



Piscès

New Knowledge for Sustainable Bioenergy

ANALYSIS OF THE VALUE CHAIN FOR BIOGAS IN TANZANIA NORTHERN ZONE (Tanga, Kilimanjaro, Arusha and Manyara)



A biogas burner developed in Tanzania

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LIST OF ABBREVIATIONS

ABC	Arusha Biogas Contractors
ARI	Acute Respiratory Infections
BDS	Business Development Services
BES	Biogas Extension Service
CAMARTEC	Centre for Agricultural Mechanization and Rural Technology
CBO	Community Based Organization
CDM	Clean Development Mechanism
CHP	Combined Heat and Power
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COSTECH	Commission for Science and Technology
DFID	Department For International Development
DITF	Dar es Salaam International Trade Fair
ELCT	Evangelical Lutheran Church in Tanzania
EWURA	Energy Water Utility Regulatory Authority
FIDE	Friends in Development Trust Fund
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
IEA	International Energy Agency
ILO	International Labor Organization
LGA	Local Government Authority
LPG	Liquefied Petroleum Gas
MEED	Masters in Entrepreneurship and Enterprise Development
MEM	Ministry of Energy and Minerals
MFI	Microfinance Institution
MIGESADO	Miradi ya Gesi ya Samadi Dodoma – An NGO in Dodoma disseminating biogas
N ₂ O	Nitrous Oxide
NGOs	Non Governmental Organization

NMB	National Microfinance Bank
PDF	Portable Document Format
PISCES	Policy Innovation Systems for Clean Energy Services
R&D	Research and Development
REA	Rural Energy Agency
REF	Rural Energy Fund
SACCOs	Savings and Credit Cooperative Societies
SDC	Swiss Agency for Development Cooperation
SIDO	Small Industries Development Organization
SME	Small and Medium Enterprises
SURUDE	Foundation for Sustainable Rural Development
TaTEDO	Tanzania Traditional Energy Development and Environment Organization
TBS	Tanzania Bureau of Standards
TCCIA	Tanzania Chamber of Commerce Industry and Agriculture
TPSF	Tanzania Private Sector Foundation
UK	United Kingdom
URT	United Republic of Tanzania
VCA	Value Chain Analysis
VETA	Vocational Education Training Authority

ABSTRACT

This study aimed at exploring weaknesses in the biogas value chain that hinder wider dissemination of the technology in Tanzania. The research included assessment of processes and activities carried out by the players, the influencers and business supporters of the biogas value chain. The methodology used is holistic, combining literature review with focus group discussions and interviews with actors and observations of processes across the value chain in Arusha and Kilimanjaro regions, where biogas technology has the longest history in Tanzania.

It was revealed that wider dissemination of biogas is hampered by weaknesses in the processes and linkages among the actors. Many potential users are not aware of the technology and therefore the market remains slim. Customers are unwilling to pay for after-sale services due to market distortion by public institution and donor projects. All these, coupled with inadequate policy environment, lack of stakeholder development, missing linkage to finance and few technicians, render the market unattractive to entrepreneurs who would have invested in the dissemination of the technology.

The government should conduct awareness campaigns through media, translate current policies into actions to development key stakeholders, set the required institutional framework and programmes to support biogas dissemination activities. It should also train more technicians and refrain from working in the market and concentrate on research and development. An association of biogas users and disseminators should be formed to assist in reducing cost by joint procurement and linkage to finance.

1. INTRODUCTION

1.1 Background

In many developing countries, traditional fuels are normally available locally at low cost. The problem associated with these traditional fuels is their characteristic of low combustion efficiency. Poor combustion efficiency leads to emission of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) which leads to increase of greenhouse gases. On the other hand, modern fuels are expensive and are characterized by high combustion efficiency. The use of fossil fuels contributes to the increase of greenhouse gases and global warming. These fuels are usually more expensive in rural areas due to high import and distribution costs. In most cases, the rural areas do not enjoy the availability of such energy sources.

There are three energy sources namely fossils, nuclear and renewable sources. The later is the only source that can be readily available for the rural poor. Renewable energy sources are solar, wind, hydroelectric, geothermal power and biomass. Renewable energy sources' main assets are their environmental cleanliness and their virtual inexhaustibility. Major drawbacks, however, are limited energy production as well as relative costliness to build and maintain¹.

Biogas, which is bioenergy produced from biomass has advantages over the others rewevable energies. These include ease of installation and maintainance, multiple uses (lighting, cooking, heating, generating electricity) in households and industrial set ups. Biogas was first introduced in Tanzania by the Small Industries Development Organization (SIDO). The Center for Agriculture Mechanization and Rural Technology (CAMARTEC) in collaboration with the German Agency for Technical Cooperation (GTZ) took over major responsibility for biogas activities from SIDO in 1983. Sustainable Rural Development (SURUDE) also started promoting biogas in central Tanzania in 1997. Over the years, various improvements have been made in the original design.

¹ http://en.wikipedia.org/wiki/Renewable_energy. Accessed August 2008

1.2 Research question and Objectives

Despite the benefits of biogas and efforts made to disseminate the technology, diffusion has not been impressive. CAMARTEC has trained over 120 entrepreneurs to take up the initiative and install biogas plants to the communities. The trained entrepreneurs are from Tanzania and other African countries. However, it is estimated that, up to 2007, less than 2,873 plants had been installed in the country (Schmitz, 2007). The slow adoption of the technology raises the question as to what hinders wider diffusion in Tanzania.

The research sought to assess prospects for upgrading biogas for the technology to foster energy access to the poor. The idea was to establish what is wrong in the value chain of biogas that hinders wider diffusion of the technology. The overall objective was therefore to explore weaknesses in the biogas value chain that hinder wide dissemination in Tanzania and thereby suggest upgrading measures.

The specific objectives of the value chain analysis were:

- Identifying actors, processes and links in the value chain for biogas
- Examining critical links, strengths and weaknesses among the links as basis for recommending action to improve the value chain for sustainability
- Assessing policy and regulatory framework in terms of their appropriateness for development of the biogas value chain
- Examining the adequacy of the support environment including Business Development Services and Finance along the biogas value chain.

It was envisaged that researching on problems hindering wider production and use of the biogas technology will provide pointers and lessons not just for dissemination of this technology, but also for others facing the same fate and ones yet to be developed. Value chain analysis has been picked due to its holistic way of assessing the marketability of biogas technology from the owner of the technology to the end user.

Actors in the value chain and the associated service providers will get feedback on their relationships with other participants and will make informed decision on how best they can improve and manage ever-changing conditions in the value chain for their social and economic development.

1.3 Framework for Value Chain Mapping

Value chain analysis (VCA) is a commonly used tool used to map out actors, processes, and links in a particular sub-sector and to identify opportunities ties and gaps within it. VCA examines at least three levels of the chain. Level one comprises *market chain actors and their linkages*. These include economic actors or chain players who own a product as it moves from primary producers to final consumers. At this level, we see biogas technology as a product moving from the owner, through different actors to the end users in a value chain. Chain players form a central component in the market chain and its principal competing channels. It encourages map users to become more aware of competitive pressures, functions and processes that are needed along the chain to satisfy more lucrative or reliable markets, and to realize mutual benefits by improving the ‘systemic efficiency’ of the chain.

Level two of the chain is *the business environment*. Actors here include those at macro level responsible for infrastructure, policies, laws, institutions and processes that shape the market system. These actors are also known as influencers. Knowledge about processes, powers and interests that are driving change in this level, enables researchers to understand the trends that are affecting the entire market chain positively and negatively. The knowledge gained here can help to determine avenues and opportunities for realistic action, lobbying and pinpoint areas where policy environment can be improved to enhance functioning of the rest of value chain.

In level three, we have *Business Development Service (BDS) Providers*. These are the business and extension services that support the market-chain’s operation. They are also known as supporters as they are needed to support the functioning of the market chain. Understanding supporters involves identifying particular business needs and their providers within the market chain. BDS may include training, consultancy and advisory services, marketing assistance,

information, technology development and transfer, and business linkage promotion. Operational BDS are those needed for day-to-day operations, such as information and communications, management of accounts, tax records, compliance with labor laws and other regulations. Strategic BDS, on the other hand, are used by an enterprise to address medium and long-term issues in order to improve the performance of the enterprise, its access to markets, and its ability to compete.

1.4 Methodology

The research adopted a holistic approach, combining literature review, interviews with actors across the value chain, observation of processes, a survey of users and descriptive analysis of survey data, etc. The players were categorized in three groups.

The first category consisted of owners of the technology (CAMARTEC), entrepreneurs who buy the technology from CAMARTEC and final users. Users were picked from CAMARTEC list of clients and some were referred to by others. Potential users were picked from the study area. A convenient sample of 46 respondents were picked from among 300 women from Tanga, Kilimanjaro, Manyara and Arusha attending a religious meeting in Arusha during data collection. Focus group discussions were held with four groups of users, two of which were from within the neighborhood of CAMARTEC in Arusha municipality, one from Suji Village in Kilimanjaro region, Suji village and one from Nambala village in Meru District. Some of the families in the focus group discussion have long experience in using biogas, dating back to as far as 1984 providing an opportunity to explore how awareness, delivery and after-sale services were provided and how perceptions of the technology have been evolving over time.

The second category comprised of actors at macro level and their accompanied policies and regulations that support wider dissemination of biogas technology including local government and ministry responsible for energy. An interview guide was prepared and discussions with key informants in these institutions in Arusha, Kilimanjaro and Dar es Salaam (for the ministry).

2. ACTORS AND PROCESSES IN THE BIOGAS VALUE CHAIN

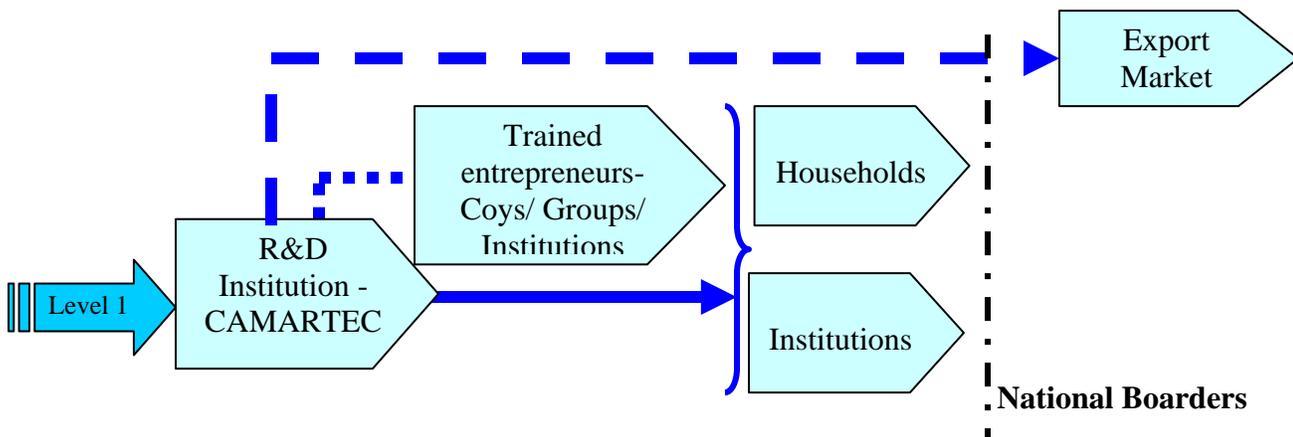
2.1 Introduction

The key findings are organized in the form of main actors and processes in the value chain, by level of actors.

2.2 Actors and Processes in the level-one Biogas Value Chain

The research found out that, biogas technology moves in the market chain to final user in three chains. Figure 1 elaborates these chains.

Figure 1: Level 1- Main Biogas Market Chain Players



Source: Research Findings Adopted from Albu and Alison (2006)

The first chain is from owners of technology, CAMARTEC, direct to the final users. The second chain is from CAMARTEC to trained entrepreneurs. The trained entrepreneurs comprise groups, companies and institutions that accessed the technology from CAMARTEC. From these entrepreneurs, the technology goes to final users, who are households and institutions. The two biogas value chains are mainly within the national boundaries. The third chain crosses national borders from CAMARTEC to international markets of Rwanda, Burundi, Malawi, Sudan, Kenya, Uganda, Zambia and Ethiopia.

Documented data shows that CAMARTEC is the major distributor of biogas technology as compared to its trained entrepreneurs taken individually. This suggests that CAMARTEC rules the current market and practices a managing and coordination power in developing and distribution of the technology. CAMARTEC sets standards according to best practices and monitors the

adherence of the same. Hence CAMARTEC practices legislative governance and not judiciary governance as we do not see any punishment made to poor quality.

The problem of setting standards and monitoring its adherence by the same institution may lead to a situation where tolerance of sub-standard products and laziness be acceptable due to acceptable excuses within the institution. This was observed during the research when users said that when they notice any failure in the biogas plant or appliance, they call a technician from CAMARTEC. They emphasized that one cannot be sure of when this technician will show up because the technicians are always very busy. Different officials from CAMARTEC supported this fact when at different situations they said the budget channeled to CAMARTEC does not allow the institution to provide much of after-sale services. Another reason was that, there are few technicians to adequately service current installed biogas plants. Due to the said problems, the excuses are acceptable for delays in service to the customers.

It is true that government budget are slim, but services like these may be charged and paid for by users. Users admitted that they are not paying for this kind of technical assistance. Here again one finds a marketable service that is provided as a public good.

CAMARTEC is not only entrusted with research and development of technologies, but also has a role of creating awareness among Tanzanian on benefits accrued on using the technology. It was revealed in the research that, the promotion role is not sufficiently done. Insufficient funding from the government was highlighted as a major obstacle for these activities. Talking with, and listening to presentations made by different key informants from CAMARTEC (as listed in the name list), they highlighted this problem as emanating from the mother ministry, the Ministry of Industry and Trade. The ministry does not have a budget for biogas promotion.

To promote the technology using available resources, CAMARTEC therefore opted to three major promotional activities. The activities include participation in Dar es Salaam International Trade Fair (DITF) where all other technologies are exhibited, other zonal exhibitions during Nane-Nane and by using existing biogas users to promote the technology in their neighborhood.

As a matter of fact, these promotion options have major limitations. The majority targeted potential users never visit the DITF or Nane-Nane. Using a neighbor's plant as a model to prompt others to use the technology is not an assured method due to the fact that CAMARTEC do not know for sure where these owners of biogas express their dissatisfaction in the operation of the technology; appliances and spare parts availability; maintenance and other technical support. When these grievances are made to the society of non users, they demoralize any urge of potential users to become users of biogas. If these complaints are not addressed, dissemination becomes difficult.

The institution is also commissioned to develop different prototypes that are tested to suit different consumption needs of different users; sale the prototypes to private entrepreneurs who in turn, install commercially to end users. The research showed that, the current CAMARTEC fixed and concrete dome is an adapted version of the Chinese technology. The later was modified to suit Tanzanian environment and address the issue of durability as needed by final users. However, it was found that CAMARTEC is doing the prototyping and install to end users. This leads to distortion of the market as CAMARTEC is a government institution and full financed, it can not operate in the same level as the entrepreneurs it trains. For the entrepreneurs' businesses to be sustainable, their total cost and profit margin have to be paid by final user while CAMARTEC costs are born by the state.

The research observed that entrepreneurs and CAMARTEC are competing in the designing of appliances like lamps and stoves. They all market and sell the appliances to same final users. This competition is good for the final users as it gives them more choices and ensures availability of appliances in the market. As CAMARTEC, a state owned institution remains in business, it affects a healthy competition.

2.3 Entrepreneurs (Private Sector Biogas Plant Installers)

Entrepreneurs comprise private sector installers of biogas plants. Six entrepreneurs trained by CAMARTEC responded to a survey on biogas initiatives. These entrepreneurs acquired biogas technology for the purpose of making it available to end users either for the aim of making profits, especially for companies or for social wellbeing, in case of groups and religious institutions. Their experiences in this business venture are shared in this section.

Entrepreneurs sell biogas technology to final user by installing plants to their customers. The process involves transportation of materials to the targeted destination. Transporting materials needs money and therefore cost of materials plus transport cost are pegged to the final price to be born by the user. Materials are stored at customer's premises during construction of the plant. Normally a plant can be constructed from one month to two months.

These entrepreneurs have a self quality check during construction. They emphasized that they must adhere to standard otherwise customers will complain. The cost of repairing a broken plant rests wholly on the installer. There is no quality controller outside the two parties and therefore no guarantee is given to the user. The installer is prone for any problem that calls for technical attention with no extra payment from the user. This situation is not healthy to any business. It calls for quality certification authority to assure the quality of a product and bind the two parties on quality of product they have exchanged. The installer can then be able to give time limit in which after-sale service may be provided and after that, cost be covered by the customers.

Although 67% of respondent cited the defect rate to be low, mostly one 1 out of 100, at the same time 33% of them said they have not checked back, this support the issue of free after-sale service. Business that are operating to get profits they find it costly to spend time on things that cannot bring-in money and therefore they install and hardly come back. In this manner they spoil their business reputation and the technology they are trying to disseminate.

On production process, it was revealed that, plant construction takes 1 to 2 months, producing one biogas lamp takes 3 days and gas stove 1.5 days. More detail on production process is needed to

establish productivity in the industry. These figures brings in two thoughts, either the products take that much time or the entrepreneurs do not know how to cost their products.

Either way, if these products take that long to be produced, they will not be competitive in the market because, taking an example of a biogas plant, the selling price must include two-month Labour cost of those involved in the construction process, material, transport, a portion of overhead cost and profit margin. All these added together and lumped to final user as a price for the product it may be very expensive. On the other hand, if these products do not actually use the stipulated time, then still, there is lack of business management skills on costing knowledge.

Entrepreneurs highlighted problems that surround the biogas business. Inside the business, they considered lack of skilled labor, working capital and poor location to hinder their efforts to disseminate biogas technology. They have difficulties to handle customers due to lack of human skills and financial capacity. Outside the business, they cited market problems, bad infrastructure, and poor access to financial assistance, burdensome regulation and lack of business providers.

Entrepreneurs also said that there is no any association of biogas installers; neither there is standard regulation in the firm. These are said to be inter-firm problems that make it difficult for biogas technology to be trusted by its users. Every individual firm commit to the standards acquired or learned but consumers need someone else to certify that the products they buy are actually to the standard. No producer can provide products and services and at the same be a regulator.

As there is no any regulator, the standards and quality check of biogas plants and its appliances has been on the producers' stake. For producers to guarantee quality, they have fixed themselves in a hard yoke of repairing and maintain biogas plants free of charge. It therefore means that, any fault is on the producers fault even when the user is careless. Unless the issue of assured and binding quality is addressed, conducting biogas installation business will be costly to installers and users.

Responding to a question on promotion of biogas technology, entrepreneurs admitted that much has not been done in this area. Many Tanzanians are not aware of this energy source alternative, therefore the market for biogas technology remains slim. They suggested the following to take the lead in promoting biogas technology; Local Government Authority, Community-based Organizations (CBOs), Users and Research and Development Institutions.

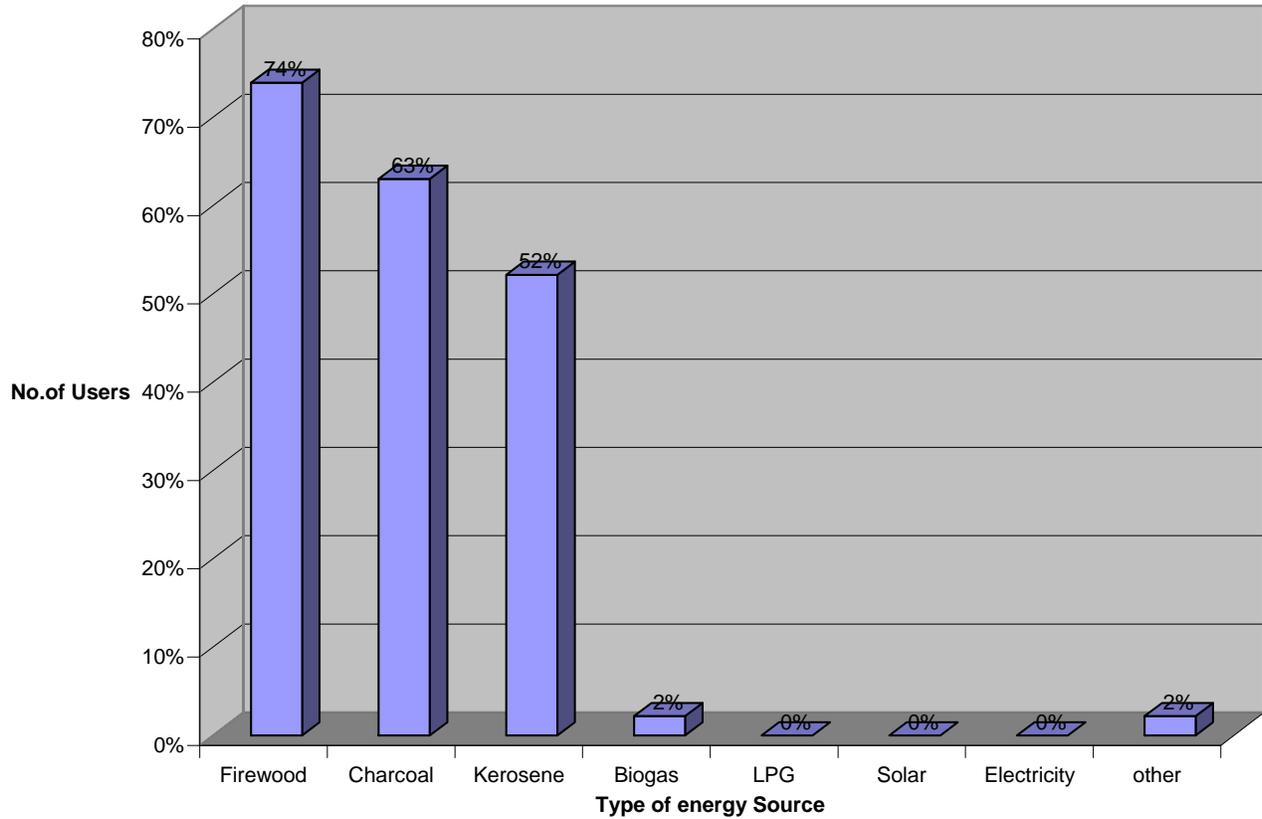
Though these suggestions came up from entrepreneurs, it was observed that, no formal link existed among them (entrepreneurs) and the mentioned parties. Entrepreneurs expect these other actors to promote biogas for them to enjoy an expanded market but they do not look at what role they need to play to make this happen. No evidence of any contractual or any other agreement relation existed among sellers of materials, transporters and even the buyers.

2.4 Users (Households and Institutions)

The following are responses from 46 women respondents representing household owners in rural areas in Kilimanjaro, Manyara and Tanga regions and 5 biogas users from Arusha region. They responded to a survey as follows;

Responding to different kinds of energy sources they know and use, the answers indicated that much was not known on biogas technology. Figure 2 shows in percentage, users of firewood, charcoal, kerosene and others in a descending order from 74, 63, 52, respectively while users of biogas and other (corn cobs, saw dust, dried banana leaves) are 2 percent and none of them uses LPG or solar energy.

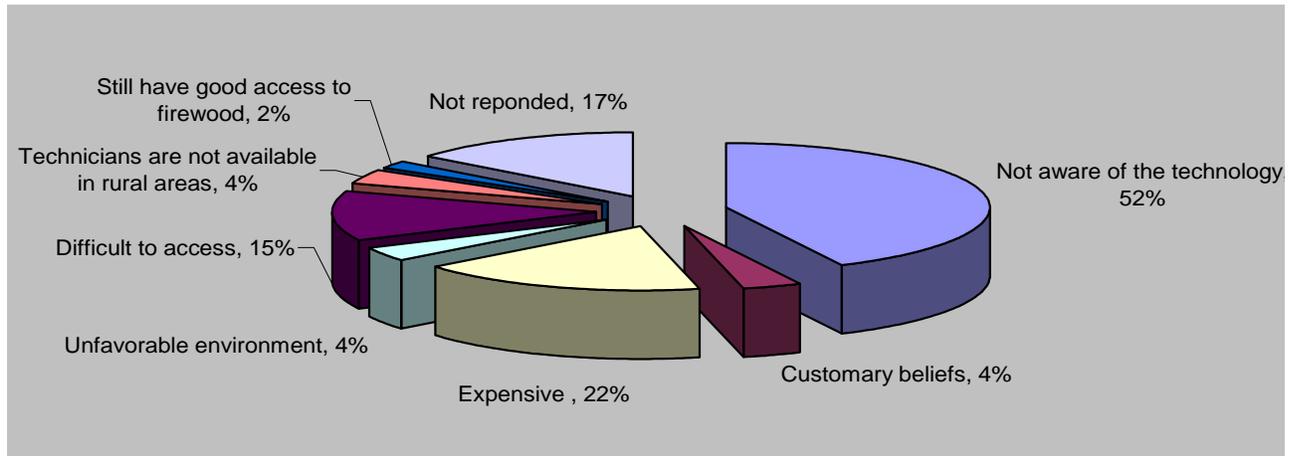
Figure 2: Types of Energy Sources Used



Source: Research Findings

When asked of the reasons that make them not using biogas, the respondents showed that they lack knowledge on this type of energy source by 52% and that the technology is expensive 22%. Responses showed that 17% percent of the interviewees did not respond to this question their reason was that, they didn't know what to say on an unknown. The responses are as shown in Figure 3.

Figure 3: Reasons for not Using Biogas



Source: Research Findings

The results suggest that potential users of this technology lack enough knowledge of the technology.

The users of biogas technology, when responding to a question on where they got information on biogas, all of them said they got information from CAMARTEC. The information disseminated to user mainly by word of mouth and during other technical training at the centre.

Users were not very happy with appliances they are using. They required much improvement to be done for the stove as follows;

- i) bigger burners and cooking pots for institutions
- ii) be adopted to have at least two burners for household
- iii) be improved to rest on a quality steel or aluminum material
- iv) to design and fix a ring around the stove as cooking pots slide out of the cooker when cooking. Especially when cooking mtori and ugali²
- v) be set on higher stand to avoid bending while cooking

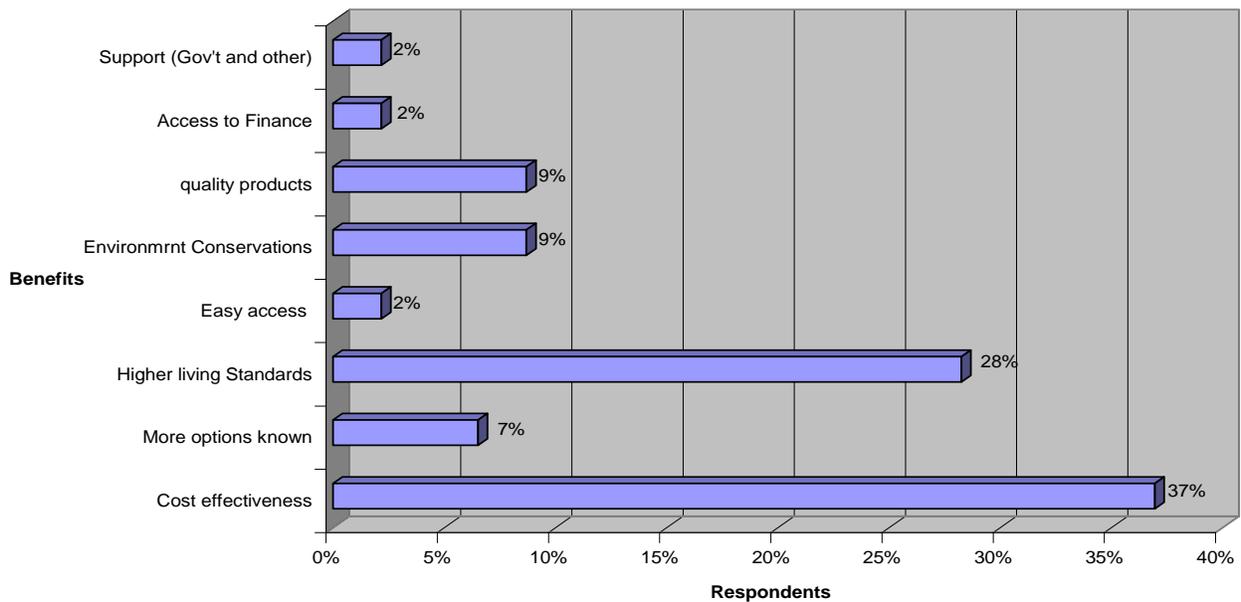
On governance, questions were asked on whether there is a place where one can process her/his grievances on a defected plant or appliance. The answer was “from where you bought the

² Heavy local food stuffs that require stiff stirring

appliance”. It was also revealed that, when there is a defect on an appliance or on the plant, the only place you can get assistance is CARMATEC or from where one got installation services like ELCT and other entrepreneurs.

Responding to importance of promoting biogas, responses showed that the endeavor is important as it will create awareness to more people and many will opt to use this technology. As users increase in number, costs will be shared among many and eventually be manageable for poor households. Figure 4 shows the benefits of promoting biogas as perceived by respondents;

Figure 4: Benefits of Using Biogas

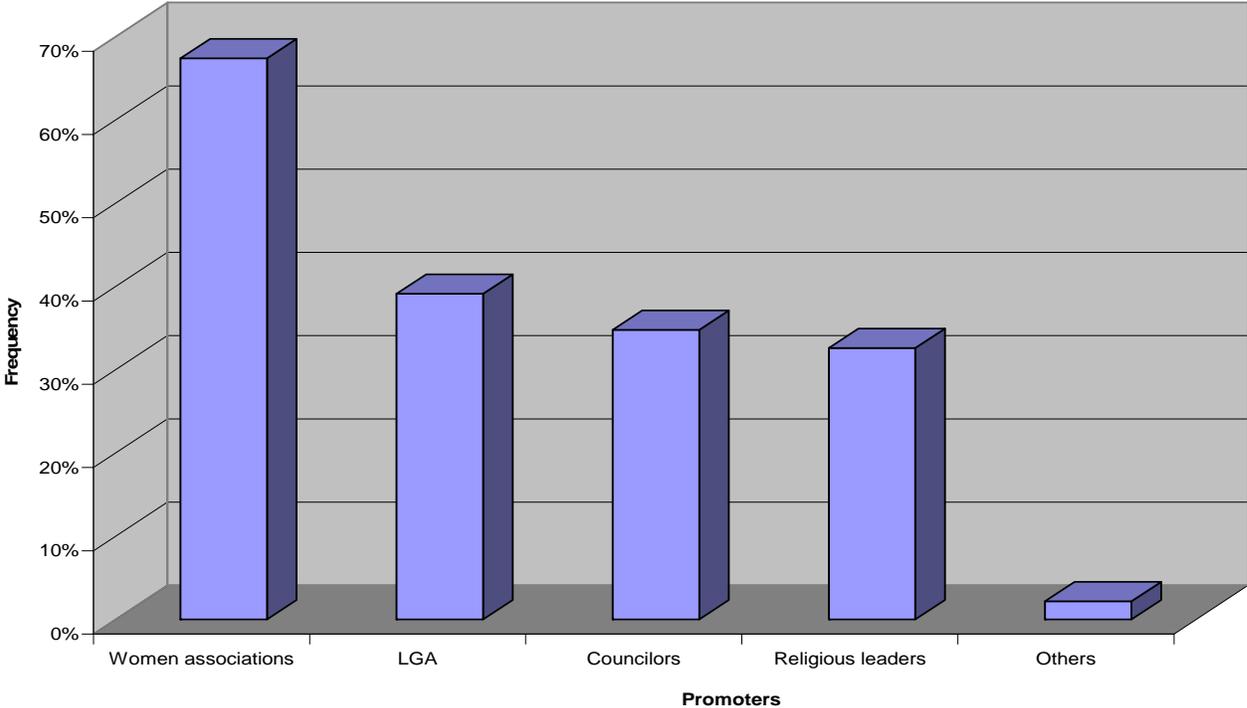


Source: Research Findings

When responding to a question on who they consider to take the role of promoting biogas technology, who they trust to bring the information to them, potential users mentioned Women Associations followed by Local Government Authority, Councilors, Religious leaders, and NGOs. Other stakeholders were independent private technicians, farmers/livestock keepers and Community Based Organizations. This question was asked to get insights on who is trusted by potential users to bring information to them.

Figure 5 shows the stakeholders and how often they were considered important by respondents; the figure shows that household potential users are confident with their own associations. They trust their own bodies to bring in information. Local Authority and councilors are the government charged bodies that ensure community development and these potential users trust them. It was observed during the research that, neither women associations nor the mentioned government bodies promoted biogas technology to potential users in villages.

Figure 5: Suggested Biogas Promoters



Source: Research Findings

2.5 Level 2 Actors: Policy and Regulatory Bodies

At this level, we have actors responsible for Business Environment. Included here are those institutions responsible for policies, regulation, infrastructure and processes that shape the market system. As explained earlier, they are also known as influencers.

Actors identified in this level include the Ministries such as Energy and Minerals (MEM), Industries, Trade and Marketing (MIT) and the Ministry of Livestock Development (MLF). Other actors at this level are regulatory bodies like Energy Water and Utility Regulatory Authority

(EWURA), Tanzania Bureau of Standards (TBS), Local Government Authorities and Developmental Partners. These institutions work hand in hand to make sure that an environment, supportive to business, is created for all players to benefit.

The research revealed the following in this level;

- For the case of biogas, the research revealed that only Livestock Policy stipulates plainly what the government intends to do, to address energy need in the society through biogas initiatives. We neither, don't see in the policy programmes set forth for implementation nor do we have evidence of institutional arrangement and monitoring and evaluation system set to check if the government achieves its intentions. There are nice words but can not translated into actions.
- Regulatory bodies are there to make sure good governance is applied in service provision. They are in place to provide leveled play ground for actors in the market including those in biogas sub sector. Their main focus is to make sure no actor plays monopoly power which creates market failure where new entrants are threatened by a lead firm. This situation affects both enterprises and consumers and finally deprives rights for more choices in the market.

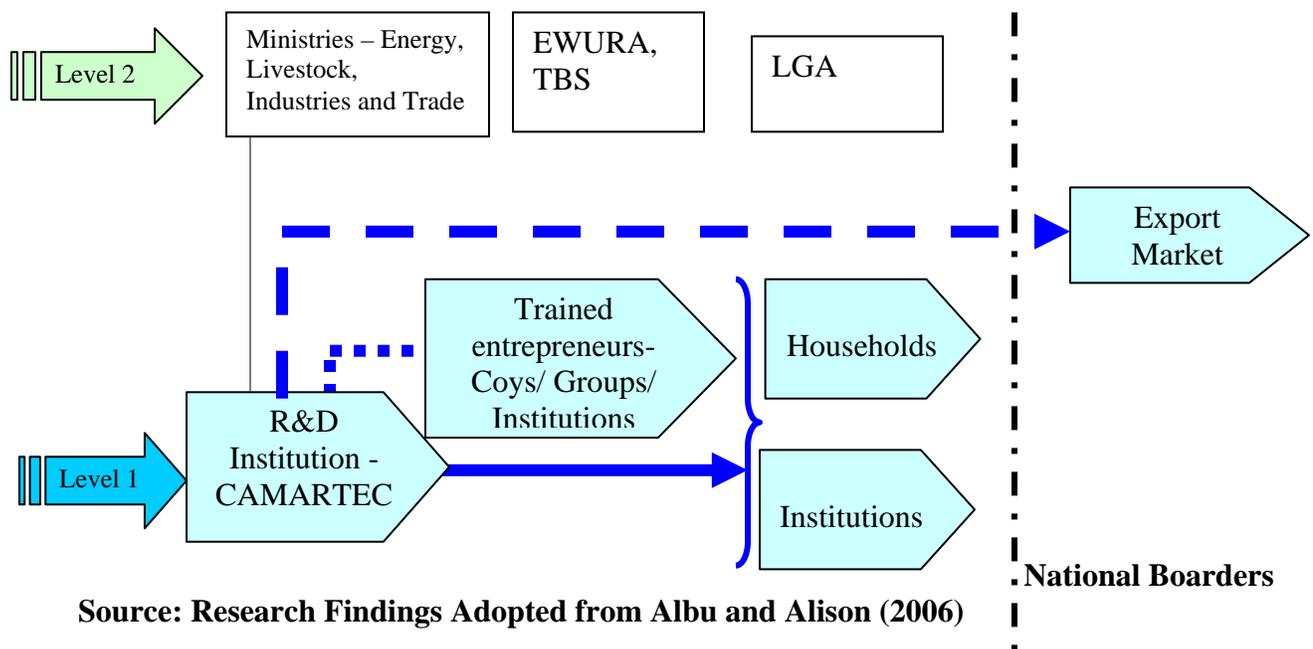
The research revealed that though biogas technology has been operating in Tanzania for more than 30 years (Makungu 2008) no regulatory authority regulates the sub sector. This was evident when users were asked about where they take their grievances about defect/bad quality products. Their answers were "to the one installed the plant or appliance". It was therefore learnt that CAMARTEC has been operating as a monopoly institution and improves design as it wishes, "when they get fund from government" and not promptly as response to customer needs.

It is also observed that, programmes for stakeholder development are there but with no financial resources. The available data says only ten entrepreneurs and institutions have been trained since CAMARTEC started. This is a very small number if biogas is to spread all over Tanzania.

The government as a facilitator of business development services and one responsible for creating awareness on benefits of using biogas has not done its work satisfactorily. This was evident in the

previous section when 52 % of the respondents were not aware of the technology. This fact was also revealed by a focus group at Ilboru. Let alone that this group lives in Arusha where the stronghold of CAMARTEC can be seen and heard, these poor women in the sub urban of Arusha confirmed their unawareness on biogas. It was observed also that staff at CAMARTEC are overwhelmed with too much workload and cannot be able to reach every corner where needs are. The weaknesses manifested at this level need solution for the biogas sub sector to flourish. The Value chain with level two of actors is presented in Figure 6;

Figure 6: Level 2 – Biogas Value Chain with Influencers



Source: Research Findings Adopted from Albu and Alison (2006)

What we find in Figure 6 is only a weak link from ministries to CAMARTEC. Weak link is due to the fact that biogas technology development is only written in policy documents but implementation strategies are missing in the case of ministry of livestock and Fishery. In case of ministry of Industry and Trade which is the host ministry for CAMARTEC, no enough support for biogas initiatives. Currently negotiations are undertaken to decide on whether to continue financing the institution for R&D or drop it off from government patronage (Schmitz 2007).

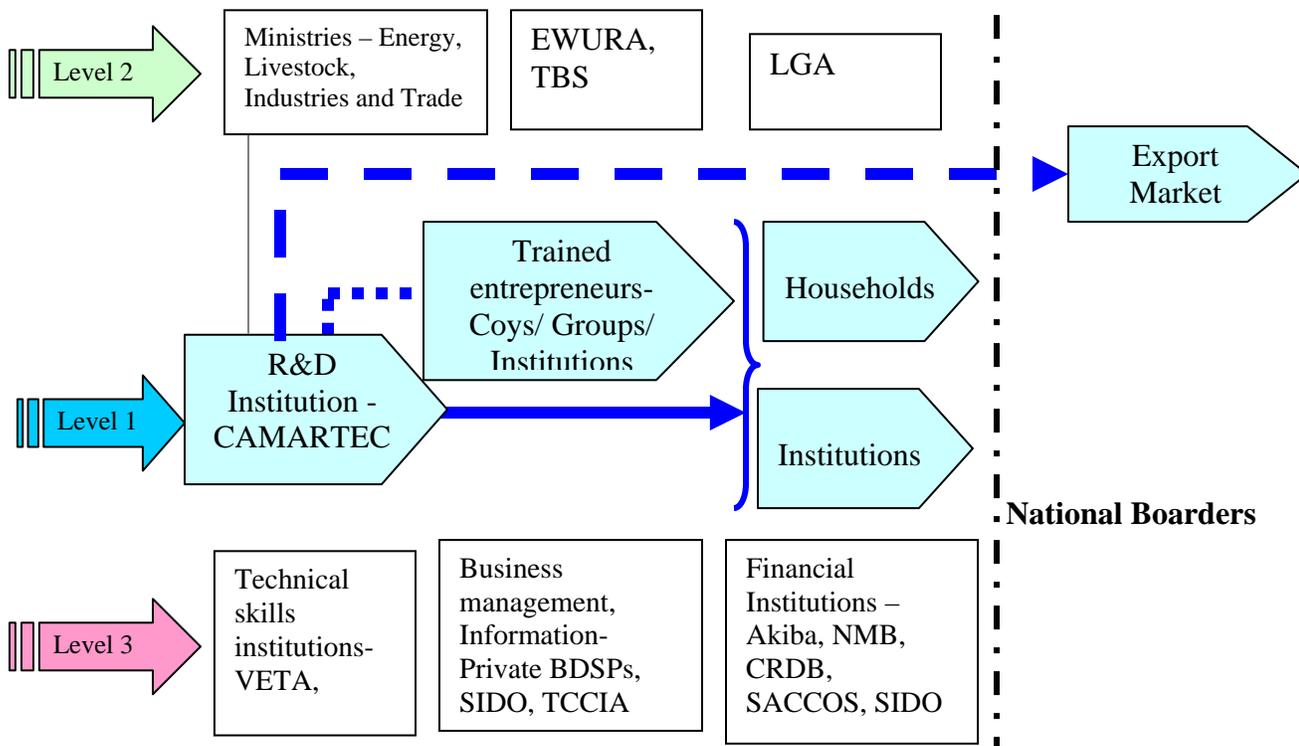
It is hoped that a biogas committee established with an objective of making friendly designs of biogas plants and appliances among others, will come up with good ideas on how to support biogas initiatives at macro level.

2.6 Level Three Actors: Business Service Providers

At this level we have business and extension services that support the market-chain’s operation. As said earlier, these actors are also known as supporters. The research observed negligible or absence of supporters in the biogas sub sector. It was revealed that trained entrepreneurs are supposed to work in level one, to distribute biogas technology to the end user. The revealed fact is, they play both levels; main distributors and support services, in a sense that they are the ones who install biogas plants and provide technical assistance. This was evident when all user respondents said the installers are responsible for technical assistance.

Figure 7 depicts the three-level biogas market chain players.

Figure 7: Level 3 – Biogas Value Chain with Business Service Providers Actors



Source: Research Findings Adopted from Albu and Alison (2006)

It was revealed that, no link existed between actors in level one and business development service providers. CAMARTEC and trained entrepreneurs/technicians are the only providers of the technology and technical services. In their responses to the survey, these actors showed lack of business management skills especially in the area of productivity and marketing.

Entrepreneurs responded to the survey saying they lack network among biogas stakeholders. This poses a barrier to the sub sector development. The stakeholders that make an impact to the development of biogas value chain were mentioned as those providing finance, business training and suppliers of materials. Though the entrepreneurs did not cite the problem of sufficient technician in the market, it was observed that the number of existing technicians is not enough.

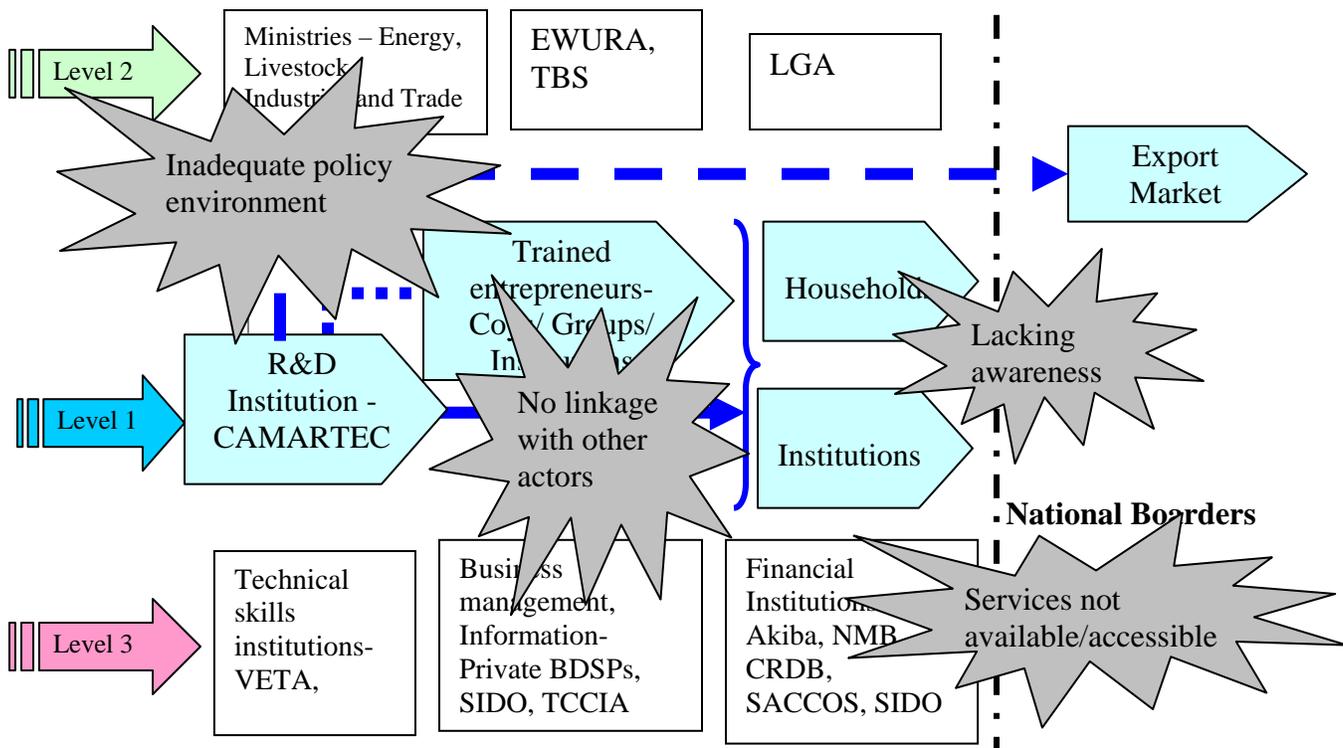
3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

The evidence on how biogas sub sector operate in northern Tanzania presented in this research, is enough to conclude that, biogas value chain has prospects to be upgraded to foster energy access for the poor. The weaknesses or gaps brought forward can be addressed using opportunities available and hence sustainable biogas access to the poor will be attained whilst creating jobs and increasing standard of living of many rural Tanzanians.

The research concludes that a critical factor that hampers the dissemination of the biogas technology is lack of awareness. As users remain unaware of the technology, the market remains slim as revealed in the research. We believe when awareness is addressed adequately, without ignoring other issues revealed here, the market will be stimulated. When biogas becomes a technology of choice to many users, many other problems will be solved through the rules of the market.

Figure 8: Critical Gaps in the Biogas Value Chain



Source: Research Findings Adopted from Albu and Alison (2006)

Figure 8 captures areas where critical gaps were spotted. The figure highlights critical weaknesses at all levels. First in the macro level where policy environment is not adequate for biogas dissemination, second at the micro level where awareness is lacking and hence calling for awareness creation. The last highlighted weakness is in the meso level where the business support services are either not available or can not easily be accessed by entrepreneurs.

It is therefore concluded that, there are possibilities to address the above gaps. Following are recommendations on how the weaknesses can be dealt at the same time harnessing opportunities available.

3.2 Recommendations

The recommendations drawn here are categorized in three levels. In the first category, we have recommendations to the influencers (the macro level) of biogas value chain. Second category recommendations are for the business support actors (meso level) and the last category for the chain players (micro level).

Macro level: central and local government

- i. The government through Ministry of Industry and Trade take up the role of awareness creation for market stimulation is important. Potential users need to know benefits of biogas, understand how to service the biodigesters and know where to get installation services and appliances. This can effectively be done through media campaigns, for example through radio and TV programmes. Radio programmes can be heard by many Tanzanians but to add into that, people need to see, to appreciate the technology, therefore a need for a television programme. These two initiatives will stimulate demand not only in rural areas but also in the urban. The beauty part of a vibrant market is that many entrepreneurs will see the opportunity of investing in provision of biogas and both areas (rural and urban) will be served adequately.
- ii. LGA using its far reaching structure should work with women associations, farmers and livestock associations to promote biogas technology. The community development, livestock and cooperative officers should work together to establish these associations where there are none and strengthen the associations capacity to work together in obtaining funds for biogas plant installation
- iii. It is recommended that the Government should be proactive in setting standards for biodigesters and appliances for the better of both consumers and operators.
- iv. A distinct policy on biogas and associated implementation strategy should be set. A program be designed and implemented through a well designed institutional framework is necessary. Stakeholders including suppliers of materials, transporters, users and specialist institutions need to be developed to be acquainted on the roles they are to play in the implementation. A monitoring and evaluation system has to be in place to make sure that activities implemented bring-in desired outcomes, otherwise corrective measures taken earlier enough to ensure things are on track.

- v. To address the monopoly problem and the market failure, regulatory framework need to be in place. Regulatory framework consisting of instruments that translate policies into implementable effect has to be in place to ensure good business environment. A regulatory framework that will provide clear and equitable rules for entrepreneurs to access the biogas sub sector, clear technical specification and technical guidance and reasonable security condition stipulated. This in turn will lead to having clear rules of the game to provide play ground for operators and a balanced between government, operators and end users of the biogas technology.
- vi. To address the problem of too few technicians the government should give scholarships to VETA and other technical schools, in the short run. As the market becomes vibrant, students will pay the value as demanded by the market.
- vii. CARMARTEC should stick to its role as R&D and be financed well by government because innovation has no market value. It means therefore that, innovation is a public good and it is government's role to sustain it. It should also be remembered that innovation is the basic need for any business to remain competitive.
- viii. A designed programme under LGA can be established to supervise newly installed plants to ensure standards in day-to-day operation of a biogas unit and routine to maintain high gas production and ensure a long life-span of the plant. Its exit strategy must include an introduction to skilled technicians who will later provide the service on cost.

Meso level – business supporters

- i. Biogas entrepreneurs should form installers association. This association is important for discussing and lobbying for issues of importance in developing the biogas sub sector. Issues like standard setting by TBS and EWURA, marketing the technology and the like will be discussed within the association.
- ii. To foster linkages with other actors, the association of entrepreneurs should create biogas technology developmental forum at District level. The forum should include representatives of all stakeholders in the biogas value chain. One of the responsibilities of this forum will be to explore synergies that can be utilized to promote all initiatives

- regarding to development and widespread of biogas among different stakeholders. The forum may be chaired by the District Executive Director and the association a secretary.
- iii. Entrepreneurs need to improve business management and productivity. It is recommended therefore that, biogas entrepreneurs establish linkage with BDS providers to be trained on business management skills. Business management skills will improve their way of making decisions on business matters especially the costing and pricing their products.
 - iv. Training on linkage and network is needed to assist this group to understand the potentialities of cutting down cost by using linkages.
 - v. Entrepreneurs need business management skills. Unfortunately BDS providers are not well known and their services not appreciated to really foster business. It is therefore recommended that, there must be affirmative marketing and advertisement of biogas technical skills, information centers, business management skills, mentoring and other Business development services. This may be done through media, on news paper, radio and television programs
 - vi. Financial support may be organized by the government though LGA, CBOs forming SACCOS and lend capital for members in turn or sourcing money from financial institutions. The use of biogas should show value and benefits accrued so that it will bring sense for any one to borrow and repay back (value for money)
 - vii. Biogas technology in Tanzania needs more innovations for upgrading its value chain. The following are suggested;
 - a) Mass production of biogas in villages. This may involve collection of dung from neighborhood to feed large plants. Any other new source may be innovated for mass production.
 - b) Distribution of biogas in the neighborhood households and business centres in villages to increase time for business in the evening
 - c) Possibility of bottling gas and sell it to villagers and in urban dwellers
- In this manner the gap in this value chain will be stimulated and more business ideas may be created as medium scaled enterprises are able to produce much more biogas and sell to many other buyers not only the household; more technicians will get business in the distribution of gas in the neighborhood, bottling technology will employ some in this

process. Distributors, transporters, wholesalers and retailers of biogas bottles will be found in every corner of the country. As much as it is appropriate to users at village level, it will be accepted with the peri-urban and urban dwellers and will be profitable to work in this field.

3.3 Market Chain Actors

This level comprises different enterprises in the movement of the biogas technology from the owner to the final user.

- i. As users are still few, it has been recommended earlier that the Government create awareness on the benefits of using biogas. At users' level, they need to form users association to support government efforts in awareness creation and to address problems in quality, poor after sale services and cost issues. As they come together, their voices can be heard and so they may be able to address the problem of small number. Group procurement within vicinity can be thought of (versus capability, and high cost)
- ii. The initial cost for installing a biogas plant being one of the problems hindering wider dissemination of biogas technology, users may negotiate innovative payment mechanisms by establishing savings and credit schemes (SACCOs) that will be used by members to collectively procure materials and hence reduce material cost as bulk purchases are cheaper. Transport cost will also be reduced in the same way.
- iii. User Association to form linkages to finance. They may start their own savings and credit scheme, link it to a Micro Finance Institution (MFI) and get a top up for installing members' biogas plants. As they manage this in group they will be able to take turns in installing household plants around a scheduled arrangement.
- iv. User Associations may also think of having a larger plant and connect enterprises at business centers in the village thereby increase their income through selling energy. This will benefit these enterprises as they will be able to work in their farms and get more time to open their shops in the evening due to biogas lighting programme. The government should take part in this programme and channel the so called "SME funds" to support energy production programmes as these have a multiplier effects. The programme benefits the owners of plants, the society around can also generate more income by using own generated biogas rather than

imported kerosene. The environment will be conserved and more time will be set for income generating activities. As biogas can be used to form electricity, farm produce may be processed, added value to it and increase income of a farmer by selling processed goods rather than raw ones.

- v. As it was revealed that some people use firewood because the source is still available, that shows lack of understanding of the negative impact caused by firewood health-wise, drudgery and environmentally. Effects on these harms must be communicated using user-friendly means. Video shows can be used to elaborate these situations. When the negative part is communicated well, then costing of the biogas can be done and be appreciated.

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