activities, together with a non potential control group to make the results clear. This indicates the impact of the employed promotion activities and indicates how well the technology is aware in rural Tanzania. The knowledge potential customers have about the biogas technology is examined secondly. The amount of knowledge people have about the features of biogas indicates the effectiveness of the promotion message and illustrates the points of attention. The barriers and benefits potential households perceive for investing in biogas are respectively the third and fourth sub-sections. This indicates the motives potential clients have for investing, or not, in biogas. The last sub-section illustrates the attitude people have towards the technology. Attitude is the sum of barriers and benefits potential clients have towards the biogas technology in Tanzania.

### 4.2.1 Awareness

The level of biogas awareness indicates the degree in which people are familiar with biogas technology. People may have heard about biogas from relatives and friends, promotion activities from the present programme, television or radio shows where biogas is mentioned, colleagues in other villages or from previous biogas programmes in Tanzania.

For the biogas programme it is feasible to know what the impact of the currently employed marketing and promotion activities is. These insights may influence future promotion approaches within the programme. Hence a distinction is made between potential biogas households exposed to local promotion activities by the programme and potential households not exposed to promotional exposures by the current programme. As a benchmark a third control group that is not exposed to biogas campaigns, or considered as potential biogas customers, are added.

The following table (table 4) concludes the level of biogas awareness among the three respondents groups.

Awareness	Level of Awareness									
	<i>Low</i>					<i>High</i>				
	1	2	3	4	5	6	7	8	9	10
The awareness about biogas technology among the not potential control group is...		X								
The awareness about the technology among potential clients <i>not exposed</i> to local promotion activities is...			X							
The awareness about the technology among potential clients <i>exposed</i> to local promotion activities is...									X	

Not surprisingly, the level of biogas awareness is very low among the not potential control group. Only a few respondents have heard about biogas through others but have a low level of involvement because they are not potential biogas users. The level of awareness among potential biogas customers that are not exposed to local promotion is relatively low as well and not much better than the control group. From this insight we can conclude that the impact of national promotion campaigns have very little influence on potential biogas customers. Similar to the control group, highest potential biogas customers that are not exposed to biogas on a local level have heard about the technology from friends, colleagues and relatives in other villages. Potential biogas customers that live in villages exposed to biogas promotion activities have a high level of biogas awareness. Almost all potential customers in these localities know about biogas technology. Comparing the level of awareness between localities exposed and not exposed to local promotion activities shows the impact of the currently employed marketing activities on a local level.

Since Tanzania is such a large and geographically widespread country with many different climatic conditions and various lifestyle cultures, not every locality is considered potential for the programme. Hence the biogas programme is not present in all regions throughout Tanzania. For the programme it is feasible to know the degree of biogas awareness in various localities in Tanzania. The programme can choose to concentrate on those regions where biogas awareness is low or focus on regions with good biogas awareness to reach maximum penetration in these localities.

Next table (table 5) illustrates the level of awareness among eight different localities in Tanzania.

**Table 5: Level of awareness per district**

	Level of Awareness									
	<i>Low</i>					<i>High</i>				
<b>Awareness of potential clients in...</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
Arusha district is...									X	
Kilimanjaro district is...								X		
The surrounding villages of Babati is...						X				
The surrounding villages of Korogwe is...					X					
The surrounding villages of Karatu is...				X						
The surrounding villages of Dodoma is...				X						
The surrounding villages of Singida is...			X							
The surrounding villages of Kondoa is...		X								

Because the programme started in the Northern Regions of Tanzania, where TDBP is stationed, it is not surprising that the level of awareness is high in these districts (Arusha and Kilimanjaro). In the other regions where field research was conducted many villages are still not exposed to local promotion activities and therefore not well aware of the technology. Except for Kondoa and Singida, all researched regions are under direct supervision of an implementing partner, which is also shown in the results.

#### 4.2.2 Knowledge

The level of knowledge indicates how much potential biogas customers know about the benefits and usability of biogas. Assessing the knowledge on relevant topics give insight in the issues that need extra attention in biogas marketing. In making a distinction between potential households exposed and not exposed to local promotion activities it is possible to see if the programme's local promotion activities correlates with more product knowledge. The not potential control group is not relevant in this equation because biogas is not applicable to them.

Relevant topics to measure the degree of knowledge potential customers have on biogas are: the direct benefits of biogas for a household (gas for cooking and lighting, bio

slurry, controlling indoor air pollution), knowledge on operating a digester (amount of water and manure needed, periodically cleaning the digester, mix proportions water and manure, applying gas to cook and light), knowledge on the costs (initial investment costs material and labour, cost of maintaining and operating the digester, cost of appliances such as stoves and lamps), and the knowledge on finance opportunities (opportunities to (micro-) finance digesters and availability of subsidies).

The following two tables (table 6 and 7) illustrate the level of knowledge potential clients have that are not exposed to local promotion activities and those exposed to local promotion on topics related to biogas.

**Table 6: Level of knowledge potential clients not exposed to promotion activities**

	Level of Knowledge									
	Low					High				
<b>Knowledge of potential clients <i>not</i> exposed to local promotion activities.</b>	1	2	3	4	5	6	7	8	9	10
The knowledge about the benefits of biogas is...				X						
The knowledge on maintaining/operating of a digester is...			X							
The knowledge about the costs of a digester is...		X								
The knowledge about finance (loan) possibilities is...	X									

**Table 7: Level of knowledge potential clients exposed to promotion activities**

	Level of Knowledge									
	Low					High				
<b>Knowledge of potential clients <i>exposed</i> to local promotion activities.</b>	1	2	3	4	5	6	7	8	9	10
The knowledge about the benefits of biogas is...								X		
The knowledge on maintaining/operating of a digester is...							X			
The knowledge about the costs of a digester is...			X							
The knowledge about finance (loan) possibilities is...			X							

Since awareness of biogas is low in villages not exposed to local promotion activities it is not surprising that many respondents have very poor knowledge on the issues related to biogas. Those aware about the technology only have some knowledge about gas production and a few about lighting. With the exceptions of a few, almost nobody knows about the related costs and the possibilities to finance a digester at a loan agency.

Potential clients exposed to local promotion activities are sufficiently aware of the benefits a digester can have for them. They are also aware of the input needed to operate and maintain a digester. However, they cannot see a direct cost benefit and only notice the benefits in terms of gas production for lighting and cooking, health improvement and

deforestation. Highest potential customers are badly aware of the digester price, some respondents roughly know the estimated costs. Furthermore they have bad knowledge on the possibilities to attract credit facilities such as micro finance and subsidies.

Potential customers exposed to local promotion activities know much about the digester itself in terms of benefits and operation while potential households that are not exposed know very little about biogas. Hence there is a direct correlation between the level of promotion and biogas knowledge. However, local promotion activities fail in communicating information about the costs of a digester and the possibilities to attract credit for construction. The programme's marketing exposures lack in communicating about relevant topics for customers to make an investment in biogas.

#### 4.2.3 Perceived Barriers

The barriers potential customers perceive for investing in biogas hampers the dissemination of the biogas technology in Tanzania. The programme can change its marketing strategy to overcome the barriers perceived by potential biogas users. Product adjustments, a new price setting, another distribution strategy and new promotion campaigns are commonly applied methods to overcome earlier identified barriers. To optimize the marketing mix (the promotion-, product-, place-, price- strategy) for the biogas programme in Tanzania, it is desirable to know and understand the barriers potential customers perceive in relation to investing in biogas. The table below (table 8) summarizes each barrier in order of importance.

Table 8: Barriers for investing in biogas

Barriers potential biogas customers perceive...	Height of the Barrier									
	Low					High				
	1	2	3	4	5	6	7	8	9	10
The price of a digester.										X
Additional costs (after sales/appliances).									X	
The availability of other energy sources.									X	
The limited usability of biogas.								X		
Operating the digester (e.g. time/skills).								X		
Geographical spread / logistics (material to construction side).							X			
The amount of gas production (enough?).							X			
Uncertainty about its functioning.						X				
The durability of the digester.						X				
The quality of the digester.						X				
The quality of appliances (e.g. stove/lamp).						X				
Maintenance of the digester.					X					
Availability construction material.				X						
The (future) availability of livestock.			X							
The availability of credit (loans).		X								
The interest rate for a loan.		X								
The risk of an exploding digester.	X									
The risk of gasification.	X									

The most dominant barrier potential biogas customers face are the high investment costs and the uncertainty about future costs (such as appliances and maintenance costs). Another dominant barrier is the availability of substitutes, firewood is often locally available and can be collected for free. Even though other substitutes such as kerosene and charcoal cost money, the price is considered to be much lower contrary to applying biogas. Many households do not see biogas as a good investment, they argue it is limited in its usability because it only provides gas for cooking and lighting and not electricity to charge mobile telephones and use other modern conveniences. They do not perceive biogas to be a big step forward in the development of their household. Respondents also perceive difficulties in finding good material for a feasible (low) price in their surroundings. Although all construction materials are mostly locally available, respondents often argue they can get the materials cheaper elsewhere. There is also uncertainty about the gas production of a digester, respondents argue that a digester might not produce enough gas for their household. Some potential customers are affected by bad experiences others had with not (or poorly) working digesters and are afraid of bad functioning digesters since they argue that many digesters are poorly designed and constructed. This also explains the low quality perception among respondents. Another barrier, although less significant, is the unawareness about operating and maintaining a digester. Some potential clients think that operating a digester evenly, or even more, time consuming as collecting firewood. Because of the poor awareness of credit facilities the respondents do not know under what conditions they can apply for a loan or subsidies. Nobody is afraid for an exploding digester or gasification.

**Figure 9: SACCOS company that facilitates credit for the construction of biogas digesters**



**Figure 10: Mixing manure with water for the digester to operate**



#### 4.2.4 Perceived Benefits

In optimizing the marketing mix it is not only important to understand the barriers potential customers perceive, but also to have knowledge about the benefits potential biogas customers identify in terms of impact on the livelihood of rural farmers. The programme can apply this knowledge to create the most appealing message in their promotion activities. Another strategy is to use this knowledge to boost the awareness of the least appealing biogas benefits.

The following table (table 9) illustrates the benefits potential customers identify in terms of drivers.

Table 9: Drivers for investing in biogas

	Level of Impact									
	<i>Low</i>					<i>High</i>				
<b>Biogas is contributing to the livelihood of rural farmers because...</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
... it provides energy for cooking.										X
... it saves time/ workload reduction.								X		
... it provides energy for lighting.							X			
... it improves health issues.							X			
... if fosters cleanness of a stable.						X				
... the availability of bio slurry.						X				
... it saves money/create income for households.					X					
... it creates (mason) employment.			X							
... it prevents soil degradation.			X							
... it prevents deforestation.		X								
... it improves sanitation issues.	X									

Even though the level of biogas knowledge is moderate among all respondents, both potential respondents exposed and not exposed to local promotion activities know relatively much about the impact of biogas on the livelihood of rural farmers. All respondents identify gas for cooking purposes as the primary feature and benefit of biogas. The positive influence biogas has on the livelihood of rural farmers is widely acknowledge. Many respondents also notice the workload reduction for woman and children together with the purpose of gas for lighting. All respondents agree on firewood collection as a time consuming task for children and woman, together with the financial benefits of having light from biogas contrary to buying kerosene or candles. Highest potential customers also notice the benefits and impact of biogas on the health situation in households. Indoor air pollution is very common in many Tanzanian households, even though many families acknowledge the dangers of smoke inhalation for children in particular. The non-smoke benefits of biogas are thus well understood by most respondents. Potential customers that understand the operation progress of biogas digesters notice the advantages of a clean stable and the availability of non chemical fertilizers. Cleaning the stable is a daily task for farmers, dung is often collected and disposed in a corner of the land. With a biogas digester, all collected manure goes directly into the plant. Many respondents are still sceptical about bio slurry, this is because of the inexperience with fertilizers or a lack of faith in bio slurry as a good fertilizer. The financial benefits are not good understood by half of all respondents. This is because many households currently collect firewood themselves, hence they have no (or very little) expenditures on energy provision. These households do not gain more income by applying biogas. The use of bio slurry results in approximately 25 per cent higher crop revenues. Since the respondents know little about

the use of fertilizers, they are sceptical about its impact on their land. Very few respondents argue that the biogas programme is making a sufficient contribution to more employment creation. This is because there are many biogas constructors in relation to the amount of constructed digesters, building digesters is not the core business of most masons. Respondents do not see that using biogas has a direct impact on their surroundings in terms of deforestation and soil degradation. Even though all potential biogas customers understand the line of reasoning that no more forest wood is needed to have access to reliable energy, a commonly used argument is: ‘if I don’t cut or collect firewood in my surroundings anymore, somebody else without a digester will collect it anyway’.

#### 4.2.5 Attitude

The attitude people have towards biogas is a good benchmark to measure buying potential of a digester among potential customers. Attitude is the sum of barriers and benefits potential customers have. Attitude is not static and can change over time (for better and worse) when potential customers are more informed about biogas or experience a biogas demonstration themselves. A bad biogas experience will cause a bad attitude of the user and might discourage potential customers to invest in biogas. Current biogas users with good experiences are more likely to positively promote the technology to other potential customers. A positive biogas attitude is thus feasible to a successful dissemination of the biogas technology in Tanzania.

The attitude is examined among three different groups: current biogas users, potential biogas customers exposed to local promotion activities and potential biogas customers not exposed to local promotion activities. Potential households that are not exposed to local biogas promotion give a good indication how the attitude towards biogas is among many potential households in Tanzania. This is because the majority of potential biogas customers are not exposed (yet) to local promotion activities. By examining the potential households that are exposed to local promotion activities it is possible to see how promotion activities have changed (or not) the attitude towards biogas. The data on current biogas users is useful to see if biogas is positively received by its users.

In the table below (table 10), the results of the three groups are summarized.

**Table 10: Attitude about biogas**

Attitude people have towards biogas.	Level of Attitude									
	<i>Bad</i>					<i>Good</i>				
	1	2	3	4	5	6	7	8	9	10
The attitude current users have towards biogas is...									X	
The attitude potential clients <i>not exposed</i> to local promotion have towards biogas is...								X		
The attitude potential clients <i>exposed</i> to local promotion have towards biogas is...						X				



Current users have a very positive attitude towards the use of biogas. This indicates that current users are happy about the functioning of their biogas digester. Those not exposed to local promotion are surprisingly slightly more positive about the use of biogas than those who are exposed to local promotion activities. A logical explanation is that potential customers that are unaware and unknowledgeable only notice the benefits a digester may have for them, while potential users with more knowledge about the technology (because of local promotion activities) also perceive costs and efforts in applying using biogas.

#### 4.2.6 Biogas Demand

The most burning question in interviewing potential biogas is: Are you interested yourself in investing in biogas? This question is asked to potential households exposed and not exposed to local promotion activities. Even though the results are not statistically significant because of the relatively small sample size, it is a useful indicator to reject or adopt the programmes perception that the demand of biogas in rural Tanzania is low.

The following table (table 11) presents the biogas demand among potential biogas customers.

**Table 11: Biogas Demand**

	<b>Biogas Demand</b>									
	<i>Low</i>					<i>High</i>				
<b>Demand</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
The demand of biogas among potential clients <i>not exposed</i> to local promotion activities is...		<b>X</b>								
The demand of biogas among potential clients <i>exposed</i> to local promotion activities is...			<b>X</b>							

The results are fairly discouraging for the programme. The overall level of biogas demand among potential customers is perceived to be negative. This is surprising because the overall level of attitude among this same respondent group is perceived positive. The reason for this is that potential households perceive too much barriers for their own situation. These motives are mostly financial in nature.

### 4.3 The Costs of Adopting Biogas

The social exchange theory assumes that we are need-directed beings with a natural tendency to try and improve our conditions. The theory is an useful tool for organizations to map the costs potential clients perceive for investing in a product or changing their behaviour. It claims that all human relationships are formed by the use of a subjective cost-benefit analysis and the comparison of alternatives. All elements that have a negative value are labelled as costs (time, money, effort etc.). The positive arguments, or benefits, are labelled as rewards. From a social exchange perspective, people calculate the overall worth of the product by subtracting its costs from the rewards it provides. Costs and rewards are subjective, the standards that humans use to evaluate the worth of the product varies over time and from person to person. Hence, the costs potential clients perceive is often different then the reality (actual costs), this phenomenon is known as 'knowledge gap' in the social exchange literature. The purpose of the (social) exchange theory is to map the costs potential clients perceive to illustrate this knowledge gap. This information is useful to design promotion campaigns whereby the actual costs and benefits are communicated, in this way potential clients will better be informed about the costs and develop a more realistic perception about the product.

The majority of the potential customers that are aware of the biogas technology notice many costs for investing in biogas. The relatively low amount of constructed digesters can be explained by the domination of costs over revenues, the revenues do not outweigh the costs potential clients perceive. Financial arguments are mostly decisive for potential clients, social arguments such as improved health conditions and workload reduction are less tangible and thus less influential in the decision making process (behaviour). Biogas digesters are perceived to be expensive but not very profitable in financial terms. Other sources of energy such as firewood, kerosene, charcoal and electricity are good and relatively cheap alternatives for biogas. When the costs of another energy source is lower than the benefits of a biogas installation, potential customers will most likely not purchase a biogas plant. This can mean two things for the biogas sector; 1) The benefits of a biogas installation are not as prosperous as initially thought and the project is deemed to fail. Or, 2) the perceived costs are not in line with the actual costs.

Following table (table 12) will illustrate the most dominant costs potential client perceive together with the actual costs and benefits of biogas. The actual costs are formulated as an argument to respond to that cost. The perceived costs derives from potential biogas respondents. The programme should be aware of these perceived costs and design strategies and campaigns that promote the actual costs and outweigh the negative perceptions potential clients have about biogas. The information about the actual costs derives from this report, SNV, TDBP, implementing partners and current biogas users.

**Figure 12: Perceived versus actual costs**

Perceived Costs	Actual Costs and Benefits
The initial investment costs are too high, the digester will not become profitable.	The construction price is high. By not having to buy charcoal and kerosene, the installation becomes profitable within 3 years or 2 years when bio slurry is used (+25% crop revenues).
The plant might not produce enough gas to substitute the need of biomass fuels and kerosene.	There is enough gas for 3 hours of cooking and 2 hours of light every day if the digester is fed with 25kg. manure and 25L. water in an average (6m <sup>3</sup> ) digester.
Biogas digesters are not durable and break down within a few years already.	Many digesters are not working properly. These are old type digesters and not from the current programme. This type of digester will function for at least 20 years.
Firewood is freely available.	Using firewood is bad for the health and it costs much time to collect. It is also not possible to light a lamp on wood.
Operating the digester cost a loads of time.	Operating the digester may take up to 1 hour per day. Gas contains a high concentration of energetic value, a meal is cooked within 30 minutes. Plus there is no need to collect firewood anymore.
It is unhygienic and dirty to operate the digester.	Manure and water have to be mixed together, this can be done by hand or mechanical mixer. The produced gas is clean and prevents indoor air pollution contrary to using charcoal and firewood. Health conditions will improve.

The perceived costs for adopting biogas are complementing section 4.2.3, the barriers potential households perceive for investing in biogas. The most dominant barriers are highlighted and elaborated, the actual costs and benefits are formulated as counter arguments to the perceived costs. The social exchange theory is not about convincing smallholder farmers to invest in biogas with counter arguments, but use these arguments in promotion campaigns to inform potential biogas customers about the actual costs and limit the currently existing knowledge gap. An example of a one-liner is: *Using firewood might cost you nothing, but is it worth the health of you and your children?* or *It will cost you one hour every day to operate your digester, how much time do you spend in collecting firewood?*. To avoid wrong costs perceptions, the biogas sector must be open and transparent in communicating the actual costs of using biogas. This is also a mean to get rid of the cost perceptions potential households currently have about biogas.

#### 4.4 Biogas Promotion Efficiency and Effectiveness

This section has a focus on the efficiency and effectiveness of the promotion (marketing) activities employed by the programme (TDBP), implementing partners, promoters, government extension officers, SACCOS companies, BCEs and individual masons. The purpose is to examine the efficiency and effectiveness of each activity employed. Qualitative field data is used together with quantitative report data to monitor the efficiency and effectiveness of the overall promotion within the biogas sector.

Field data from is gained from various stakeholders in the programme, potential households both exposed and not exposed to marketing communication activities, and a non potential control group. This (qualitative) field data is combined with (quantitative) data from a recently published user survey (Akyoo & Kileo, 2012) and baseline report (Savanna Forever, 2011).

##### 4.4.1 Effectiveness Promotion Activities Employed by the Programme

The first step is to measure the impact of the promotion activities according to potential biogas customers. The amount of people that become ‘aware’ of a product existence from a specific source relates to the ‘effectiveness’ of that communication channel. The question asked to potential biogas customers is both clear and simple: ‘*How have you heard about biogas?*’. The results are in order of impact whereby the activity with most impact is listed first. Next table (table 13) visualizes the impact of each promotion activity.

Table 13: Impact promotion activities

Promotion activities	Impact Promotion Activities									
	Low					High				
	1	2	3	4	5	6	7	8	9	10
Mouth to mouth (viral marketing)										X
Door to door promotion									X	
Village meetings								X		
Church visits							X			
Visits to exhibitions/ fairs						X				
Regional newspaper/magazine advertisements					X					
National newspaper/magazine advertisements				X						
Regional radio advertisements				X						
Visits to loan agencies (e.g. SACCOS)			X							
Regional TV advertisements		X								
National radio advertisements		X								
National TV advertisements		X								
Mobile promotion	X									

As shown in the summarizing table, most people heard about biogas through others. In marketing this phenomenon is also known as ‘mouth to mouth promotion’ or ‘viral marketing’. The existence and benefits of biogas is communicated through existing social networks and peer groups. Ironically, this most effective mean of promoting biogas is also the only marketing activity that cost no money for the programme. Current biogas users act as ambassadors for the technology and spread the word among their friends and relatives. It is therefore very important that all digesters work properly, non working digesters have a bad influence on potential clients (bad publicity). Other effective means in promoting biogas are: door to door promotion, village meetings and church visits. It becomes clear that the four most effective marketing activities are all employed on a local and household level. The table also shows that the promotion activities employed on a regional level are moderately effective while the activities employed on a national level are least effective. Agricultural exhibitions and fairs are interesting because a large share of the visitors is a smallholder farmer and thus potential for the programme. Unfortunately only a few respondents have heard about biogas at these meetings. Some respondents have seen advertisements or information about biogas in regional and/or national newspapers/magazines. Few can remember hearing a radio advertisement about biogas but only a very few can remember seeing something about biogas on the television. Even though radio and television advertisements score poorly in terms of impact, mass media commercials are proven to influence people’s subconscious mindset and have the potential to become effective when communicated frequently. Only one respondent became familiar with the technology through mobile promotion.

#### *Promotion Scales & Activities Employed per Stakeholder*

The promotion intervention are segmented in figure 11 to make further analysis more convenient. The following table clusters all promotion activities in three different scales: local promotion activities, regional promotion activities and national promotion activities. Inhere local promotion activities are defined as promotion activities whereby human interaction is possible between promoter and potential customer.

**Figure 11: Promotion activities per geographical scale**

<b>Local Level Promotion</b>	<b>Regional Level Promotion</b>	<b>National Level Promotion</b>
<ul style="list-style-type: none"> <li>- Mouth to Mouth</li> <li>- Door to Door</li> <li>- Village Meetings</li> <li>- Church Visits</li> <li>- Exhibitions and Fairs</li> </ul>	<ul style="list-style-type: none"> <li>- Newspaper Advertisement</li> <li>- Radio Advertisement</li> <li>- Television Advertisement</li> <li>- Visit SACCOS</li> </ul>	<ul style="list-style-type: none"> <li>- Newspaper Advertisement</li> <li>- Radio Advertisement</li> <li>- Television Advertisement</li> <li>- Mobile Promotion</li> <li>- Website</li> </ul>

Appendix C illustrates all promotion interventions for each geographical scale together with the stakeholder that is carrying out that activity.

As this table shows, every form of promotion on all levels is done by TDBP themselves. Inhere TDBP is leading by example. Implementing partners are active in promotion activities on both a local and regional level. Promoters and BCEs (masons) are solely active on a local level (where they can generate their own sales). Since all stakeholders are doing their own marketing, potential clients get exposed to various types of promotion activities and from different sources. This broad attention for promoting biogas might be feasible for a fast growing awareness of the technology. However, since everyone is doing their own marketing and promotion, there is a lack of coherent strategy among all stakeholders involved. Potential clients might get confused since similar messages are transferred from different sources. *For example; TDBP is doing promotion on a local level in different villages in Arusha region. In this same village a local promoter and BCE are active. When potential clients are interested or willing to make an investment in biogas they do not know where to go to, contact the national programme, the IP or the local mason?* On a regional level both TDBP and the implementing partner for that region employ activities. Some implementing partners (e.g. MIGESADO) also advertise on a national scale for biogas. Here they contribute to the awareness of the technology throughout the country but also create confusion among potential clients.

#### 4.4.2 Efficiency Promotion Activities Employed by the Programme

The second step is to measure the ‘efficiency’ of the promotion interventions. A promotion activity is perceived to be efficient according to three determents: 1) The costs per reached potential customer are low. 2) As little as possible promotion budget is ‘waste’ to non potential customers. And, 3) there is synergy between all stakeholders in doing promotion.

Much time, money and efforts are invested in awareness creation and knowledge transfer of the biogas technology through marketing-communication interventions. TDBP, implementing partners, promoters and BCEs together with individual masons are the most dominant stakeholders involved in biogas promotion. Since there are no (complex) marketing evaluation tools in place within the biogas programme, there is no nationwide quantitative data available on the promotion costs per reached customer and the amount of people reached per promotion intervention. Qualitative data from all stakeholders and potential customers is the basis in assessing the efficiency of the promotion activities employed by the programme. Their insights and views give vital information about the impact of promotion interventions in relation to the costs, the amount of non potential customers reached per communication exposure (waste), and the degree of cooperation in doing promotion among all stakeholders in the programme.

#### *Costs Per Reached Potential Customer*

The costs per reached customer is a good indicator to measure the efficiency of a specific promotion activity. Local promotion activities are proven to be more efficient because

potential customers are selected prior to engaging them. However, local promotion activities have a much smaller range and coverage than national or regional mass media communication interventions. Hence a proper balance must be made between the cost of the promotion activity and its commercial impact.

The following table (table 14) illustrates the costs of the promotion activity together with its impact. The column ‘promotion costs’ represents the amount of money invested in local, regional or national promotion activities. The amount of people that became aware of biogas through promotion intervention on that level relates to the column ‘impact of promotion’.

**Table 14: Promotion costs versus impact**

	Promotion Costs			Impact of Promotion		
	Low	Medium	High	Low	Medium	High
Local Promotion		X				X
Regional Promotion	X			X		
National Promotion		X		X		

In line with previous findings it becomes clear that promotion on a local level is most effective, because of its relatively low costs it is also perceived to be most efficient. All stakeholders are actively involved on a local level. Local promotion is very time consuming but does not need to cost much money. Especially for local promoters, BCEs and masons it is a relatively cheap and effective mean in promoting biogas. The involvement of TDBP and IPs in local promotion make the total costs for local promotion activities rise. This is because the costs for transport and overnights for personnel does not outweighs the benefits of extra promotion interventions. Contrary to local masons and promoters, TDBP and IPs have little knowledge about most localities. Promoting biogas on a local level is thus most effective and efficient when employed by local promoters and BCEs (masons). The overall costs per reached potential customer is low for local promotion activities.

Very little money is spend on regional promotion activities. Both TDBP and IPs -and to some extent promoters- are involved in regional promotion activities. Although the IP is supposed to organize promotion activities on a regional level, they are more involved in local promotion activities. An often heard complaint from IPs is that there is no coherent marketing strategy set within the whole programme and there are not much options to promote biogas on a regional level. Sometimes regional radio and television commercials are initiated by TDBP and IPs. This has very little impact because mass communication channels are sparsely used since it is too expensive to advertise frequently. In addition, highest potential biogas customers do not have electricity to watch television or listen to the radio. Promotion on regional fairs, exhibitions and livestock markets are more successful means in creating biogas awareness. Participation is relatively cheap while these markets can be selected before

attending them. Because much money is spend on mass media promotions with little impact, the money spend per reached potential customer on regional promotion exposures is medium.

The programme invests considerable amounts of money in national promotion activities. However, very little potential biogas customers become aware of biogas through national promotion interventions. An implementing partner who rather stays anonymous says: *“Spending money on national promotion activities, mass media in particular, is like throwing money in a bottomless pit. Those who notice the commercials on radio and television are not even potential for us because they have electricity, there is no need for them to construct a biogas digester. Newspaper advertisements are worthless because our potential group does not read newspapers, most of them do not even know how to read.”* Most budget for national promotion activities goes to radio, television and newspaper advertisements. TDBP is the only stakeholder involved in national promotion activities. Even though considerable amounts of money are invested in national promotion exposures, the impact of these activities is minimal. Hence the costs per reached potential customer are high for national promotion activities.

### *Promotion Waste*

All non potential customers that are reached during a promotion intervention are labelled as ‘waste’ in the field of marketing. There is no waste when a promotion exposure only reaches potential clients. The less waste an activity has, the more efficient this promotion intervention is. It is nearly impossible to have no waste at all during a promotion campaign. Selective promotion and direct marketing activities strive to a minimum amount of waste. A percentage of waste is taken for granted when the overall costs per reached potential customer is low.

Potential clients are evaluated prior to engagement during local promotion activities such as door to door visits or village meetings about biogas. It shows immediately when someone has no cows to produce gas or is already connected to the grid. People with no interest in agricultural activities do not attend to village meetings about biogas. Hence the amount of waste is reduced to a minimum for local promotion activities.

Advertisements in regional mass media channels have very little impact, only a very few potential customers notice these commercial exposures. The people who read newspapers and watch television mostly live in urban areas and are not considered as potential biogas clients. The amount of waste is thus high for regional mass media campaigns. There are much potential biogas customers at livestock markets and agricultural exhibitions. The farmers that attend these fairs are considered to be potential biogas ambassadors in their community. There is thus little waste while promoting at regional markets and exhibitions. The overall level of waste for regional promotion activities is considered to be medium.

National promotion activities have much waste. Most money for national promotion exposures is invested in radio, television and newspaper commercials. Since only a very little potential biogas customers get exposed to these messages, the amount of waste for national promotion activities is very high. In their biogas user survey, Akyoo and Kileo (2012) found out that *“...mass media has been found to contribute minimally towards awareness of biogas*



*technology...*” (p. 4). In here they confirm the poor contribution of radio, television and newspaper advertisements on both national and regional level.

### *Synergy Among Stakeholders*

A high degree of synergy among the stakeholders contributes to more efficiency in the employed promotion activities. Cooperation, coherence and strategy are indicators to assess the level of synergy for each geographical scale.

Promoters, BCEs and individual masons are most active in promotion activities on a local level. They rely on their IP to provide them with marketing-promotion material such as brochures, calendars and biogas sign boards. From TDBP they expect to get commercial trainings to develop skills in doing their own promotion. But the reality is different. Local masons and promoters have good knowledge about the village and the families, but they lack essential information to sell a biogas digester. Many masons do not know how to make a financial cost-benefit calculation in advance, how much gas each type of digester produces on a daily basis, where construction materials must be bought, and even what the price of a digester is. Hence they cannot find good arguments to convince potential households to invest in biogas. Many BCEs and masons need the help of an IP to close the deal with a household. Not only local promoters and mason employ promotion activities on a local level, also TDBP and IPs are actively involved in local promotion interventions. Two masons near Dodoma complain about frequent interference of TDBP and their IP in the villages where they are constructing plants. Here TDBP is promoting the build of biogas demonstration plants that are heavily subsidized and IPs are promoting plants they build themselves. Hence some masons feel that they have to compete with TDBP and their IP. Local promoters, BCEs and masons like to have more and better support from the programme to gain knowledge and skills for doing their own promotion. Currently there is little cooperation on a local level, the synergy in biogas promotion at a local level is thus low.

Not much promotion activities are employed on a regional level. Sometimes TDBP or an IP advertises in regional newspapers and through regional radio- and television- stations. From time to time (not regularly nor frequently) there are livestock markets and agriculture exhibitions where TDBP and IPs participate. Some IPs complain there are little possibilities to promote on a regional level and that mass media exposures are ineffective and inefficient. Sometimes they receive budget from TDBP to invest in mass media campaigns. Although they rather invest this money in different promotion strategies. Other complaints are the lack of promotion strategies, poor coordination, too less and poorly designed promotion material and a lack of financial budgets. Since there is no plan to promote biogas on a regional level, the synergy in biogas promotion at a regional level is low.

TDBP is the most dominant party involved in doing biogas promotion on a national level, there is no cooperation with other stakeholders in designing and implementing national promotion activities. Some IPs also set up promotion activities on a national level by using mass media channels to promote biogas. The promotion campaigns on a national level all have the purpose to increase biogas awareness throughout Tanzania. IP commercials can be

confusing since their exposure does not fit the biogas brand identity. The impact of these campaigns is thus minimal. This is also because there is no clear strategy in place, there are no tools to assess the employed promotion activities and there is too little budget available to set up an effective biogas campaign on a national level. All advertisements are different and there is no strong brand communicated. The level of synergy on a national level is thus low.

*Efficiency Biogas Promotion*

The efficiency of promotion activities is depending on the costs per reached potential customer, the amount of waste and the level of synergy. A combination of these determents illustrates the level of promotion efficiency on each level.

Next table (table 15) summarizes the costs per reached potential customer, the amount of promotion waste and the level of synergy in doing promotion. Each of these three indicators is split in three columns with a score ranging from +1 to -1, from good to bad respectively. Each geographical scale is assessed on the three indicators. A high score relates to a good degree of efficiency while a low score corresponds with a poor level of efficiency.

Table 15: Promotion costs, waste and synergy	Costs Per Reached Potential Customer			Promotion 'Waste'			Synergy		
	Low +1	Medium 0	High -1	Low +1	Medium 0	High -1	High +1	Medium 0	Low -1
Local Promotion	X			X					X
Regional Promotion		X			X				X
National Promotion			X			X			X
Score:	Local Promotion +1			Regional Promotion -1			National Promotion -3		

With a moderately positive score of +1, local promotion activities are most efficient in promoting biogas in Tanzania. Although local promotion activities score good in terms of 'costs per reached potential customer' and 'promotion waste', there is little to no synergy among stakeholders in employing promotion activities on a local level. Poor cooperation, a lack of strategy, insufficient marketing tools and poor commercial skills are issues that need to be solved to increase the level of promotion efficiency on a local level.

Regional promotion activities have a slightly negative efficiency score of -1 due to a lack of promotion strategy and investing in insufficient mass media exposures. Regional fairs such as livestock markets and agricultural exhibitions are much more efficient means in promoting biogas on a regional level.

The currently employed national promotion interventions have little to no impact, with a score of -3 they are considered to be highly inefficient. IPs and BCEs complaint there is a lack of promotion strategy, cooperation and marketing expertise in the programme (TDBP). Mass media campaigns are inefficient and there is no strong brand with clear and transparent products and prices communicated.

#### 4.4.3 Promotion Effectiveness Versus Efficiency

The following table (table 16) concludes the effectiveness and efficiency of all promotion activities employed by the programme and its partners. The effectiveness and efficiency are both evaluated by giving a score ranging from -2 to +2 for each promotion activity. The maximum score for effectiveness and efficiency combined is +4 while the lowest possible score is -4.

Promotion Activities:	Effectiveness					Efficiency					Score
	Low		High			Low		High			
	-2	-1	0	+1	+2	-2	-1	0	+1	+2	
<b>Local promotion.</b>					X				X		<b>+3</b>
<i>Visit demonstration plants.</i>					X					X	+4
<i>Door to door promotion.</i>					X				X		+3
<i>Village meetings.</i>					X				X		+3
<i>Church visits.</i>				X				X			+1
<i>Local exhibitions/fairs.</i>				X				X			+2
<i>Biogas sign boards.</i>		X					X				-2
<b>Regional promotion.</b>		X					X				<b>-2</b>
<i>Regional television.</i>	X					X					-4
<i>Regional radio.</i>	X					X					-4
<i>Reg. newspaper/magazines.</i>		X				X					-3
<i>Reg. exhibitions/fairs.</i>				X				X			+2
<i>Regional livestock markets.</i>				X				X			+2
<b>National promotion.</b>	X					X					<b>-4</b>
<i>National television.</i>	X					X					-4
<i>National radio.</i>	X					X					-4
<i>Nat. newspaper/magazines.</i>	X					X					-4
<i>Mobile promotion.</i>	X							X			-2
<i>Website</i>	X					X					-4

Unsurprisingly, local promotion activities are the most effective and efficient means in promoting biogas in Tanzania. Most activities on a local level are very effective, but there is room for improvement in terms of efficiency. The efficiency of local promotion is not optimally developed because there is no strong and coherent marketing-promotion strategy in place, local promoters and BCEs (masons) lack sufficient promotion skills and tools, and there is little cooperation and synergy with other stakeholders in doing promotion. Visits to demonstration plants with potential customers, local village meetings and door to door visits are the most effective and efficient means in promoting biogas. Biogas sign boards is the only local promotion activity which is not effective nor efficient.

Mass media exposures on a regional level are both ineffective and inefficient. Especially on a regional level there is no coherent marketing-promotion strategy at all. IPs and TDBP invest in mass media advertisements without knowing the impact of these activities. Sometimes IPs and TDBP visit regional fairs and markets for agriculturalists to promote biogas. These are much more effective and efficient because a large share of the visitors are potential biogas customers while human interaction is possible.

National promotion activities are very ineffective and highly inefficient. The lion share of the national promotion budget is spend on mass media exposures. Too little time and money is invested in a clear strategy, effective promotion tools, training commercial skills, gaining (professional) marketing expertise and fostering promotion synergy among all stakeholders.

#### **4.5 Summary**

The fourth chapter found out where the highest potential biogas regions are. Consequently, the programme should have a focus on these areas for further dissemination of the technology. The biogas perceptions among potential customers are discussed, it appears that potential clients are poorly aware of the technology unless they are exposed to local promotion activities. Even though potential customers are moderately positive about the biogas technology, the demand is low and households perceive too many barriers. However, there is a misconception between the actual costs of applying biogas and the costs potential clients perceive. Potential households are poorly informed about the costs of applying biogas, the facilitation of loans for construction and the financial benefits of applying biogas. The chapter also makes clear that local promotion activities are most effective and mass communication exposures are highly inefficient. Next chapter will apply marketing models and principles to evaluate the current status of the programme and contribute to new insights.

## **5 | STRATEGIC BIOGAS MARKETING**

---

This chapter will apply various marketing techniques to assess the marketing activities employed by the programme and to come up with insights for the design of future marketing activities. The first section is evaluating the market and business attractiveness of the biogas sector by applying the MABA analysis. This analysis will provide a strategic advice for the sector based upon its current status. The penetration rate of the technology together with the most feasible dissemination strategy are discussed in the second section. In the third section, the levels of promotion are evaluated by using the AIDA model. A social marketing approach that aims to foster behaviour change is customized for the programme in the fourth section. The last section in this chapter will calculate the financial benefits of applying biogas. The programme can use this calculation as a tool to indicate the level of potential for each potential client with an interest in the biogas technology.

## 5.1 The Market and Business Attractiveness (MABA) of Biogas

The MABA analysis compares the market attractiveness (MA) with the business attractiveness (BA). The MABA Analysis is a useful tool in making decisions related to designing a marketing strategy or identifying new business opportunities. This strategic matrix illustrates the right action for the biogas programme to follow considering its current status in the market.

### 5.1.1 Business Attractiveness

Business attractiveness is the horizontal axel. The attractiveness is low, medium or high, ranging from 1 to 5 respectively. For business attractiveness the following indicators are examined: the market share, productivity, performance of the product, price and the awareness of the biogas programme. Each indicator is given a weight between 0 and 1, the total weight of all indicators combined results in 1.

There are only a very few other suppliers of biogas installations who are not related to TDBP's biogas programme. TDBP has by far the largest market share in the market for rural biogas digesters. There is nearly no competition and many localities are not reached yet by the programme. The indicator 'market share' is given a maximum score of 5 since there is so little competition and much market potential. The importance of this indicator in terms of weight is set on an average of 0,20. Unfortunately, the level of productivity in terms of amount of biogas digesters constructed are low. Even though much time and money is invested in the programme, less than 5,000 digesters are constructed since the project officially started in 2009. Therefore the indicator 'productivity' is given the lowest possible score of 1, the importance in terms of weight is set on an average 0,20. The digesters perform well and meet the expectations of its users. The only restriction on biogas is its impossibility to generate electricity. The indicator 'product performance' is scoring 4 with a weight of 0,20. The price of a digester is a major obstacle for potential farmers. Although many households have the financial possibility to make an investment in biogas, there are still much uncertainties about the costs and financial profitability. Therefore the indicator 'price' is given a score of 2, the importance is set on a weight of 0,20. The programme is officially launched in 2009. Since then, only a fraction of the potential biogas customers have heard about the technology. There is not a strong brand communicated and there is a lack of contributing marketing strategies. Therefore the indicator 'programme awareness' is given a score of 1, the importance in terms of weight is set on an average 0,20.

### 5.1.2 Market Attractiveness

For market attractiveness the following indicators are examined: market size potential market, impact, market growth, ease of construction and distribution of materials, and the intensity of substitutes. Similar to business attractiveness, all indicators are given a score which is multiplied with its determined weight.

The potential biogas market in Tanzania is estimated at a minimum of 165,000 households. Currently the programme constructed less than 5,000 digesters. There is still much penetration potential in the biogas market. Hence the indicator 'market size' is given a score of 4. Because a large potential biogas market is essential for future growth ambitions, the importance in terms of weight is set on 0,25. Using biogas has multiple benefits for households in terms of finance, energy provision and health improvements. Biogas is by many households perceived to be a step between traditional biomass fuels and electricity. Many potential households are still too little informed about the use of biogas and its benefits. Biogas does meet its expectations according to current users. The indicator 'impact' is scoring an average 3 with an importance weight of 0,15. There is not much growth in the market for biogas digesters. Globalization and modernization decreases the share of smallholder farmers in the economy. Many young people migrate to urban areas for employment opportunities and economies of scale make large farmers more and more dominant. Even though smallholder farmers still dominate the economy, its share is decreasing. Therefore the indicator 'market growth' is given a score of 1 with an importance weight of an average 0,20. Tanzania is a geographically widespread country, the essential construction materials are not available everywhere and need to travel great distances to reach the biogas plant construction site. Some places are hard to reach with trucks or motorbike. The digesters itself are not difficult to construct, a good training in constructing them is essential. The indicator 'ease of distribution & construction' is given a score of 2 with an importance weight of 0,15. The primary biogas substitute firewood is freely available in Tanzania, woman and children spend many hours on collecting this source of energy in their surroundings. Processed sources of energy such as kerosene and charcoal are bought most of the time. Firewood, charcoal and kerosene can be bought for relatively low costs. The price of energy is rising while the amount of available firewood is decreasing, this might foster the feasibility of biogas in Tanzania. The indicator 'intensity substitutes' is given a score of 2 because traditional biomass fuels are so much embedded in society and available everywhere for relatively low costs. The importance weight is set on 0,25.

### 5.1.3 Determine the Market & Business Attractiveness for the Biogas Programme

The business- and market- attractiveness is easy to calculate. A high score means that the business or market dimensions are very attractive. The score of each dimension determines the place of the biogas programme in MABA's strategic matrix. Next tables (table 17 and 18) present the indicators for both dimensions together with their weights, scores and total scores. The lowest possible score is 1 and the highest possible score is 5 for each indicator.

Table 17: Business attractiveness biogas programme

	Business Attractiveness		
	Weight	Score	Total Score
Market Share	0,20	5	1,00
Productivity	0,20	1	0,20
Product Performance	0,20	4	0,80
Price	0,20	2	0,40
Programme Awareness	0,20	1	0,20
<b>Total Score:</b>			<b>2,40</b>

Table 18: Market attractiveness biogas programme

	Market Attractiveness		
	Weight	Score	Total Score
Market Size	0,25	4	1,00
Impact	0,15	3	0,45
Market Growth	0,20	1	0,20
Ease of Distribution & Construction	0,15	2	0,30
Intensity Substitutes	0,25	2	0,50
<b>Total Score:</b>			<b>2,45</b>

The market share indicator boosts the total score of the business attractiveness dimension. The programme's market share would be much lower if there was more competition and dynamics in the market. The programme has a very poor score in terms of number of constructed digesters (productivity), the investment costs (price) and the awareness of the programme. The product does meet its expectations. Hence the total score of the dimension business attractiveness is a below average 2,40.

There is still much potential in the biogas market, only a fraction of the current market is served by the programme. There are some threats for the programme: there is little to no market growth, the distribution of materials to the construction site is difficult, and the intensity of substitutes such as firewood make biogas less attractive. The programme does have a positive impact on families throughout Tanzania. The total score of the dimension market attractiveness is a below average 2,45.

#### 5.1.4 MABA's Strategic Matrix Evaluation

Based upon the attractiveness scores of both dimensions it is possible to determine the place of the biogas programme within the strategic MABA matrix. The MABA matrix provides a strategic advice which can be used as a guideline in designing marketing strategies and approaches. Both axels range from a low to a high level of attractiveness. The lowest possible score is 1 and the maximum score is 4. Because of its below average score, the programme just fits in the central square of the matrix. The strategy that relates to this central square is '*selective policy and a focus on revenues*'. It is thus important for the programme to improve their business attractiveness and 'hope' that the external market attractiveness will develop positively for the programme. The red areas of the matrix suggest an exit strategy, this is



because a low market attractiveness and/or business attractiveness is not perceived to be a viable environment to continue with the programme.

The strategic advice in the central square is twofold, ‘selective policy’ and ‘a focus on revenues’ (see section 2.8.2). With selective policy the programme should have a focus on growth in geographically selected core areas, reach a maximum biogas penetration in these areas and invest selectively in expanding these areas. This is the opposite of the current strategy of the programme, which is to cover large and widespread areas of Tanzania. The strategic advice focus on revenues is situated in the sought of selective policy. The programme must optimally benefit within the localities where they are active before investing in expansion to ‘uncovered’ potential regions and villages. It should have a focus only on households with an interest and proven potential for biogas. The idea of this policy is that the growth of the programme is in line with the amount of constructed digesters.

Figure 12: Market and business attractiveness biogas

		Business Attractiveness		
		5 High	Medium	Low 1
Market Attractiveness	High		2.40	
	Medium	2.45		
	Low			

## 5.2 Potential Diffusion of the Biogas Technology in Tanzania.

Roger’s (1995) ‘Diffusion of Innovation’ theory seeks to explain how innovations are taken up in a population. This theory can be applied to measure the adoption potential of the biogas technology among potential biogas users in Tanzania. Applying the theory on potential biogas customers gives three valuable insights into the process of social change: 1) What qualities (intrinsic characteristics) make biogas spread successfully in Tanzania? 2) The importance of peer to peer conversations and peer networks. And, 3) understanding the needs of user segments (at one point in time) (Robinson, 2009).

### 5.2.1 Intrinsic Characteristics

The intrinsic characteristics potential biogas customers associate with the technology has influence on the decision to adopt or reject biogas. The intrinsic characteristics are thus essential determents to analyze the diffusion process of biogas technology in Tanzania.

The relative advantage of biogas compared to other technologies in social and economical terms is low to moderate. The investments costs are perceived high and operating a digester costs much time contrary to electrical energy from the grid. Since there is no electricity grid in remote areas in Tanzania, people can use biogas on a household level for cooking and lighting purposes. Unfortunately biogas is not suited to generate electricity, power factories or heavy machinery. Hence the compatibility of biogas for rural farmers is medium because it only provides energy for basic needs provision and not for conveniences

such as mobile telephone adapters, televisions and farmers machinery. Biogas digesters are proven to be durable because of the simplicity of its design. Rural households can easily learn to operate a digester and local masons can be trained in constructing them. Biogas users still have to operate the digester by filling the digester with manure and water every day. The ease of use (simplicity) of the biogas technology is thus medium-high. It is not possible to try and experience a biogas digester before purchase, once a digester is constructed it is there permanently. Potential customers can visit other digesters in their area for a demonstration of the technology. Therefore the trialability of biogas is medium. Most households are aware of the core benefits of biogas and understand the results in terms of energy provision, workload reduction and improved health conditions when applying biogas. However, potential customers find it hard to notice direct results in economical terms. This is because there is uncertainty about the amount of energy (gas) provided by the digester, people do not know how much more crop revenues they can expect and because there is no fixed quantity of money spend on energy by each households. Even though the core results (benefits) of biogas are visible by all potential households, not all results are observable. Hence the observability of the biogas technology is medium.

Following table (table 19) is summarizing the adoption potential of the biogas technology in Tanzania according to the determents of Roger's theory on the diffusion of innovations.

**Table 19: Intrinsic determents for biogas dissemination**

	<b>Technological Adoption Potential</b>				
	<i>Low</i>		<i>High</i>		
<b>Intrinsic determents for biogas dissemination.</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Relative advantage		<b>X</b>			
Compatibility			<b>X</b>		
Simplicity (ease of use)				<b>X</b>	
Trialability (try and experience)		<b>X</b>			
Observability (observable results)			<b>X</b>		

### 5.2.2 Importance of Peer Networks

Generic marketing interventions such as advertisements are useful techniques to spread information about innovations. But it is generally acknowledged that personal conversations and peer networks promote the adoption of a (new) technology among potential customers. This is also true for biogas in Tanzania. Most current biogas users made an investment in the technology on the advice of people in their network who have good experiences with biogas. Only a very few biogas users made the investment in the technology solely on the marketing interventions of the programme. The experiences and recommendations from other biogas users are decisive for most current customers (Field Work, 2012). This phenomenon is also known as 'viral marketing' in the marketing literature. Mouth to mouth exposure involving influential people in the community are important developments for the successful

dissemination of biogas in Tanzania. The programme itself has little influence on these viral marketing exposures.

### 5.2.3 Understanding the Needs of User Segments

According to Roger (1995) and many other diffusion researchers, a (potential) population can be broken down into five different segments. These segment characteristics are based on the propensity of potential customers to adopt an innovation at a certain point in time. Innovations spread when they evolve to meet the needs of successive segments, each segment is thus static. Based upon the penetration rate of biogas in Tanzania, an estimation about the place of the biogas technology among current user segments can be made. The predetermined user segments are illustrated in Rogers 'Technological Adoption Lifecycle Model' (Robinson, 2009).

The penetration rate of biogas in Tanzania is easy to calculate. Previous studies estimated the technological potential of biogas in Tanzania at a minimum of 165,000 constructed digesters (SNV, 2007; SNV, 2008). Since the current programme has not more than 5,000 digesters constructed in May 2012 (Field Work, 2012), the penetration rate of biogas in Tanzania is estimated to be 3.03 per cent ( $165,000 / 5,000 * 100\%$ ).

A penetration rate of 3.03 per cent coincides with the second stage of the technological adoption lifecycle model. The first 2.5 per cent biogas users are first stage innovators. The second stage is the domain of the 'early adopters' (see illustration). Early adopters leap in when the benefits of biogas become apparent to more and more potential households. Early adopters are on the lookout for a strategic leap forward in their life and businesses, clever innovations such as biogas gives them an advantage over their peers. Contrary to the majority, early adopters have more time and money to invest in new technologies. Early adopters tend to be more economically successful in life and well connected to important stakeholders in their community. They love to be seen as leaders and social prestige is one of their biggest drivers. This natural (intrinsic) desire to be a trend setter causes the 'take-off' of an innovation. Early adopters like to talk about their successes, the more they crow and preen, the more likely biogas will be perceived positively by the majority of the population.

### 5.2.4 Illustrating the Potential Diffusion of the Biogas Technology in Tanzania

The intrinsic characteristics, or product advantages and qualities, potential biogas customers perceive in relation to the technology is moderately positive. The most dominant point of critique is that biogas does not provide electrical energy to charge a cell phone or use a computer. Hence many potential biogas customers might perceive the biogas technology as a step between traditional energy and electrical energy from the grid. High investment costs together with a long term commitment and uncertainty of new energy technologies in the nearby future make the risk of investing in biogas too high for highest potential households.

Peer networks and positive user experiences can help to overcome risk avoiding behaviour and negative perceptions. Early adaptors play a vital role in further dissemination of the biogas technology because they are seen as leaders (role models) in their community. The early adaptor is considered to be the 'individual to check with' before using a new

technology. Other potential households will follow their example to gain a higher social status and experience the same benefits as their 'leaders' in their community. The role of the early adopter is thus to decrease the perceived uncertainties about biogas and convince peers in their interpersonal network to adopt the biogas technology.

### 5.3 Biogas Promotion Scales

The AIDA model stresses the importance of clear and bounded tasks and responsibilities for each geographical scale. For the biogas programme this model is useful to illustrate the most feasible marketing-communication dimensions in promoting biogas in Tanzania.

#### 5.3.1 The AIDA Model for the Biogas Sector

The AIDA model is a useful model to design promotion strategies for each level of the biogas programme. The AIDA strategy for the biogas sector is based upon the explanation of the model itself, findings from previous sections and field work data from respondents. This section will evaluate marketing strategies for each promotion scale by using the AIDA approach.

##### *Awareness on a National Level*

On a national level people must get an answer to; *What is the product?* The first step is to make potential customers 'aware' of the product. National marketing-communication activities have the potential to foster awareness throughout the country. Mass media campaigns are proven to be effective in creating a strong awareness, but appear to be ineffective and inefficient with a limited budget or specific (small) target group. Potential biogas users live in rural areas with little to no access to electricity. There is thus a small chance to get exposed to mass media exposures. Previous chapters and sections confirm the poor contribution of mass media exposures in awareness. Instead of creating awareness on a national level, the programme can stimulate biogas awareness on a local and regional levels by supporting local marketing initiatives. TDBP itself has little to no relation with most localities and are therefore less efficient and effective in employing promotion activities themselves. A feasible role of TDBP in promotion activities is to support stakeholders on other levels with the essential marketing and business information for successful promotion. National marketing activities for the programme can be: provide promotion material to other levels, give commercial trainings to BCEs and individual masons, exchange marketing knowledge about the business and market with all stakeholders and find new promotion opportunities to foster biogas awareness. The biogas programme is barely active on the internet. Online activities are effective and efficient means to build a database and exchange information among all partners within the programme and other stakeholders. A good website with an integration of social media and news blogs will increase the awareness of biogas among social organisations (NGOs etc.). The primary task of TDBP is to define and guard a coherent promotion strategy for the whole sector (top-down approach) but delegate all

operational tasks and responsibilities to the lower levels for a adequate dissemination of the technology (bottom-up approach).

#### *Interest on a Regional Level*

The interest for biogas must be triggered on a regional level. On a regional level potential clients must get an answer to; *What can the product do?* Potential customers get specific information about the primary benefits of biogas through face to face interaction and printed brochures. Promoting the awareness of a brand is very good possible on a regional level when this is not done on a national level. This is most effective through mailings and exhibitions that incorporate the regional characteristics of that area. Implementing partners are the most important stakeholders active on a regional level. Their primary role is to coordinate the promotion and marketing activities in their region. An important feature of the regional level is the exchange of information about the product and market. There is an exchange of information between the regional level with both the national and local levels. This exchange of information and knowledge is essential in designing appealing marketing campaigns for future promotion interventions. Implementing partners should not promote the construction of digesters by themselves but inform potential customers about the benefits and costs of biogas digesters together with the possibility of construction in their village and contact details of local masons. Similar to TDBP on a national level, the role of IPs is to streamline the strategy of the programme, train local masons and guide potential biogas customers to local BCEs and masons.

#### *Desire on a Local Level*

The desire for biogas is best stimulated on a local level. Potential biogas households must get an answer to; *What can the product do for me?* Potential customers should develop desire by attending real life biogas demonstrations and participate in discussions during village meetings about biogas. Door to door visits are also considered to be local activities since (nearly) all households in a geographically selected area are approached. Local promotion activities are proven to be most effective and efficient for the biogas programme. Local promoters and BCEs (masons) have good knowledge about the localities where they are active. Potential clients can ask specific information about the costs and options for their digester directly to the masons that construct them. Masons and promoters should cooperate during local promotion interventions to create synergy and reach a maximal penetration rate in the selected villages. The whole marketing strategy of the programme should be designed to support local promotion activities as best as possible.

#### *Action on a Household Level*

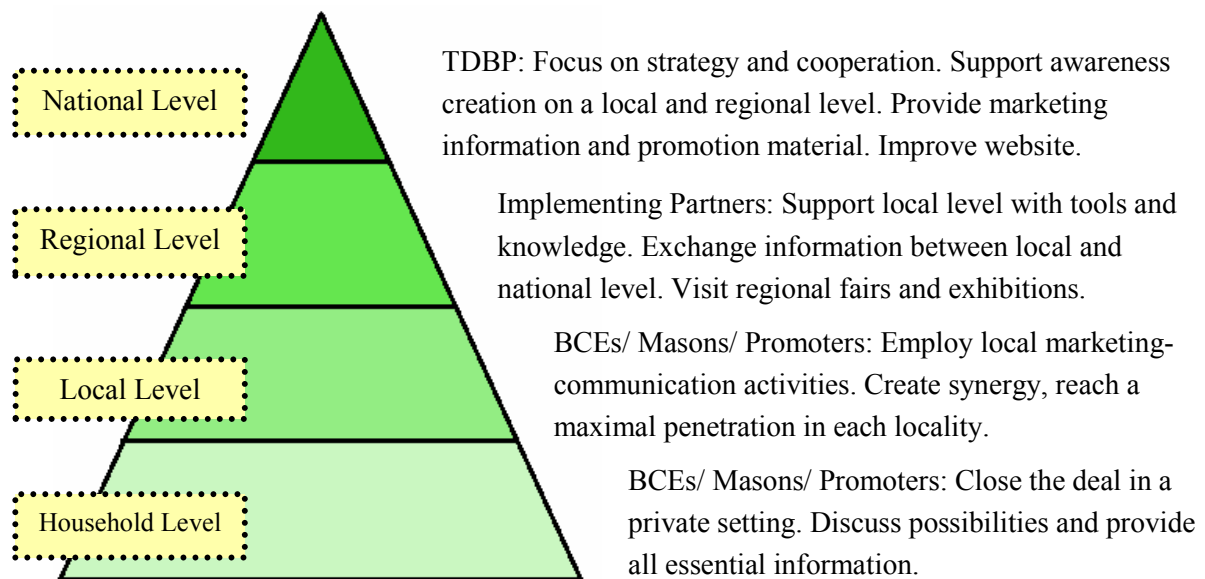
Promotion at a household level is a direct follow-up of local level promotion activities. The intention is to ‘close the deal’ on a household level in private. House visits are relatively expensive because it costs much time and requires travelling while only a single household gets exposed to the promotion intervention. It is therefore only feasibly to visit potential clients with an outspoken interest (desire) in biogas. Masons and promoters must have

sufficient commercial skills and marketing tools to become successful in closing a deal. Good knowledge about the benefits, costs, materials, service, maintenance, operation and construction time are thus essential ingredients. The question that masons and promoters must trigger at potential biogas customers is; *Where can I sign?*

### 5.3.2 The Biogas Promotion Pyramid

The following illustration (figure 13) of the AIDA pyramid summarizes the promotion strategy per level for the biogas programme in Tanzania.

**Figure 13: Biogas promotion scales**



## 5.4 Stimulating Change: from Biomass to Biogas

The Four E's is a theoretical framework designed as a pure social marketing theory to change bad behaviour into good and sustainable behaviour. The model has been used in developing countries to stimulate the use of sustainable energy. The four E's in this theory are: enable, encourage, exemplify and engage. The four E's is a very useful framework for policy makers, it is a systematic process to achieve behavioural goals and encourage people to make sustainable choices.

Since the use of biogas is also a sustainable choice, the four E's framework can be applied as a tool for the biogas programme in developing sustainable policies. By giving a meaning to every E, the programme can design durable and sustainable approaches to educate potential customers about the importance of clean biogas. The idea is that people become better aware about the importance of the environment and recognize the role of biogas as a sustainable solution.

Next figure (figure 14) illustrates the four dimensions of the theory together with possible implications for the biogas programme. The explanation of each indicator derives from the theory itself together with previous findings and field work data.

**Figure 14: Four E's framework for the biogas programme**

<p><b>Enable</b></p>	<p>Enabling people to gain access to information about sustainable energy solutions. Provide people with useful and transparent information about the costs and revenues of renewable energy, in specific biogas. Make people aware about the financial benefits of biogas and learn them how they can profit from the use of biogas. Train people in operating and maintaining their digester and how to make full advantage of the available bio slurry. Provide potential biogas customers with the right tools to access the biogas feasibility for their own (financial/social-) situation. Remove the barriers that people perceive. Enable customized loans with a low interest rate for potential households and make them accessible to potential households with an interest in biogas. Provide learning material about the environment and its relation with energy provision. Start educating people about the environment and the benefits of biogas at a young age. When children become aware of the importance of the environment, it is more likely they make more sustainable choices when they grow older. The overarching programme (TDBP) should enable a feasible environment to invest in biogas and where biogas entrepreneurs, partners and clients can easily exchange information and improve on the programme. Government institutions can support a fast expanding biogas information network and set the basis for a feasible biogas market.</p>
<p><b>Encourage</b></p>	<p>People must be encouraged to change their behaviour and invest in using biogas. Hence it is important that there is a perception that using biogas is rewarding. The programme should encourage people to use biogas, they can do this by trainings, network and capacity building, set up strategies and providing subsidies for the construction of digesters or the start of BCEs. The government can encourage the dissemination of biogas by lowering the taxes on construction material, provide state insurances for low rate and long term biogas loans, ease the registration of BCEs and by subsidizing the programme with financial help. Through fines on woodcut and higher tariffs for unsustainable energy sources, the government can decrease the attractiveness of unsustainable energy sources. Influential people that use biogas are good ambassadors for the programme, village elders and community leaders gain much respect and are very influential in their communities. Social pressure is an effective method to encourage potential clients to invest in biogas. Campaigns about the fast deforestation and degradation of the environment</p>

	<p>might encourage people to invest more in sustainable energy solutions, such as biogas. Subsidies can have a focus on lowering the initial building costs of a digester but can also be used for accessible and attractive (low interest) loans.</p>
<p><b>Exemplify</b></p>	<p>Before potential customers engage in using biogas, they like to witness the functioning of a digester. Visits to demonstration plants (learn by example) are proven to be the most successful promotion method for the programme. The attitude of biogas among current users is very positive. The programme should encourage people with a high status in their community to use biogas. They will become good ambassadors for the programme and it is more likely that others in the community will follow their example. The programme should invest in demonstration plants at influential people's houses. A mobile demonstration plant can be used to visit fairs, exhibitions and village meetings throughout the country.</p>
<p><b>Engage</b></p>	<p>Engaging people in using biogas is the last step of the transition from biomass to biogas. Personal interaction is a proven and successful strategy for promoting a social benefit. Local level promotion activities have the potential to engage people in networks of biogas users. Cooperation and synergy between the programme, government, masons, loan companies, promoters and potential clients will strengthen the biogas community. Networking and personal interaction play a key role in engaging people with biogas.</p>

## 5.5 Economic Feasibility Biogas.

Assessing the financial consequences is an important step for potential customers to get insight in the costs and benefits of applying biogas. The break-even point (BEP) calculation and return-on-investment (ROI) are two methods that derived from the field of traditional business economics but can be used to pre-calculate the economic feasibility of biogas for potential households. Biogas substitutes the need for purchasing traditional biomass fuels such as firewood and charcoal, and the available bio-slurry increases crop revenues with an average of 25 per cent annually. Both calculation are based on 'best practice' preconditions, whereby households in the old situation buy traditional biomass fuels and do not use fertilizers for the land while using biogas as their primary fuel and make use of the available bio-slurry in the new situation.

### 5.5.1 Break Even Point

The break-even formula is designed to calculate at what point in time sales revenues equals the investment and production costs. For (potential) biogas customers the break-even analysis is the point (break-even point) where the financial gains of using a digester start to exceed the



investment costs. By calculating the savings on traditional biomass fuel expenditures together with the extra income per hectare from higher crop revenues minus the operation and maintenance costs, it is possible to estimate the point in time (in weeks, months or years) when the investment in a biogas digester has paid itself back. The formula is both simple and effective.

<b>Break- Even Point</b>	=	Initial Investment Costs Digester
		$\frac{\text{Monthly Savings on Energy Expenditures} + \text{Additional Monthly Income from Higher Crop Revenues} - \text{Monthly Maintenance and Operation Costs}}{\text{Initial Investment Costs Digester}}$

### *Investment and Maintenance & Operation Costs*

The most popular biogas plant is a 6 cubic meter digester from the CAMARTEC design. This model digester best fits the needs of an average household in rural Tanzania with three (or more) cows and a small plot of land to grow crops. This is the most logic plant size for highest potential biogas customers and thus for a successful dissemination of the biogas technology throughout the country. The initial investment costs for a 6M<sup>3</sup> digester is 970,000 TZS, the annual costs for maintenance and operation are estimated at 3 per cent of the investment costs (SNV, 2009; Field Work 2012). The monthly costs for maintenance and operation are thus 2,425 TZS (970,000 \* 3% / 12 months). To make further analysis convenient, the monthly costs for operation and maintenance are set on 2,500 TZS per month.

### *Energy Expenditures*

Rural households can save a substantial amount on their energy expenditures when applying biogas as their primary source of energy. Most rural households are not connected to the national electricity grid and are forced to use traditional biomass fuels. Firewood and charcoal is their primary source of energy for cooking purposes while kerosene is bought to have light at night. In their survey, Haskamp & Ingwe (2005) found out that rural households spend an average of 33,000 TZS per month on firewood, charcoal and kerosene. Their research was carried out in Northern Tanzania but the gained data is perceived to be a good representation for Tanzania as a whole (Haskamp & Ingwe, 2005).

### *Additional Income*

Over 80 per cent of the poorer households live in rural areas and depend on agricultural activities as their primary source of income, food security and employment. Not surprisingly is the agricultural sector the most dominant sector of the economy. Approximately 85 per cent of the arable (farm-) land is used by traditional agro-pastoralists and smallholder farmers with a farm size between 0.2 and 2 hectares (Ministry of Agriculture and Food Security Tanzania, 2001). Almost 50 per cent (49.6%) of the household income in rural areas derives from agricultural activities. These households are defined as smallholder farmers. Their mean per capita income

from agricultural activities is 11,324 TZS per month (NBS, 2009). With an average household size of 5,7 persons in rural Tanzania (National Bureau of Statistics Tanzania, 2001), the mean household income from agriculture is 64,546.8 TZS per month ( $5,7 * 11,324$ ). With an average farm size between 0.2 and 2 hectares the mean revenues per household per hectare are 58,678.9 TZS<sup>1</sup> per month.

Farmers in Tanzania can increase their crop revenues with an average of 25 per cent by actively using bio slurry as a fertilizer. With a mean monthly income of 58,678.9 TZS per hectare from agricultural activities, households can increase their revenues with 25 per cent to 73,348.6 TZS per month. Their additional income from actively using bio slurry is thus 14,669.7 TZS per month per hectare. To make further analysis convenient, the additional income from using bio slurry is set on 14,500 TZS per month per hectare.

#### *Break Even Point Calculation*

The break even calculation is based upon the initial investment costs of the most popular and convenient digester (6M<sup>3</sup>), the average rural household energy expenditures on traditional fuels per month, the additional income revenues from bio slurry for one hectare per month and the estimated operation and maintenance costs per month.

<b>Break- Even Point</b>	=	$\frac{970,000}{(33,000 + 14,500 - 2,500)}$	= <b>21.55 Months</b>
------------------------------	---	---	-----------------------

An average smallholder farmers household with a few cattle and one hectare of arable land can pay back its digester within 22 months, which is less than two years. This is the most common 'average' household configuration in rural Tanzania. Hence, this calculation will correspond with the situation of many smallholder farmers in rural Tanzania. The payback time of a digester is 31.8 months when excluding the additional income from bio slurry usage.

Next table (table 20) illustrates the breakeven point for the most common type of digesters and smallholder farmland sizes. Household energy expenditures are set on an average of 33,000 TZS per month. The results are the number of months when a potential household have paid the digester back, all months are rounded upwards. The three per cent annual operation and maintenance costs that correspond with the initial investment costs per digester type are included in the results.

<sup>1</sup> Calculation mean income household per hectare:  $0.2 + 2 \text{ hectares} = 2.2 \text{ hectares} \rightarrow 2.2 \text{ hectares} / 2 = 1.1 \text{ hectare average} \rightarrow 64,546.8 \text{ Tsh} / 1.1 \text{ hectare} * 1 \text{ hectare} = 58,678.9 \text{ Tsh per hectare per household}$

**Table 20: Breakeven point for biogas investment**

<b>Energy Expenditures: 33,000 TZS Per Month</b>		<b>Digester Size + Initial Investment Costs (in TZS)</b>			
		<b>4M<sup>3</sup> Digester</b>	<b>6M<sup>3</sup> Digester</b>	<b>9M<sup>3</sup> Digester</b>	<b>13M<sup>3</sup> Digester</b>
<b>Arable Farmland + Additional Revenues (in TZS)</b>		<b>850,000</b>	<b>970,000</b>	<b>1,200,000</b>	<b>1,500,000</b>
<b>0.5 hectare</b>	<b>7,250</b>	<b>23</b>	<b>26</b>	<b>33</b>	<b>42</b>
<b>1 hectare</b>	<b>14,500</b>	<b>19</b>	<b>22</b>	<b>27</b>	<b>35</b>
<b>1,5 hectare</b>	<b>21,750</b>	<b>17</b>	<b>19</b>	<b>24</b>	<b>30</b>
<b>2 hectare</b>	<b>29,000</b>	<b>15</b>	<b>17</b>	<b>21</b>	<b>28</b>
<b>2.5 hectare</b>	<b>36,250</b>	<b>13</b>	<b>15</b>	<b>19</b>	<b>23</b>

**5.5.2 Return On Investment**

The return on investment calculation is used complementary to the break-even analysis. Potential biogas customers can use the return on investment tool to calculate the financial gains of using biogas over a certain period. Similar to the break-even analysis, the return on investment calculation for biogas is based upon household savings on energy expenditures and additional income because of bio-slurry benefits.

The formula to calculate the return on investment for biogas is: Number of Years \* (Annually Savings on Energy Expenditures + Additional Annual Income from Higher Crop Revenues – Annual Maintenance and Operation Costs) – Initial Investment Costs. The result is a positive or negative amount of TZS over a ‘X’ number of years.

<b>Return On Investment</b>	=	Number of Years	*	Annual Savings on Energy Expenditures + Additional Annual Income from Higher Crop Revenues – Annual Maintenance and Operation Costs	–	Initial Investment Costs Digester
-----------------------------	---	-----------------	---	---	---	-----------------------------------

An average rural household in Tanzania with one hectare of arable land will pay back its digester within 22 months. The profit for 5 years of applying biogas is 1,730,000 TZS. In 10 years the digester earns 4,430,000 TZS for this household and 9,830,000 TZS in 20 years of service. This shows that applying biogas is very profitable for the average rural household in Tanzania.

In the appendices of this document (appendix D), there is a table that shows the return on investment for an 1, 5, 10, 15 and 20 year period of using biogas. The projected lifetime of a biogas digester is 20 years (SNV, 2009).

## 5.6 Summary

This chapter shows that the market and business attractiveness for the biogas sector is slightly below average. The applied analysis claims that the most feasible strategy for the programme is to invest selectively and have a focus on maximizing the penetration of biogas at localities where the programme is currently active. The diffusion of the technology is still in an early stage of adoption, currently 3.03 per cent of the potential market is penetrated. Consequently, there remains much potential for future dissemination. This diffusion theory argues the programme should have a focus on influential leaders in communities in this stage of the dissemination process. The most feasible promotion dimensions are explained by applying the AIDA model. This model has a focus on stimulating promotion at local and household level. Also the four E's theoretical framework has a strong focus on stimulating biogas at local level. This framework is about enabling, encourage and exemplify to engage potential households in investing in biogas. The last section in this chapter presents the financial attractiveness of applying biogas.

## **6 | SYNTHESIS, DISCUSSING BIOGAS DISSEMINATION**

---

This penultimate chapter will discuss the research sub-questions and assumptions that were drafted in the methodology of this study. The assignment is to grasp the biogas perceptions of potential biogas customers, evaluate the marketing performance of the sector and to contribute to valuable social marketing insights for the design of future strategies. The last chapter of this study, conclusion and recommendations, will answer the central question of this study and make recommendations regarding the assignment of this study.

This synthesis will discuss the questions and assumptions on the basis of the results in this study. But also on information from the background, introduction, context and the different views on biogas diffusion. It will thus combine ‘synthesize’ the data gathered from articles, reports and field work.

The first section in this chapter will elaborate on the research sub-questions and the second section will examine to what extent the previously described assumptions are consistent with the reality. The last section will conclude this chapter.

## 6.1 Getting the Answers

This section aims to answer the sub-questions as formulated in the methodology of this study. The questions relate to the two major parties in this study: potential biogas customers and the biogas programme itself. The answers to these questions together with the validity of the assumptions contribute to the necessary information to answer the central question in the conclusion of this study. The central research question is:

- **What is the status of the marketing activities employed by the biogas sector and how can (social-) marketing methods and principles improve the marketing and promotion strategy as applied by the programme?**

The first step is to answer the sub-questions that relate to potential biogas clients. After that, the questions considering the biogas program itself will be treated.

### 6.1.1 Sub Questions Considering Potential Biogas Customers

- **Where are the highest potential biogas regions in Tanzania?**

Various studies and reports made an attempt to illustrate the highest potential regions in Tanzania. However, no study has combined all available data in a single map. In this study all indicators that assess biogas potential are given a score and weight, the score is multiplied with the weight to determine the total score for a particular region. For example: the availability of cattle is far more important than the temperature zone, inhere cattle is given a weight of 3 while the temperature zone gets a weight of 1.

The results made clear that there are more potential than not potential biogas regions in Tanzania. There is much biogas potential in the Northern, Western and Southern regions of the country. In the North-East and around Lake Victoria in the North-West, there is a concentration of highly potential districts. There are roughly three not potential biogas areas, in the North-West, the Central part of the country and a large area in the South-East of Tanzania. See section 4.1 for a comprehensive map of the highest potential areas in Tanzania.

Large areas are not yet discovered by the programme, this indicates there are much potential areas remaining in Tanzania. The biogas programme is primarily active in the Northern regions of the country. Even though there is much potential in the North, not every region where the programme is active is perceived potential and the programme is not present in the highly potential areas. See appendix E for a map that illustrates the area where the implementing partners of the programme are currently active. The diffusion of the technology might be higher if the programme had started its activities in the highest potential regions. Because Tanzania is such a stretched out and sparsely populated country with many regional differences, the program should only be active in areas with a high level of potential.

- **To what extent is the potential target group aware of the technology?**

There is a clear difference between potential clients that are exposed and not exposed to local promotion activities. Most people are aware of the technology in villages where local masons and BCEs are active. However, villages that are not exposed to local promotion activities are very poor aware of the technology. See also section 4.2.1.

The programme with its partners is concentrated in a few regions and many potential areas are not covered. Consequently, the majority of the potential households are not exposed to local promotion activities. Because the level of awareness is very low in villages not exposed to local promotion activities, it reasonable to assume that the overall level of biogas awareness among the potential target group in Tanzania is very low.

- **What are the perceived drivers and barriers for investing in biogas?**

Since many potential households are not aware of the biogas technology, they do not perceive any drivers or barriers to make an investment. The potential target group that is aware about the programme have various reasons to invest, or not, in biogas.

The main driver for investing in biogas is the availability of gas for cooking. Potential clients also recognize the contribution of biogas in terms of workload reduction and an improved health situation. This is mainly because the program is very much promoting these secondary benefits in their marketing interventions and produced promotion material. Households that are not exposed to local promotion activities do not understand the concepts of workload reduction and a better health environment at first glance because they are not educated about these topics. This demonstrates that the efforts of the program to educate the secondary benefits of biogas on a local level is working. There are also drivers that are less obvious to the potential target group. Households do not see how biogas is improving their financial situation, are insufficiently aware of the usability of bio slurry and do not notice the impact biogas may have on the issues of deforestation in their surroundings.

The most dominant barrier is the price of a digester, both the initial investment costs and additional costs such as appliances and after sales. Biogas is perceived expensive among potential households. However, this study also illustrates that potential clients are badly aware about the cost of a digester. The price of a digester is not uniform because the costs of construction material differs from region to region. In many cases, masons and BCEs themselves cannot tell in advance what the price of a digester is. The price perception of potential clients has thus much to do with a lack of knowledge. The availability of other energy sources, substitutes, is also an obstacle that hampers the dissemination of biogas. Firewood is often freely available while charcoal and kerosene is not perceived to be a heavy burden on the expenditures. The limited usability of biogas is perceived to be a barrier as well. Nearly all households own one or more mobile phones while more and more modern conveniences find their way to rural households. A solution that provides these household with electrical energy is thus more desirable.

See section 4.2.3 and 4.2.4 for more information about the drivers and barriers potential biogas customers perceive.

- **What is the demand for biogas among potential clients?**

Even though the attitude towards biogas is fairly positive, the demand of biogas is low. This illustrates that the barriers outweigh the benefits for investing in biogas. This can mean two things for the biogas programme: 1) the benefits are not as prosperous as initially thought and the project is deemed to fail, or 2) the perceived barriers are higher than the actual barriers. Since nearly all current biogas users are very positive about the technology and their investment, it is reasonable to assume that there is a knowledge gap between the barriers perceived by potential households and actual height of the barriers. The following question will elaborate on this knowledge gap.

- **Is there a difference between the perceived and actual costs for adopting biogas?**

All elements that have a negative value are labelled as costs (time, money, effort etc.), this are thus the barriers potential biogas customers perceive for investing in biogas. Positive arguments, or benefits, are labelled as rewards. From a social exchange perspective, people calculate the overall worth of the product by subtracting its costs from the rewards it provides. Costs and rewards are subjective, the standards that humans use to evaluate the worth of the product varies over time and from person to person. Hence, the costs potential clients perceive is often different then the reality (actual costs), this phenomenon is known as knowledge gap in the social exchange literature.

This study illustrates that the perceived costs are not in line with the actual costs of adopting biogas, see section 4.3 for a detailed overview. Potential clients have thus a wrong perception about the costs of biogas. The most dominant arguments relate to the financial consequences of applying biogas. Households are badly informed about the initial investment costs of constructing a digester and future costs such as after sales and appliances. It is the task of the program to provide specific price information to potential clients and support masons and BCEs with effective calculation methods to pre-calculate the price of a digester.

Next question will elaborate on the financial consequences of investing in biogas.

- **What are the financial benefits of using biogas?**

Potential biogas customers understand the primary benefits of biogas and its impact on the livelihood of households. However, they do not notice the financial benefits of applying biogas and only perceive high investments costs. Simple marketing calculations such as the breakeven point and return on investment can pre-calculate the feasibility of applying biogas for households according to their situation.

Applying biogas substitutes the need for fossil fuels. An average smallholder farmer household in Tanzania spends approximately 33,000 TZS on firewood, charcoal, kerosene and paraffin each month. Using the available bio slurry increase crop revenues with an average of 25 per cent. The mean household income from agricultural activities is 58,500 TZS per month per hectare, their additional income from actively using bio slurry is thus 14,500



TZS per month per hectare. An average rural household with one hectare of arable land can thus financially benefit 47,500 TZS per month in applying biogas.

An average smallholder farmer household with a few cattle and one hectare of arable land can pay back its digester within 22 months, which is less than two years. This is calculated on the basis of an average 6m<sup>3</sup> digester, the savings on energy expenditures and additional income from applying bio slurry. When excluding the additional income from bio slurry usage, the payback time of a digester is 31.8 months. But especially in the long term a digester becomes profitable. The additional income is 1,730,000 TZS over a period of 5 years and even 7,130,000 TZS in 15 years. Applying biogas is thus financially profitable for smallholder farmers in Tanzania. See also section 5.5.

### 6.1.2 Sub Questions Considering the Biogas Programme

- **How are marketing and promotion activities currently organized?**

There is not much organization and structure in the currently employed promotion activities. There is no coherent plan or strategy in place for the sector and every stakeholder involved is doing promotion in its own way. The amount of promotion material provided by the programme is limited to calendars for biogas users and sparsely available information brochures that lack essential information. TDBP, IPs, BCEs and masons are most actively involved in promoting biogas. Local government officials, SACCOS corporations and promoters play a significant minor role in promoting the technology.

TDBP is involved in promotion activities on all levels, inhere TDBP is leading by example. Implementing partners are promoting on both a local and regional level. Masons and BCEs are solely active on a local level. Since all stakeholders are doing their own marketing, potential clients get exposed to various types of promotion activities from different sources. There is thus a lack of coherence among all stakeholders. Potential clients might get confused since similar messages are transferred from different sources. See also section 4.4.

Next question will elaborate on the effectiveness and efficiency of the employed promotion activities.

- **What is the effectiveness and efficiency of the employed promotion activities?**

Local promotion activities are the most effective and efficient means in promoting biogas in Tanzania. Most activities on a local level are very effective, but there is room for improvement in terms of efficiency. The efficiency of local promotion is not optimally developed because there is no strong and coherent marketing-promotion strategy in place, local promoters and BCEs (masons) lack sufficient promotion skills and tools, and there is little cooperation and synergy with other stakeholders in doing promotion. Visiting demonstration plants with potential customers, attending local village meetings and organize door to door promotion activities are the most effective and efficient means in promoting biogas. Biogas sign boards is the only local promotion activity which is not effective nor efficient.

Mass media exposures on a regional level are both ineffective and inefficient. IPs and TDBP invest in mass media advertisements without knowing the impact of these activities. Most rural households, the target group of the programme, do not have access to televisions and only a few listen to the radio. Sometimes IPs and TDBP visit regional fairs and markets for agriculturalists to promote biogas. These are much more effective and efficient because a large share of the visitors are potential biogas customers while human interaction is possible.

National promotion activities are very ineffective and highly inefficient. The lion share of the national promotion budget is spend on mass media exposures. Too little time and money is invested in a clear strategy, effective promotion tools, training commercial skills, gaining (professional) marketing expertise and fostering promotion synergy among all stakeholders. See also section 4.4.

- **In which diffusion stage is the biogas programme currently, how much diffusion potential remains and what is the best strategy for further dissemination?**

Previous studies estimated the technological potential of biogas in Tanzania at a minimum of 165,000 constructed digesters. Since the current programme has not more than 5,000 digesters constructed in May 2012, the penetration rate of biogas in Tanzania is 3.03 per cent. A penetration rate of 3.03 per cent coincides with the second stage of Roger's technological adoption lifecycle model. He claims that the first 2.5 per cent users are first stage 'innovators' and the second stage is the domain of the 'early adopters'.

Early adopters leap in when the benefits of biogas become apparent to more and more potential households. They are on the lookout for a strategic leap forward in their life and businesses to give them an advantage over their peers. Contrary to the majority, early adopters have more time and money to invest in new technologies. Early adopters tend to be more economically successful in life and well connected to important stakeholders in their community. They love to be seen as leaders and social prestige is one of their biggest drivers. This natural (intrinsic) desire to be a trend setter causes the 'take-off' of an innovation. Early adopters like to talk about their successes and the more they crow and preen, the more likely biogas will be perceived positively by the majority of the population.

Early adaptors play a vital role in further dissemination of the biogas technology because they are seen as leaders (role models) in their community. The early adaptor is considered to be the 'individual to check with' before using a new technology. Other potential households will follow the their example to gain a higher social status and experience the same benefits as their 'leaders' in their community. The role of the early adopter is thus to decrease the perceived uncertainties about biogas and convince peers in their interpersonal network to adopt the technology. In this stage of diffusion the programme should thus have a focus on individuals with a high level of influence in their communities.

- **What social marketing strategies and insights can contribute to new ideas for the programme and a higher demand for biogas?**

The result chapters of this study, chapter 4 and 5, provide various insights that may contribute to new marketing strategies that foster the demand of biogas in Tanzania. Even though most applied models and strategies are used to provide valuable insights in the mindset of potential customers and the performance of the program, some applied models also provide strategic advices considering the current situation. Although chapter 4 and 5 elaborate on these strategies, the main findings are briefly illustrated. The AIDA model, MABA analysis, the four E's framework and the diffusion strategy provide straightforward recommendations for the biogas programme. The diffusion strategy is describes in previous question will not be elaborated inhere.

The AIDA model in the biogas sector illustrates the most feasible dimensions of employing marketing-communication activities. It stands for awareness, interest, desire and action. This are the four steps every potential client goes through in when planning to make an investment. The results from the most effective and efficient means of promoting biogas are incorporated in this model and determine the outcome. Unsurprisingly, biogas promotion on a local level is most effective and most efficient when employed by local masons and BCEs. The program itself and the IPs should take a more supportive role, providing commercial trainings to masons together with disseminating promotion materials is an effective means to foster promotion activities on a local level. Since mass communication exposures are very ineffective in reaching potential customers, the budget spend on mass communication is more efficiently spend in other means of promotion. Not every region in Tanzania is considered potential, national promotion activities are thus very inefficient. The AIDA model applied on the biogas sector stresses the importance of local promotion activities, community-based marketing interventions and a bottom-up approach. The role of TDBP and IPs should be supportive and not leading. See also section 5.3.

The MABA analysis stands for market attractiveness and business attractiveness. This model is used to assess the attractiveness of the market and the business itself and provides a strategic advice considering its current status. According to this analysis, the biogas programme is performing below average on both dimensions. The strategy that belongs to their situation is two-fold: 'selective policy' and 'a focus on revenues'. With a selective policy the programme should have a focus on growth in geographically selected core areas, reach a maximum biogas penetration in these areas and invest selectively in expanding these areas. This is the opposite of the current strategy of the programme, which is to cover large and widespread areas of Tanzania as fast as possible. The strategic advice focus on revenues is situated in the sought of selective policy. The programme must optimally benefit within the localities where they are active before investing in expansion to 'uncovered' potential regions and villages. It should have a focus only on households with an interest and proven potential for biogas. The idea of this policy is that the growth of the programme is in line with the amount of constructed digesters. See also section 5.1.

The four E's framework is designed as a pure social marketing framework which stands for: enable, encourage, exemplify and engage. The first E is enable, this simply means that the programme must foster a feasible environment to invest in biogas in the first place.

They can do this by providing information, educate people on the use of biogas, stress the importance of the environment, enable access to finance mechanisms, lobby at governmental institutions to stimulate the use of biogas, remove the perceived barriers, and so forth. The second step is to encourage potential households to invest in biogas. Subsidies, lowering the taxes on construction material and offering low interest and long time loans are strategies to encourage households to use biogas. Social pressure is an effective method to encourage potential clients to invest in biogas. Influential people that use biogas are good ambassadors for the programme, village elders and community leaders gain much respect and are very influential in their communities. Which is the third step in the framework, exemplify. Visiting demonstration plants (learn by example) is proven to be the most successful promotion activity. The programme should encourage people with a high status in their community to use biogas, is likely that others in the community will follow their example. Engaging people in using biogas is the last step of the transition from biomass to biogas. Personal interaction is successful in promoting a social benefit. Local level promotion can engage people in networks of biogas users. Cooperation and synergy between the programme, government, masons, loan companies, promoters and potential clients will strengthen the biogas community. See also section 5.4.

## **6.2 Are the Assumptions Valid, or Not?**

This section will elaborate on the assumptions as illustrated in the methodology. The assumptions are made in regard to the contextual dimensions for the biogas programme and to the two main parties involved in this study: potential biogas customers and the programme itself.

### 6.2.1 Contextual Dimensions

- **The performance of the programs is shaped by institutional barriers for renewable energy dissemination, the poverty context and the remoteness of localities. These external influences hamper a successful dissemination of the biogas technology.**

The programme is very limited profiting from the involvement and support of governmental institutions and partner NGOs. An inadequate government and inefficient organizational structures hampers business registrations and access to feasible credit facilities. The poverty context also plays a significant role in the dissemination. Biogas is perceived to be expensive. Even though many 'poorer' households will financially benefit from applying biogas, they lack assets to make the initial investment and are not willing to engage in a loan at a SACCOS company. The loans for biogas digesters are too expensive, with interest rates exceeding 25 per cent while the payback time is usually 6 to 8 months. There is a low population density in remote areas together with a very limited basic infrastructure. Many villages are hard to reach,

especially with construction material. This results in disproportionately high costs for constructing plants in remote localities.

This confirms the assumption. There are many contextual barriers the programme has no influence on, these are externally determined. A low level of government involvement has also to do with a lack of capacity and knowledge. Credit facilities at commercial enterprises are expensive throughout Tanzania and the geographical spread of localities make it economically not profitable to construct plants in very remote areas. The contextual barriers play thus a significant role in the dissemination on biogas in Tanzania and hampers further dissemination.

### 6.2.2 Potential Biogas Customers

- **There is a low demand for biogas in Tanzania because potential clients have a negative attitude towards the technology.**

The attitude people have towards biogas is a good benchmark to measure buying potential of a digester among potential customers. Attitude is the sum of barriers and benefits potential customers perceive. Attitude is not static and can change over time (for better and worse). Current biogas users have a very positive attitude about the technology. The potential target group is moderately positive about the technology, but certainly not negative. The low demand for biogas is thus not a result from a negative attitude towards the technology. The reason for this low demand is the cost perception of biogas, biogas digesters are perceived too expensive for most households.

- **Potential clients are insufficiently aware about the financial benefits of using biogas.**

This assumption is valid. Potential households are very poorly aware about the use of bio slurry to increase crop revenues, which is directly benefitting the family in financial terms. Because households do not keep track of their energy expenditures, they do not see how much money biogas can save them. But this poor knowledge of the financial benefits is only a part of the problem. It appears that these households are also very badly aware about the costs of applying biogas. They do not know how much the construction costs are, what service and after sales will cost them, and what the price of appliances such as light bulbs and stoves is.

- **Biogas is perceived to be a step on the energy ladder between traditional biomass and electricity. The impact on the livelihood in terms of socio-economic growth is too small for most households, because it does not provide the energy supply needed to use modern conveniences.**

The concept of the energy ladder (see section 2.3) is very much applicable in Tanzania and for the biogas programme. Studies revealed a positive correlation between rising incomes, the use of modern fuels and an increased energy consumption. A growing Tanzanian economy is accompanied by an increase in energy demand and modern sources of energy. Electricity is

the preferred source of energy because it can be applied to power modern conveniences such as mobile phones and televisions. There are also a number of projects and organizations that foster the use of solar panels and small scale hydro turbines in Tanzania. A major barrier of biogas is its inability to power modern conveniences. Even though not all modern conveniences have penetrated rural areas in Tanzania, nearly every families own one or multiple mobile phones. The demand for electricity is growing in rural Tanzania.

More and more rural households have a need for electricity. They perceive the inability of biogas to produce electricity as a barrier for investment, they rather invest in a technology that provides electricity. Hence, it is reasonable to assume that many households in Tanzania perceive biogas as a step between traditional biomass and electricity.

### 6.2.3 The Tanzania Domestic Biogas Programme

- **A lack of coherence in the employed marketing activities has a negative effect on the effectiveness and efficiency of the employed promotion activities.**

This is also very much true for the biogas programme. Because there is no coherent marketing plan or strategy in place, every stakeholder in the programme is employing their own marketing activities. Even though many local promotion activities are effective, the overall level of efficiency is low. The involvement of TDBP and IPs on a local level is often perceived counterproductive. They are not well aware of the local context and may ‘spoil’ the market of local masons. There is no strong message and brand communicated, the exposed information differs per stakeholder. A lack of coherence in the employed marketing activities has a negative effect on the effectiveness and efficiency of the employed promotion activities.

- **The initial investment costs of biogas are too high for the ‘average’ smallholder farmer in Tanzania. Biogas demand remains low because there are no feasible finance mechanisms in place.**

There is no straightforward answer to this assumption. The price perception of biogas among potential customers is very high. In reality, the average rural household in Tanzania can pay its digester back within 22 months due to savings on energy expenditures and higher crop revenues. After that, the digester becomes profitable. But this assumption is about feasible finance mechanisms. However, this study did not found any link between biogas loans and demand. Various SACCOS companies are interviewed for this study, but only one company provided loans for biogas. Everyone knows that loans are expensive and have a short payback time, sometimes exceeding 25 per cent interest over a period from 6 to 8 months. Hence, people prefer not to engage in a loan at a SACCOS company. Households complain about the lack of low interest and long term credit mechanisms, not only for biogas but also for other issues such as a motorbikes and construction material for houses. The program itself is not frequently addressing the possibility of biogas loans in their promotion exposures. Maybe because they understand themselves as well that these loans are not feasible for potential clients. It is thus reasonable to assume that more feasible credit facilities and a better

awareness of these loans will encourage the demand of biogas, although this is not confirmed by this study.

- **There is much market potential undiscovered and the programme is still in an early stage of diffusion.**

This is confirmed by this study. The current penetration rate of biogas is approximately 3.03 per cent. Many highly potential and above average potential areas are not reached by the program, yet.

### **6.3 Conclusion**

This chapter discussed the research questions and assumption as presented in the methodology of this document. The purpose of this synthesis is to work towards the central question and have a better understanding of the results. Next and last chapter will elaborate on the central question of this study and make recommendations for the sector.

## 7 | **LOOKING BACK & LOOKING FORWARD**

---

This last chapter attempts to answer the central question of this study in two sections, ‘looking back’ and ‘looking forward’. The central question in this study is:

- **What is the status of the marketing activities employed by the biogas sector and how can (social-) marketing methods and principles improve the marketing and promotion strategy as applied by the programme?**

The first section will briefly illustrate the status of the presently employed marketing activities by the sector. The second section will indicate the applicability of marketing methods and principles to improve the promotion strategy as applied by the programme. Hence, the title of this conclusion is: ‘Looking Back and Looking Forward’. The last section in this chapter will also illustrate some recommendations and ideas for future improvements.



## 7.1 Looking Back

The biogas sector in Tanzania is not performing according to expectations. There is a gap between the programme's ambition and the present day reality. The current penetration rate of biogas is approximately 3.03 per cent. Even though the technology is still in an early stage of diffusion and many potential areas are not reached by the program yet, the demand for biogas among potential customers that are aware of the technology is low. Biogas is perceived to be too expensive and is often not seen as a fully fledged solution because it does not provide electricity. The programme itself is experiencing many barriers and challenges in the dissemination of the technology. There is very little support from the government, inadequate strategies and organizational structures, a lack of entrepreneurial skills and private sector initiatives, poor access to feasible credit facilities, a limited energy use in rural areas, poverty, and disproportionately high costs for constructing plants in remote localities. These contextual dimensions make it difficult for the programme to reach a high level of penetration. There is also a knowledge gap between the perceived and actual costs, potential biogas clients are poorly informed about the costs of a digester and create the perception that biogas is too expensive for them. This is also because there is no coherent promotion strategy in place to efficiently promote biogas. There is no clear message transferred to potential clients. Masons and BCEs lack skills to 'sell' their digester by pre-calculating the investment costs and the long term financial benefits of using biogas.

TDBP is involved in all promotion scales, from national level to household level. National mass promotion activities have very little influence on the target group, this is thus highly ineffective and inefficient. Implementing partners are also involved in promotion activities on all levels, some partner organizations even have staff employed that construct digesters for them. For most masons constructing biogas digesters is not their primary source of income, they are not so actively involved in promoting the construction of a digester when they earn more money in constructing buildings. Local promotion activities are the most effective means in fostering the demand of biogas. Visiting biogas demonstration plants in particular is very effective as well as door to door visits. Individuals with a high social status in their community are good ambassadors for the technology.

Subsequently, the programme has much to improve on its marketing strategy. However, the attitude towards biogas is moderately positive among potential clients. This indicates that households are interested in the technology but perceive too many barriers for their own situation. Next section, looking forward, will elaborate on the applicability of marketing methods and principles to improve on the currently carried out promotion.

## 7.2 Looking Forward

The core purpose of marketing, especially social marketing, is to grasp people's behaviour and change this into another behaviour. For the biogas sector this means understanding the drivers for using traditional biomass fuels and change this into the use of biogas. This study illustrates a small range of social marketing evaluations that contribute to new marketing insights. The AIDA model, MABA analysis, the four E's framework and the diffusion theory provide straightforward strategic marketing recommendations for the biogas programme. This section aims to glue these different strategic views together.

The diffusion theory claims that the programme should change its marketing approach by promoting those benefits that appeal to the characteristics of the early adapters. Early adopters tend to be more economically successful in life and well connected to important individuals in their community, social prestige is one of their biggest drivers. Early adapters are inspired by technologies that give them an advantage over their peers. The programme should thus position biogas as a product that sets households a step higher on the development ladder. Economical drivers are naturally very important and appealing. It is the task of the programme to demonstrate the financial benefits of applying biogas. This is most effective on a local level. As the AIDA pyramid in section 5.3 illustrates, biogas promotion is most effective and most efficient when employed by local masons and BCEs. The role of TDBP should be supportive instead of leading by example. Both TDBP and IPs should have a focus on assisting masons and BCEs, not employ marketing-promotion activities themselves. Masons and BCEs should be supplied with promotion material and be trained in developing commercial skills. Communication and cooperation should also be improved, not only among stakeholders of the programme, but also with government institutions and officials, other renewable energy projects, and potential customers. This are also important aspects in the 4 E's social marketing framework. This framework illustrates four steps to converting a behaviour. Enable the right environment to invest in biogas and learn people about its benefits, encourage biogas by financial support, demonstrate the benefits, and foster a network of peers. This framework is not very specific and can be broadly interpreted. The MABA analysis is more straightforward with its advice. The programme should have a focus on growth in geographically selected core areas, reach a maximum biogas penetration in these areas and invest selectively in expanding these areas. It should only have a focus on households with an interest and proven potential for biogas. See also section 5.1. Promotion activities should aim to get rid of the wrong cost perceptions that potential clients perceive and communicate the actual costs of applying biogas. Masons and BCEs should be able to pre-calculate the costs and financial benefits of a digester in their promotion interventions.

This brings the study back to the concept of community-based social marketing. Community-based social marketing approaches have once again demonstrated that behaviour change is most effective when initiatives are delivered at local level. Local promotion

activities appear to be most effective and efficient, now and in the next phase of the biogas programme.

### 7.3 Recommendations

This last section of this study will sum up a range of ideas and recommendations that might foster a higher demand for biogas and a viable biogas sector. This section attempts to contribute to the assignment of this study: ‘examine how (social) marketing can contribute to a further dissemination of the technology’. The ideas and recommendations are primarily focussed on providing knowledge and tools to stimulate the dissemination of biogas on a local level.

- Communicate the actual costs of applying biogas. Be clear, straightforward and transparent in communicating the price of a digester. Educate potential clients about the financial benefits of applying biogas. When the target group is well informed about the costs and financial benefits of biogas, it is unlikely that they will form a wrong cost perception.
- Stimulate the availability of long term and low interest loans. An average household can pay a digester back within 22 months due to savings on energy expenditures and additional income from applying bio slurry. Develop a custom loan for each household which can easily be paid back according to their situation. Use the available subsidies in a revolving fund for households to attain attractive long term loans for financing digesters. Provide discounts on the interest as a form of subsidy. Make use of the already existing infrastructure (e.g. through SACCOS companies) but give it an own brand name (e.g. The Bioloan). The length of the loan period should thus be in line with the payback time of the digester itself. This way the client will not suffer from less purchasing power.
- Reach a high penetration degree in the localities where the program is currently active, focus on individuals with a high status in the community (the early adaptors) to create a spin-off of the technology (through social peer pressure).
- Make masons and BCEs fully responsible for promotion activities on specifically chosen localities, focus on a maximum penetration in those areas before skipping to a new locality, not allow masons to go freewheeling without a strategy throughout the country. This will also make masons and BCEs less depending on the efforts of the programme and its partners, it will foster a self-sustaining market.
- Provide masons with appropriate tools and skills to effectively sell digesters. Design clear and coherent promotion material with contact details of local masons, the IP in that region and the website of TDBP. Design simple models that enable masons to

make a inventory of the costs and calculate the financial benefits for each household situation.

- Start learning people about the benefits of biogas at a young age. Provide school material about the importance of the environment and the benefits of biogas. This will enable them to make sensible choices when they grow older.
- Focus on well performing masons only, do not let bad performing masons spoil potential localities and exclude them from the program. It is economically more efficient to work with small groups of masons that are dedicated to the programme.
- Have a focus on localities and households which are proven to be potential. Not focus on the poorest farmers or those very remotely. Concentrate the strategy and cluster the dissemination to create a spin-off in the most potential localities.
- Stimulate an information network where the program, partner organizations, masons and potential clients are able to share knowledge, find promotion and calculation tools, gain marketing data and have insight into construction schemes. Since the penetration rate of the internet is low, especially among masons and rural households, physical meetings can be held on a regional and local level. Another option is to facilitate biogas stores. A place where a range of information is available for every stakeholder involved.

#### **Ideas for future studies in the biogas programme:**

- There is currently little cooperation between the biogas programme and other energy projects in Tanzania. Masons are specifically trained to construct digesters and the programme is focussed on delivering energy by the use of biogas. Masons and BCEs can widen their scope by also offering other renewable energy system such as solar panels, oil presses for jatropha seeds together with generators that run on this oil, and small scale hydro and wind turbines. Masons can be trained in installing other energy systems as well or cluster themselves with other specialists. This way they can offer a range of energy solutions to rural households and are not limited to a single product. Hybrid forms of energy delivery are also possible. A small biogas digester produces gas for cooking while small solar panels provide enough electricity to charge a cell phone and power a few LED lamps. Future studies can examine the integration of renewable energy projects and products.

## FINAL REFLECTIONS

---

Spending four months in Tanzania has been a great experience. From the Netherlands I arranged my internship in Arusha and booked a flight to Nairobi, Kenya. This was pretty much all I organized in advance. Because my flight arrived late in the evening and the busses to Arusha departed early in the morning, I had to spend the night walking in and around Nairobi airport. Next day I arranged a bus to Arusha. And there I stood in the early afternoon, at the Impala hotel with my big suitcase and laptop bag. No idea where I was, without any Tanzanian currency on me and no place to stay. From this point I realized that my time in Tanzania would be a great adventure. Luckily it was not difficult to find a taxi driver that was willing to take me to a cash machine and a bag-packers hostel. Next objective was to find an apartment. During my first days in Arusha I walked around town and spoke to people on the streets. Via this guy I met another guy who had a friend who knew someone who rent out apartments. In sum, I managed to find a nice and spacious apartment which was almost next to the SNV office for a very reasonable price. With two bathrooms and two bedrooms there was no need for Alex to find a room or apartment as well. Because I had never been in Africa before, the whole experience was new for me. I was told I might experience a culture shock. Luckily, this did not get me at all. I felt comfortable right away.

The weeks before departure I became familiar with the biogas technology, read literature on social marketing and wrote my thesis proposal. In the Netherlands I worked as a project manager and marketer for two companies that are involved in realizing renewable energy projects. Even though the applied technologies and market is very different, I think that my interest and experience in renewable energy projects and marketing helped me to understand the technology and the potential market for biogas. At SNV I was introduced to TDBP, with who I closely worked together during my research. In collaboration with TDBP and SNV I made a plan to assess the employed marketing activities and evaluate how social marketing techniques can foster the dissemination of biogas in Tanzania.

Together with my interpreter John and a driver from SNV or TDBP, I went to many localities in the Northern and Centre areas of the country to interview respondents. This also

helped me to learn some very basic Kiswahili skills. With John I spoke a hybrid language, combining English and Afrikaans (Dutch). We were able to communicate very well and I do not think I misinterpreted much information. I was informed about the problem that time is not ruled by the clock and that I might have difficulties in making appointments with people, in reality I very rarely experienced any of these issues.

I do have the feeling that some respondents were not completely honest and real in their answers. Especially local partners (IP's) tend to give very positive answers about the programme's performance, even though they supervised the construction of a handful digesters only. I had the feeling that everyone is very enthusiastic about biogas but only a few are willing to make the investment. This is of course not unusual, the construction costs are very high for the majority of rural households and the technology is only limitedly demonstrated. Some areas perform better than others, I think this has much to do with the implementing partner. It seems that IPs are the drivers of the programme and that masons and BCEs very much rely on the efforts of their IP. The geographically spread of villages, a poor infrastructure and a lack of transport hinders masons to cover large areas. Moreover, I found out that the villages are very different from each other, not only culturally but also climatically because of the differences in altitude. From this moment onwards I realized that a uniform marketing approach for the whole country will not work because the differences are too big and the distances too large. Hence, a decentralized marketing-communication approach customized to local conditions is preferred.

Considering the biogas programme and this study in the bigger picture of development, I do believe that this programme has the potential to contribute to socio-economic progress in Tanzania. However, tangible developments are only noticed when behaviour change is achieved. As the theory of behaviour change visualizes in its graph, a spin-off of the technology may occur when a penetration level of 12-15 per cent is reached. However, it is uncertain if the programme will ever reach that level of penetration. Until then, the programme should improve on its marketing strategy, continue educating people about the environment and improve on the institutional context of renewable energy dissemination. It is also wise to cooperate with other renewable energy projects, offer hybrid forms of renewable energy sources, stimulate local promotion activities, improve on the credit facilities and reach a maximum biogas penetration in the localities where the programme is currently active.

During my time in Tanzania I wrote a marketing report for the programme and SNV. This report was very practical in nature with many marketing methods and frameworks that assess the currently employed marketing interventions and contribute to ideas for future dissemination. The translation of my internship assignment to this academic study was a difficult job. Because there are no leading theories applied, I feel that I miss a theoretical red thread in this thesis. A mix of methods, approaches and insights determined the outcome. However, I feel I contributed to some practical marketing insights for the sector and produced a thesis that meets the academic requirements.

---

## BIBLIOGRAPHY

---

- Ahlborg, H. and Hammar, L., 2010, Drivers and barriers to rural electrification in Tanzania and Mozambique – grid extension, off-grid and renewable energy sources. Environmental Systems Analysis, Chalmers University of Technology, Göteborg, Sweden.
- Ahlborg, H. and Hammar, L., 2011, Drivers and barriers to rural electrification in Tanzania and Mozambique – interaction between stakeholders. Environmental Systems Analysis, Chalmers University of Technology, Göteborg, Sweden.
- AICD, 2008, Underpowered: The State of the Power Sector in Sub-Saharan Africa, Background Paper 6. World Bank Institute, Washington.
- Akabah, E.M., 1990, Real incomes and the consumption of woodfuels in Ghana: An analysis of recent trends. In: Energy Economics 12 (3) , pp. 227-231
- Alanne, K., Saari, A., 2004, Distributed energy generation and sustainable development, In: Renewable and Sustainable Energy Reviews 10 (2006), pp. 539-558
- Alcheva, V., Cai, Y., Zhao, L., 2009, Cause Related Marketing. How does cause-related marketing strategy shape consumer perception, attitude and behaviour. Kristianstad University College, School of Health and Society. Retrieved 5 August 2012,online available at: [<http://urn.kb.se/resolve?urn=urn:nbn:se:hkr:diva-5739>]

- Akyoo, A.M. Kileo, O.J., 2012, Biogas User Survey (BUS) Analysis Report
- Babbie, E., 1986, The Practice of Social Research. Wadsworth Publishing Company, Belmont.
- Bang, U., 2009, Poverty alleviation and access to sustainable energy services. Retrieved 26 July 2012, online available at:  
[[http://www.careclimatechange.org/files/carbon/CARE\\_Poverty\\_Alleviation\\_and\\_Sustainable\\_Energy.pdf](http://www.careclimatechange.org/files/carbon/CARE_Poverty_Alleviation_and_Sustainable_Energy.pdf)]
- Barns, D.F., Qian, L., 1992, Urban interfuel substitution, energy use, and equity in developing countries: Some preliminary results. The World Bank, Washington.
- Broadhead, J., Kilmann, W., 2008, Forest and energy: Key Issues. FAO Forestry Paper 154
- EIA, 2004, The impact of high oil prices on the global economy. Economic Analysis Division Working Paper. International Energy Agency, Paris
- FAO, 2012, The United Republic of Tanzania – Maps. Retrieved 10 June 2012, online available at: [<http://www.fao.org/countryprofiles/maps/en/?iso3=TZA&lang=en>]
- Glowa, T., 2002, White Paper: Advertising Process Models. Retrieved 20 July 2012, online available at: [[http://www.glowa.ca/Advertising\\_Process\\_Models.pdf](http://www.glowa.ca/Advertising_Process_Models.pdf)]
- GTZ , 2007, Eastern Africa Resource Base: GTZ Online Regional Energy Resource Base: Regional and Country Specific Energy Resource Database: II - Energy Resource. Retrieved 8 August 2012, online available at:  
[[https://energypedia.info/index.php/East\\_Africa:\\_Overview\\_of\\_Regional\\_Energy\\_Resources](https://energypedia.info/index.php/East_Africa:_Overview_of_Regional_Energy_Resources)]
- GTZ, 2007, Feasibility Study for a National Biogas Programme in Tanzania
- Gwang'ombe, F.R.D., 2004, Renewable Energy Technologies in Tanzania.



- Hague, P., date unknown, White Paper: The Role of Promotion in Business to Business Markets. Retrieved 9 July 2012, online available at:  
[<http://www.b2binternational.com/publications/white-papers/ad-testing-b2b-advertising/>]
- Haraldsson, H.V., 2000, Introduction to Systems and Causal Loop Diagrams. Lund University. Retrieved 13 August 2012, online available at:  
[[http://ns310278.ovh.net:8001/rid=1244140954250\\_1167059429\\_1461/Introduction%20to%20Systems%20and%20Causal%20Loop%20Diagrams.pdf](http://ns310278.ovh.net:8001/rid=1244140954250_1167059429_1461/Introduction%20to%20Systems%20and%20Causal%20Loop%20Diagrams.pdf)]
- Hasting, G., 2003, The Critical Contribution of Social Marketing. In: Marketing Theory September 2003 (3), pp. 305-322
- Herbert, A., Shepherd, A., 2002, Spin-off study: Impact Assessment for Poverty Reduction. International Development Department, School of Public Policy.
- Hiemstra-van der Horst, G., Hovorka, A.J., 2008, Reassessing the “energy ladder”: Household energy use in Maun, Botswana. In: Energy Policy, 36, pp. 3333 – 3344
- Hossier, R.H., 1993, Urban energy systems in Tanzania: A table of three cities. In: Energy Policy, 21(5), pp. 510 – 523
- Hosier, R.H., Dowd, J., 1987), Household fuel choice in Zimbabwe: An empirical test of the energy ladder hypothesis. In: Resources and Energy, 9, pp. 347-361
- Hulme, D., 2007, Integrating quantitative and qualitative study for country case studies of development. Paper drafted for Global Development Network Meeting Comparative Analysis: Methodological Workshop, pp. 1-45
- Jumbe, C.B.L., 2004. Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. Energy Economics 26 (1), pp. 61–68
- Kahsai, M.S., Nondo, B., Schaeffer, P.v., Gebremedhin, T.G., 2011, Income level and the energy consumption-GDP nexus: Evidence from Sub-Saharan Africa. In: Energy Economics 34, 2012. United States. pp. 739-746

- Katyega, M., Marandu, M., 2001, Power Sector Reform in Tanzania – Proceedings of a National Policy Seminar. In: AFREPREN, 2001, Power Sector Reform in Africa.
- Kotler, P., Zaltman, G., 1971, Social Marketing: An approach to planned social change. In: Journal of Marketing, Jul;35, pp. 3–12
- Kotler, P., 2009, Up and Out of Poverty. Pearson Education, Inc.
- Lainé, L., 2011. Green Deal or No Deal. In Consumer Focus. Retrieved 14 June 2012, online available at: [<http://www.consumerfocus.org.uk/files/2011/03/Green-deal-or-no-deal.pdf>]
- Leach, G., 1988, The energy transition. In: Energy Policy 20 (2), pp. 116-123
- Lefebvre, R.C., 2000, Theories and Models in Social Marketing. In: Handbook of Marketing and Society. Sage Publications, Newbury Park.
- Lymio, B., 2007, Improving Energy Resilience in Tanzania, Sustainable Energy Watch 2007, HELIO International. Retrieved 12 July 2012, online available at: [<http://www.helio-international.org/Tanzania.En.pdf>]
- Malti, E., Mnenwa, R., 2012, Affordability and Expenditure Patterns for Electricity and Kerosene in Urban Households in Tanzania., REPORA Research Report 11/2, Dar es Salaam.
- Marfufu, L., Ludwig, J., Andrea, M.O., Meixner, F.X., Helas, G., 1997, Domestic biomass burning in rural and urban Zimbabwe – Part A. In: Biomass and Bioenergy 12 (1), pp. 53-68
- Marree, F. and Nijboer, M., 2007. Biogas: viable or not? An explorative study to the feasibility of introducing biogas and the impact on HH's livelihoods in the Northern regions of Tanzania. SNV –Netherlands Development Organization
- Martin, J., 2009, Distributed vs. Centralized electricity generation: are we witnessing a change of paradigm?, HEC, Paris.

- Mas-Colell, A., 1977, The Recoverability of Consumers' Preferences from Market Demand Behaviour. In: *Econometrica* 45 (6), pp. 1409-1430
- McKenzie-Mohr, 2000, Promoting Sustainable Behaviour: An Introduction to Community-Based Social Marketing. In: *Journal of Social Issues* 56 (3), pp. 543-554
- Mehrara, M., 2007. Energy consumption and economic growth: the case of oil exporting countries. In: *Journal of Energy Policy* 35 (5), pp. 2939-2945
- Mihaela, P., 2008, Globalization and the New Energy Challenges, In: *Academy of Economic Studies – Bucharest, Romania, Faculty of International Business and Economics*, pp. 170-216
- Mwema, F., Shabbir, G.H., 2011, A Review of Biomass Energy Dependency in Tanzania, In: *Energy Procedia* 9 2011, pp. 338-343
- National Bureau of Statistics (NBS), 2010, Tanzania Mainland in key statistics. Retrieved 12 June 2012, online available at:  
[[http://www.nbs.go.tz/index.php?option=com\\_content&view=article&id=105&Itemid=109](http://www.nbs.go.tz/index.php?option=com_content&view=article&id=105&Itemid=109)]  
]
- Orgerie, A-C., Lefèvre, L., Guérin-Lassous, I., 2011, On the Energy Efficiency of Centralized and Decentralized Management for Reservation-Based Networks. In: *IEEE Globecom* 2011.
- Pickens, P.M., 2002, *Community-Based Social Marketing as a Planning Tool*. University of Oregon-Architecture and Allied Arts Department.
- Rogers, E.M., 1995, *Diffusion of Innovations*. Fourth edition. The free press.
- Savannas Forever Tanzania, 2011, *Tanzania Domestic Biogas Programme: Baseline Report for Leguruki, Gidas, Mavumo and Endamariiek*. University of Minnesota.

- Schoot Uiterkamp, B.J., 2011, Assessment of the Tanzanian Biogas Sector: First Empirical Results using the Appropriate Energy Model. Master Thesis Utrecht University
- Serrat, O., 2010, The Future of Social Marketing., Asian Development Bank, Washington.
- SNV, 2000, Biogas Market Assessment in Doti, Nepal
- SNV, 2009, Programme Implementation Document Tanzania Domestic Biogas Programme
- SNV, 2011, Drafts Terms of Reference: Social Marketing Strategy for TDBP
- Smith, D.C., Park, C.W., 1992, The Effects of Brand Extensions on Market Share and Advertising Efficiency, In: Journal of Marketing Research 29 (3), pp. 296-313
- Stern, D.I., 2003, Energy and Economic Growth., In: Rensselaer Working Papers in Economics 0410 (2004), pp. 1-4,1 Department of Economics, Rensselaer Polytechnic Institute, New York.
- Sustainable Consumption Roundtable Commission, 2006, Report Summary 'I Will if You Will'. Retrieved 14 June 2012, online available at: [[http://www.sd-commission.org.uk/data/files/publications/I\\_Will-Summary.pdf](http://www.sd-commission.org.uk/data/files/publications/I_Will-Summary.pdf)]
- ten Have, S. , ten Have, W. , Stevens, F. , van der Elst, M. , & Pol-Coyne, F. (2003). Key management models: The management tools and practices that will improve your business. Harlow, Essex, UK: Financial Times Prentice Hall/Pearson Education Limited.
- Thorp, A.R., 2011, Globalization and Energy Demands in the 21<sup>st</sup> Century, In: School of Doctoral Studies (European Union) Journal – 2011, pp. 78-84
- Toman, T., Jemelkova, B., 2003. Energy and economic development: an assessment of the state of knowledge. In: The Energy Journal 24 (4), pp. 93-112
- Wikipedia, 2012, Diffusion of innovation model. Retrieved 20 July 2012, online available at: [[http://en.wikipedia.org/wiki/Diffusion\\_of\\_innovations](http://en.wikipedia.org/wiki/Diffusion_of_innovations)]

Wilkins, G., 2002, Technology transfer for renewable energy – overcoming barriers in developing countries, The Royal Institute of International Affairs, Earthscan, London.

Winrock International, 2007, Biogas for better life: an African Initiative.

XE, 2012, Universal Currency Converter. Retrieved 8 October 2012, online available at:  
[[www.xe.com](http://www.xe.com)]

## **APPENDICES**

---

- APPENDIX A: Table to determine most potential biogas areas
- APPENDIX B: Maps to determine most potential biogas areas
- APPENDIX C: Employed promotion activities per scale and stakeholder
- APPENDIX D: Return on investment table
- APPENDIX E: Map Tanzania with programme and implementing partners

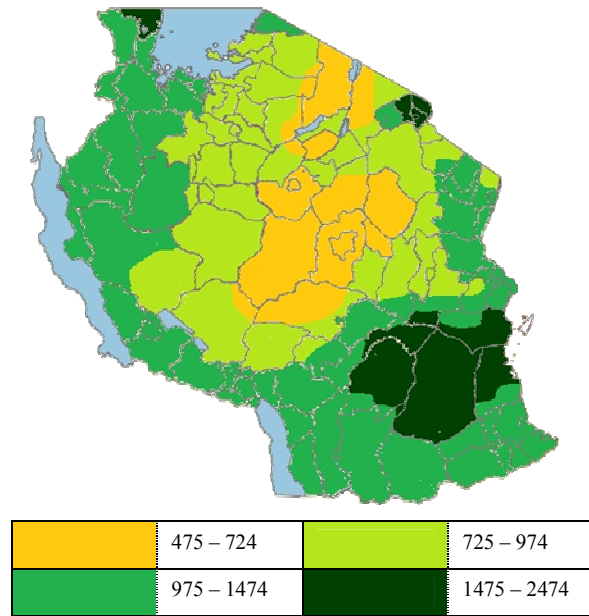
**APPENDIX A: Table to calculate most potential biogas areas****Table 3: Table to calculate most potential biogas areas**

<b>Subject</b>	<b>Amplifier + Weight</b>	<b>Subject</b>	<b>Amplifier+ Weight</b>
<b>Distance Collecting Firewood</b>	<b>3</b>	<b>People Below Poverty Line</b>	<b>1</b>
<i>1 – 1.9km.</i>	<i>- 1</i>	<i>Under 20 %</i>	<i>+ 2</i>
<i>2 – 2.9km.</i>	<i>0</i>	<i>20.1 – 30 %</i>	<i>+ 1</i>
<i>3 – 3.9km.</i>	<i>+ 1</i>	<i>30.1 – 40 %</i>	<i>0</i>
<i>4 – 11km.</i>	<i>+ 2</i>	<i>40.1 – 50 %</i>	<i>- 1</i>
		<i>Above 50 %</i>	<i>- 2</i>
<b>Average Annual Precipitation</b>	<b>2</b>	<b>Poverty Headcount by District</b>	<b>1</b>
<i>475 – 724mm</i>	<i>1</i>	<i>Top 10 Districts</i>	<i>+ 2</i>
<i>735 – 974mm</i>	<i>0</i>	<i>Top 11 – 20 Districts</i>	<i>+ 1</i>
<i>975 – 1474mm</i>	<i>+ 1</i>	<i>Middle</i>	<i>0</i>
<i>1475 – 2475mm</i>	<i>+ 2</i>	<i>Bottom 11 – 20 Districts</i>	<i>- 1</i>
		<i>Bottom 10 Districts</i>	<i>- 2</i>
<b>Improved Water Access</b>	<b>1</b>	<b>Environmental Status</b>	<b>1</b>
<i>Top 10 Districts</i>	<i>+ 2</i>	<i>Low – med. prod. potential</i>	<i>0</i>
<i>Top 11 – 20 Districts</i>	<i>+ 1</i>	<i>High prod. potential</i>	<i>+1</i>
<i>Middle</i>	<i>0</i>	<i>Low soil suitability</i>	<i>- 1</i>
<i>Bottom 11 – 20 Districts</i>	<i>- 1</i>	<i>Erratic rain / cold stress</i>	<i>- 1</i>
<i>Bottom 10 Districts</i>	<i>- 2</i>	<i>Steep slopes / mountains</i>	<i>- 1</i>
		<i>Severe land degradation</i>	<i>- 2</i>
<b>Livestock à Square Kilometre</b>	<b>3</b>	<b>Average Annual Temperature</b>	<b>1</b>
<i>&lt; 1</i>	<i>- 2</i>	<i>15.5 – 20C</i>	<i>0</i>
<i>1 – 4</i>	<i>- 1</i>	<i>20.5 – 30C</i>	<i>0</i>
<i>5 – 9</i>	<i>0</i>	<i>30.5 – 35C</i>	<i>+ 1</i>
<i>10 – 19</i>	<i>+ 1</i>		
<i>20 – 49</i>	<i>+ 2</i>		
<i>50 – 99</i>	<i>+ 3</i>		
<i>100 &gt;</i>	<i>+ 3</i>		

**APPENDIX B: Maps to determine most potential biogas areas**

**Map 4**

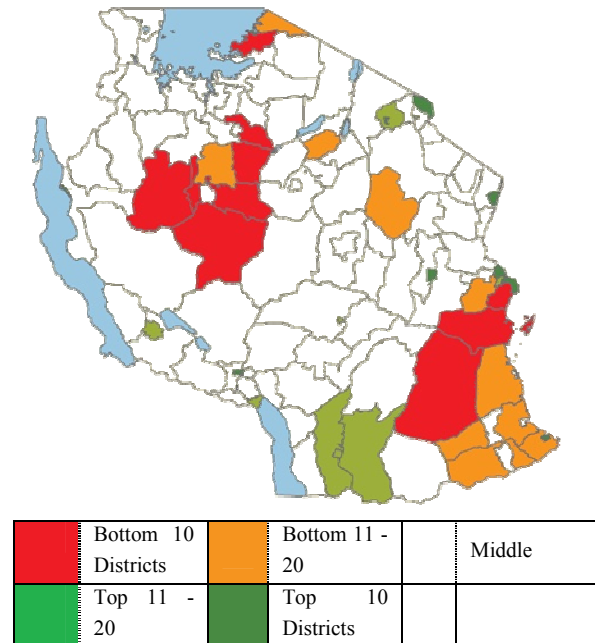
**Average Annual Precipitation (in mm)**



Source: FAO, 2011

**Map 5**

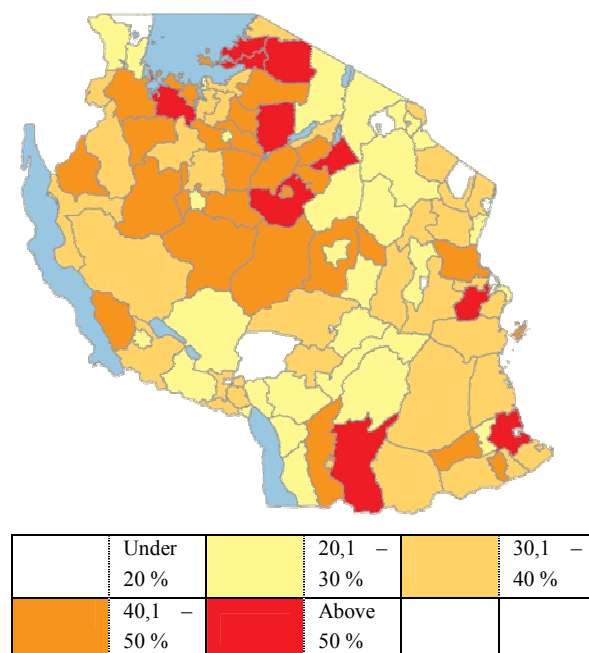
**Improved Water Access by District**



Source: NBS, 2009

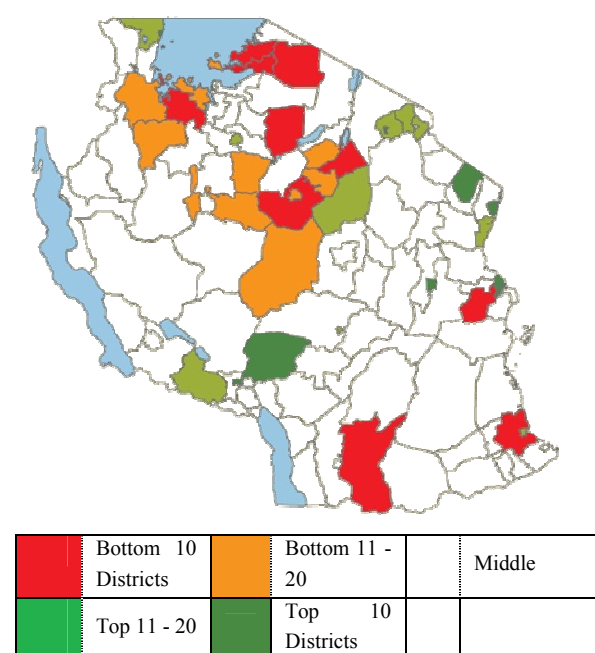
**Map 7**

**Percentage of People Below the Basic Need Poverty Line**



**Map 8**

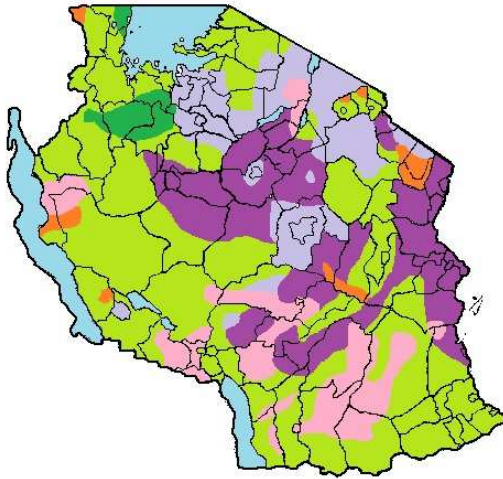
**Poverty Headcount by District**





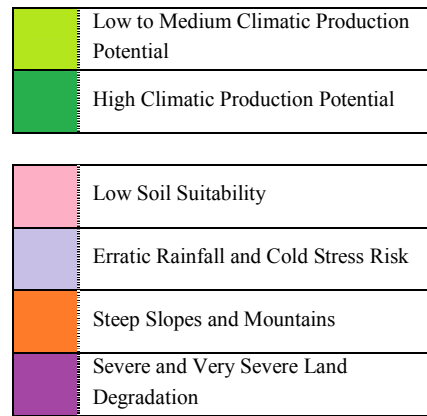
Source: NBS, 2009

**Environmental Conditions**



Source: NBS, 2009

**Map 10**



Source; FAO, 2011

**APPENDIX C: Employed promotion activities per scale and stakeholder**

Activity	Promotion Activities per Stakeholder			
	TDBP	IPs	Promoters	BCEs / Masons
<b>Local promotion.</b>				
<i>Visit demonstration plants with potential clients.</i>	X	X	X	X
<i>Door to door promotion.</i>	X		X	X
<i>Village meetings.</i>	X	X	X	X
<i>Church visits.</i>	X		X	X
<i>Exhibitions/ fairs.</i>	X	X	X	X
<i>Biogas sign boards.</i>	X	X		X
<b>Regional promotion.</b>				
<i>Regional television.</i>	X	X		
<i>Regional radio.</i>	X	X		
<i>Reg. newspaper/magazines.</i>	X	X		
<i>Visit loan companies (SACCOS)</i>	X	X		
<i>Regional farmers exhibitions.</i>	X	X	X	
<i>Regional livestock markets.</i>	X	X	X	
<b>National promotion.</b>				
<i>National television.</i>	X	X		
<i>National radio.</i>	X	X		
<i>National newspaper/magazines.</i>	X	X		
<i>Mobile promotion</i>	X			
<i>Website</i>	X			

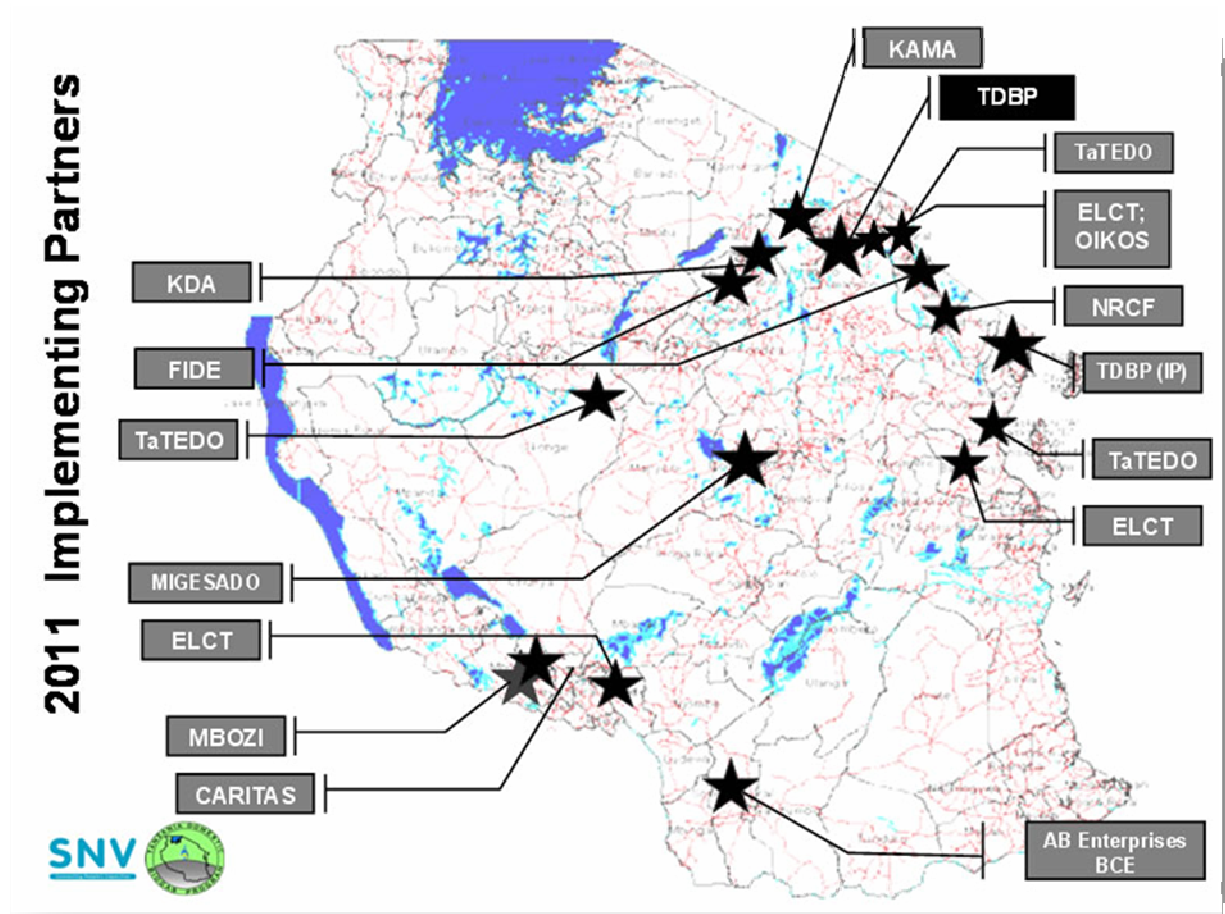
**APPENDIX D: Return on investment table**

Following table illustrates the return on investment over a specific period (number of years) in Tanzanian Shilling for various types of digester and different farmland sizes. Household expenditures are set on an average of 396,000 TZS. It calculates the financial gains of using biogas together with bio slurry contrary to purchasing biomass fuels and not using bio slurry as a fertilizer. The results are shown for a 1, 5, 10, 15 and 20 year period of using biogas. The projected lifetime of a biogas digester is 20 years (SNV, 2009).

<b>Energy Expenditures: 396,000 TZS Per Year</b>		<b>Digester Size + Initial Investment Costs (in TZS)</b>			
		<b>4M<sup>3</sup> Digester</b>	<b>6M<sup>3</sup> Digester</b>	<b>9M<sup>3</sup> Digester</b>	<b>13M<sup>3</sup> Digester</b>
<b>Number of Years</b>	<b>Arable Farmland</b>	<b>850,000</b>	<b>970,000</b>	<b>1,200,000</b>	<b>1,500,000</b>
<b>1</b>	<b>0.5 hectare</b>	<b>- 392,500</b>	<b>- 517,000</b>	<b>- 753,000</b>	<b>-1,062,000</b>
	<b>1 hectare</b>	<b>- 305,500</b>	<b>- 430,000</b>	<b>- 666,000</b>	<b>- 975,000</b>
	<b>1.5 hectare</b>	<b>- 218,500</b>	<b>- 343,000</b>	<b>- 579,000</b>	<b>- 888,000</b>
	<b>2 hectare</b>	<b>- 131,500</b>	<b>- 256,000</b>	<b>- 492,000</b>	<b>- 801,000</b>
	<b>2.5 hectare</b>	<b>- 44,500</b>	<b>- 169,000</b>	<b>- 405,000</b>	<b>- 714,000</b>
<b>5</b>	<b>0.5 hectare</b>	<b>1,437,500</b>	<b>1,295,000</b>	<b>1,035,000</b>	<b>690,000</b>
	<b>1 hectare</b>	<b>1,872,500</b>	<b>1,730,000</b>	<b>1,470,000</b>	<b>1,125,000</b>
	<b>1.5 hectare</b>	<b>2,307,500</b>	<b>2,165,000</b>	<b>1,905,000</b>	<b>1,560,000</b>
	<b>2 hectare</b>	<b>2,742,500</b>	<b>2,600,000</b>	<b>2,340,000</b>	<b>1,995,000</b>
	<b>2.5 hectare</b>	<b>3,177,500</b>	<b>3,035,000</b>	<b>2,775,000</b>	<b>2,430,000</b>
<b>10</b>	<b>0.5 hectare</b>	<b>3,725,000</b>	<b>3,560,000</b>	<b>3,270,000</b>	<b>2,880,000</b>
	<b>1 hectare</b>	<b>4,595,000</b>	<b>4,430,000</b>	<b>4,140,000</b>	<b>3,750,000</b>
	<b>1.5 hectare</b>	<b>5,465,000</b>	<b>5,300,000</b>	<b>5,010,000</b>	<b>4,620,000</b>
	<b>2 hectare</b>	<b>6,335,000</b>	<b>6,170,000</b>	<b>5,880,000</b>	<b>5,490,000</b>
	<b>2.5 hectare</b>	<b>7,205,000</b>	<b>7,040,000</b>	<b>6,750,000</b>	<b>6,360,000</b>
<b>15</b>	<b>0.5 hectare</b>	<b>6,012,500</b>	<b>5,825,000</b>	<b>5,505,000</b>	<b>5,070,000</b>
	<b>1 hectare</b>	<b>7,317,500</b>	<b>7,130,000</b>	<b>6,810,000</b>	<b>6,375,000</b>
	<b>1.5 hectare</b>	<b>8,622,500</b>	<b>8,435,000</b>	<b>8,115,000</b>	<b>7,680,000</b>
	<b>2 hectare</b>	<b>9,927,500</b>	<b>9,740,000</b>	<b>9,420,000</b>	<b>8,985,000</b>
	<b>2.5 hectare</b>	<b>11,232,500</b>	<b>11,045,000</b>	<b>10,725,000</b>	<b>10,290,000</b>
<b>20</b>	<b>0.5 hectare</b>	<b>8,300,000</b>	<b>8,090,000</b>	<b>7,740,000</b>	<b>7,260,000</b>
	<b>1 hectare</b>	<b>10,040,000</b>	<b>9,830,000</b>	<b>9,480,000</b>	<b>9,000,000</b>
	<b>1.5 hectare</b>	<b>11,780,000</b>	<b>11,570,000</b>	<b>11,220,000</b>	<b>10,740,000</b>
	<b>2 hectare</b>	<b>13,520,000</b>	<b>13,310,000</b>	<b>12,960,000</b>	<b>12,480,000</b>

	2.5 hectare	15,260,000	15,050,000	14,700,000	14,220,000
--	-------------	------------	------------	------------	------------

**APPENDIX E: Map Tanzania with programme and implementing partners**



Source: Website TDBP, retrieved 08-10-2012