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Swedish University of Agricultural Sciences

Department of Economics

The Rapid Rise of Innovation in Green Technology: Biogas Entrepreneurship

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**The Rapid Rise of Innovation in Green Technology:
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Abstract

The development of farm-operated biogas plants in Sweden is increasing. This study investigates the process that firms go through in developing such ventures. The aim is to identify obstacles and opportunities that individual farmers have encountered during the implementation process, and through a comparative analysis find similarities and differences between cases. The overall goal is to increase understanding of the factors that influence farmers' development of farm-based biogas production, and more specifically, explore opportunities for support organizations to contribute to the innovation process.

Findings indicate that the implementation process has changed over time. In early cases, starting twenty years ago, farm entrepreneurs did their own research and traveled abroad to gain knowledge. Even with these efforts, biogas plants were not immediately built because the current technology was not applicable in the Swedish context. As a result, several years went by before Swedish farm entrepreneurs progressed from an initial idea to actual implementation. The analysis suggests that the problems faced in the implementation process mainly arose from a lack of Swedish expertise and knowledge.

More recent cases show that a change has occurred in the market. Swedish support organizations have increased their capabilities and now provide help in the implementation process. However, the expertise offered is predominantly knowledge-based and only contributes in small ways to farmers' practical know-how. As support organizations reach out to biogas entrepreneurs within the field, their most important role is to act as a link between established biogas operations and farmers interested in developing their own ventures.

Sammanfattning

Utvecklingen av landsbygdsbaserad biogasproduktion ökar. Den här studien undersöker den process företag går igenom vid utveckling av en sådan verksamhet. Målet är identifiera hinder och möjligheter de individuella lantbrukarna övervann vid implementeringsprocessen, och genom en jämförande analys hitta likheter och skillnader mellan de olika fallen. Det övergripande målet är att öka förståelse för de faktorer som influerar lantbrukarnas utveckling av lantbruksbaserad biogasproduktion, och mer specifikt, upptäcka möjligheter för supportorganisationer att bidra till innovationsprocessen.

Svaren som påträffades indikerar att implementeringsprocessen har förändrats över tidens gång. I tidigare fall, för tjugo år sedan, fick entreprenörer på landsbygden söka kunskap på egen hand genom att resa utomlands. Trots dessa ansträngningar kunde biogasanläggningar inte byggas omedelbart eftersom den dåvarande teknologin inte kunde appliceras i det svenska sammanhanget. Resultatet av detta bidrog till att flertal år passerade innan svenska entreprenörer kunde fortskrida från idé till faktiskt implementering. Analysen antyder att problemen i implementeringsprocessen härstammade från brist av svensk expertis och kunskap.

Nyare fall visar att en förändring har skett på marknaden. Svenska supportorganisationer har ökad sin förmåga och kan nu tillhandahålla hjälp i implementeringsprocessen. Dock, är den erbjudna expertisen dominant kunskapsbaserad och bidrar endast lite till lantbrukarnas praktiska kunnande. Allteftersom supportorganisationer involverar sig med entreprenörer inom biogas, är deras viktigaste roll att agera som en länk mellan ägare av en biogasproduktion och lantbrukare som är intresserade av att utveckla sin egen.

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1. Introduction

The rapid change in oil price has been experienced throughout the world (www, stat, 2011). Its affects have rippled down to Sweden. Companies, both small and large face the issue of increasing prices and are looking for ways to minimize their energy costs. This change has influenced them to take action and search for options such as water-, wind-, solar- and bio energy, also known as alternative energies. Sweden's natural assets provide great potential when it comes to exploring and using these energies. In 2007, Sweden had more than 90,000 companies with a turnover between 0,5 and 10 million SEK, 75 of whom where producers of either wind-, water-, sun-, or bio energy (Statens energimyndighet, 2009).

Bio energy is any energy produced from biomasses and accounts for about 23 percent of Sweden's energy production (Energimyndigheten, 2011). It is a growing market and has increased by 31,5 percent since 2004. Today almost 90 percent of all bio energy produced comes from forestry. In comparison, the Swedish Board of Agriculture has stated that farming stands for as little as two percent of Sweden's total bio energy production (www, jvs, 2012). The potential however has been cited as being much larger, and policy initiatives have been set in order to increase production. This all indicates that the production and use of bio energy within rural firms in Sweden is an up-and-coming industry with strong developmental roots.

1.1 Problem Background

Rural firms consume energy on a daily basis, and as a result, they also face the same issue with increasing costs for inputs. As a result, farmers too are looking for alternatives. Studies have shown that a rural firm creates a good environment well suited for bio energy production (www, svj, 2011). Nääs (2010) claims that; the agricultural sector stands for 76 percent of the total biogas potential in Sweden but only one percent is currently being produced in farm-operated plants. In addition to this, Swedish agriculture advisors have suggested lucrative economic benefits for those farmers who build a farm-operated plant (Jobacker & Johansson, 2009). Furthermore, Pålsson et al. (2010) states that biogas is the best bio fuel in comparison to other bio energy fuels in relation to its climate influence and should be explored further.

The Swedish Board of Agriculture created a biogas investment support¹ in 2009 worth 100 million SEK (www, sjv, 2011). Agricultural business owners have embraced this support and its creation has led to amplified interest in farm-operated biogas plants. Accordingly, the number of biogas plants has tripled since then. However, only about 25 farm-operated biogas plants are presently in use in Sweden (Eliasson, 2011). This indicates a need for a broader understanding of the problems the rural firm owners face when wanting to develop biogas production.

If biogas has been claimed to be the best bio energy alternative on the market and the agricultural sector stands for 76 percent of the total biogas potential, why is only one percent being produced? With its positive influence on the individual farmer as well as society, is it

¹ An investment support created to support manure based biogas production for farmers and small agricultural businesses (www, länsstyrelsen, 2011).

not important to understand why we are so far off its full potential? In order to answer what society can do, there is a need to look at the individual farmer. There, it can be identified what needs to be done. In this early stage of biogas' lifecycle, the 25 adopters can easily be recognized and must be accounted for as an important group. To establish where the actual issues and obstacles occur, we can only interview those who have gone through the implementation process to get answers. This raises questions surrounding the process from idea to actual implementation, such as the individual farmer's decision process and what it looks like. What else needs to be done to motivate the farmer to proceed from just an idea to actual implementation? By asking these questions to those who already have progressed, obstacles can be identified and perhaps later eliminated in the future. By doing so individuals and society can reap the benefits.

1.2 Problem Formulation

The introduction has introduced several questions within the general topic of farm-based biogas production. In order to begin to address these questions and establish an understanding for further research and reports the problem formulation was narrowed down as followed:

- 1. What are the success factors and challenges when developing biogas production in a rural firm?*
- 2. When identified, what are the supporting advocates' contributions for successful implementation?*

As mentioned above. This report is an initial study, and it is supposed to be used as a foundation for students, professors and organizations who would like to do further research. There are still areas that have not been included but are equally important.

1.3 Aim and Research Questions

As the problem formulation states: the aim for this report is to identify the success factors and challenges farmers endure when developing biogas production.

The most important applicable research questions are:

1. Do farmers get the support needed to facilitate implementation?
2. What are the significant obstacles farmers face in the development process from original idea to finished result?
3. Has the implementation process changed from the time the farmers decided to adopt compared to today?

1.4 Delimitations

The study is based on four rural farms located in southern Sweden. Their personal experiences and reflections from idea to actual implementation are the foundation of this study. As the problem background states; this study's focus has been on farmers who already have developed biogas production. Therefore, no consideration has been given to farmers that have shown interest but have decided not to implement. This might be interpreted as contradictory; however, it is hard if not impossible to get answers to why someone makes a decision. In addition to this, it is not certain whether the answers given may have anything to do with the

actual biogas development. On the other hand, interviews with organizations and support agencies have taken place but are not included. However, there will be an assumption about their characters such as:

- All organizations that promote biogas are considered to be change organizations.

Though, the effects of eventual differences in expertise and knowledge between change organizations and their agents have not been included in this study.

The adopters (rural farm owners) have also been subject to limitations, these are:

- The technical skill of the adopter was of no importance for the implementation and did not affect the time it took to go from idea to completion.
- The adopters are considered to be risk neutral.

1.5 Outline

Following this introductory chapter, where the background and problem have been presented, chapter two establishes a frame of reference. This chapter includes theories that will be used and applied to the problem formulation presented in chapter one. The theories range from definition of an innovation followed by its diffusion process. An entrepreneurial point of view on the topic then closes out the last section. Chapter three incorporates chosen methods for this study with justifications of selected approaches. Merits and limitations of each method are also discussed. As the study is based on interviews, chapter four presents the empirical findings. The observations from previous chapter are analyzed with chosen theories in chapter five. Chapter six features conclusions of this study and are later discussed in chapter seven.

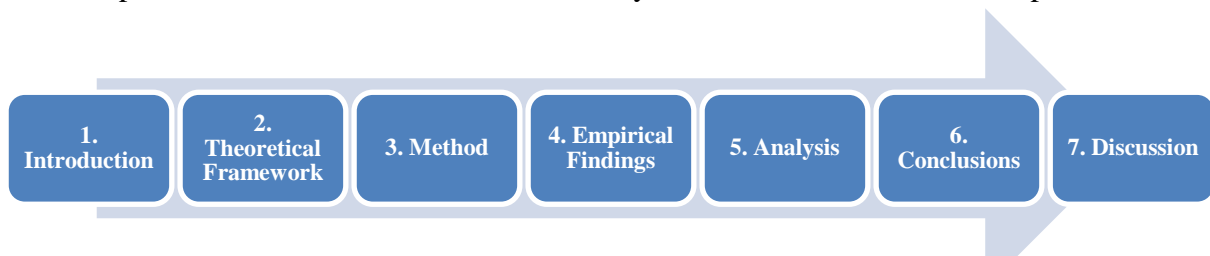


Figure 1 Visual outline

Hilm, 2011

2. Theoretical Framework

This chapter provides the reader with the theoretical frame that is used to analyze and answer the research questions. The first section will explain what an innovation is, its diffusion, and important characteristics for it to occur. This is followed by a subchapter presenting different characteristics of entrepreneurs.

2.1 Innovation, Definition and its Consequences

An innovation is an idea, practice or object that is perceived as new by an individual or unit (Rogers, 2003). Whether the idea is new or not, as long as it is being received as new by the individual or unit, it is considered an innovation. Consequently, as long as the information contains new information, it is perceived as an innovation. When exposed to an innovation, the individual is pushed into a state of mind where uncertainty of the idea, project or object is evident: The innovation offers a new alternative but it is unclear whether it is technically superior or inferior to earlier solutions. Also, the individual usually cannot say beforehand how the innovation will perform economically, which adds to uncertainty.

2.2 Diffusion of Innovation

Communication is a process where individuals create and share information with each other in order to reach a phase of understanding (Rogers, 2003). To take it a step further, diffusion is the process in which an innovation is communicated and spread through specific channels between members of a social system. It is different from other communications in the sense that the conversations refer to a new idea.

The diffusion process takes time, which can stall a new idea or process (Rogers, 2003). Several years can pass before an innovation becomes accepted and used. Thus, the innovation process is a social, dynamic development where the main driving function is learning. It is a social interaction between individuals and units (Lundvall, 1992).

2.2.1 Communication Channels and Networks

Communication channels and networks are important for individuals or groups interaction with each other (Rogers, 2003). These channels can be utilized in favor of spreading a message or in this case new technology (innovation). Communication networks are defined as interconnected individuals who are linked by patterned flows of information. In other words, communication is an interactive process where two people can share information and either move toward (or apart) from each other. This implies that when new ideas, projects and processes are being implemented or rejected, they are usually accompanied by a social change (Rogers, 2003 & Lundvall, 1992).

In present day, mass media is the most rapid and efficient channel in terms of creating an audience and adopters (Rogers, 2003). It ranges from newspapers/magazines, radio and television. Furthermore, interactive communication like Internet that has grown rapidly in the last few years and become an important communication tool for individuals and companies.

In comparison to mass media, which is focused asynchronous communication towards large audiences, interpersonal channels involve two or more individuals interacting face-to-face

(Rogers, 2003). Some individuals seek information and communicate with organizations specialized within the field. This will be further addressed below.

Lundvall (1992) determined two different kinds of networks: trade and knowledge. The trade network is the link between producers and users of traded goods and services. By contrast, the knowledge network focuses on the flow and exchange of information. Two different types of personal networks are also worth mentioning: interlocking and radial. The interlocking personal network consists of a group of people who all interact with each other (Rogers, 2003). On the other hand, the radial personal network is a set of people who are connected through a principal but do not interact with each other.

Another aspect to take into account is that one of the most significant issues in the diffusion of innovations is that individuals participating in the information flow are to some degree heterogenic (Rogers, 2003). Rogers also claims that in the diffusion of innovations, there should preferably be heterogeneity in respect to the innovation but homogeneity in social status and education. Essentially, the process is facilitated when the individuals involved are more like-minded but can contribute with different information, as high degrees of heterogeneity among individuals can lead to communication problems among the members of the group.

2.2.2 The Change Organization and its Agents

The change organizations and their employees (often called *change agents*) possess specific skills and knowledge that potential adopters of an innovation lack (Rogers, 2003). To be more specific, a change agent is an employee who influences the decision maker's innovation choice to become more favorable to the agent's way. As an employee, a change agent provides a communication link between resources, expertise and client system. One role of many is to make the distribution of an innovation to adopters easier. In order to be successful, feedback is needed on a continuous basis in order to meet clients' expectations. They also need to understand the client's individual need so that they can provide them with personal information regarding their situation.

The change agent's aims and goals are as follows:

1. Develop a need for change
 - Point out new ideas and create new needs for the client.
2. Establish an information exchange relationship
 - Build a relationship with the client after the relationship is established.
3. Diagnose problems
 - Evaluate and analyze malfunctioning segments.
4. Create an intent to change in the client
 - Attempts to motivate the client's interests (in this case the innovation).
5. Translate an intent to action
 - Seeks to influence the client's behavior in accordance to his/her needs. In this stage the change agents spend most of the timework with opinion leaders to make a collective difference. (The opinion leader's role will be discussed in section 2.3.1 *Different categories of adopters*).

6. Stabilize adoption and prevent discontinuance
 - Reinforcing the adopter and freeze the new behavior.
7. Achieve a terminal relationship
 - Agents want to eventually develop an independent, self sustaining behavior for clients. The intention is for the adopter to become a change agent of his own (Rogers, 2003).

A Common critique of the change agent is that he/she usually follows a path from least resistance to most resistance when interacting with individuals (Rogers, 2003). Another common complaint is that agents act like mass media with focus on knowledge about the innovation and not the usage of it.

2.2.3 The Diffusion Process

Diffusion can be defined as:

1. An innovation that is...
2. communicated through certain channels...
3. over time...
4. among the members of a social system (Rogers, 2003).

The definition of a social system is a set of corresponding units that are engaged to solve a problem for a common goal (Rogers, 2003). All members of the unit work together and seek a solution for the common problem to be solved. Its structure, leaders and norms affects the diffusion. Furthermore, Rogers also identifies four dimensions in the diffusion process. The process consists of (1) an innovation, (2) an individual or unit of who has the knowledge/experience of using the innovation, (3) another individual or unit who lacks the experience/knowledge of usage of the innovation, (4) a communication channel to connect the two.

The innovation-decision process is an information-seeking and information-processing method which eventually leads the individual to a decision (Rogers, 2003). A technological innovation can offer benefits to the adopter, but the advantages are not always obvious. In addition uncertainty in the early stages will always be evident as, the innovation's effectiveness is not yet clear.

Rogers (2003) explains the different rates of adoption with five crucial elements:

1. Relative advantages:
 - Economic terms
 - Social status
 - Convenience
2. Compatibility, in accordance to:
 - Existing values
 - Past experience
 - The needs of the adopter
3. Complexity

4. Trialability in regards to:
 - What degree the innovation can be tested on a limited basis
5. Observability, meaning:
 - Are the results of the implementation visible to others?

Innovations that retain favorable characteristics on all five elements are more likely to be adopted and diffused at a faster rate than if they had not (Rogers, 2003).

2.3 The Innovation-Decision Process

Research has shown the individual is relatively passive when being exposed to an innovation decision (Rogers, 2003). This is confirmed by people who are not actively seeking new information. Instead they might stumble upon the innovation by accident. Also, individuals tend to be exposed to ideas that go hand in hand with their interests and needs. Need in this case is when the individuals reach a point of dissatisfaction and something must be done to improve the situation. A need can also rise when a person becomes aware of an innovation. Change agents, for example, can create needs for their client when introducing them to existing solutions, as discussed above.

Some researchers claim it is not until we need an innovation that we expose ourselves to it (Rogers, 2003). This phenomenon is called selective perception, and is defined as the tendency to interpret communication messages, in terms of the individual's existing attitudes and beliefs. When the individual gains initial knowledge of an innovation, he/she forms an attitude towards it then makes a decision to adopt or reject. In turn, the individual then look for confirmation of his/hers decision. This is a procedure that consists of several choices or actions, and it originates from the uncertainty it creates. This progression, the innovation-decision process consists of five stages: (1) knowledge, (2) persuasion, (3) decision, (4) implementation and (5) confirmation. It contains information-seeking and information processing and leads the individual to a decision to adopt or reject.

Lundvall (1992), states that knowledge arising through learning is the most important element in a decision process. Knowledge is defined as the point when an individual is exposed to a new idea or method and learns how it functions (Rogers, 2003). As previously mentioned, mass media can play a significant role in this stage by reaching a substantial audience. Later on, in the persuasion stage, the individual attempts to understand the innovation's consequences, learning about its advantages and disadvantages. During this process, the individual begins to create a favorable or unfavorable attitude toward the innovation. He/she actively seeks more information and decides which sources to believe in. Interpersonal communication is most likely to be used in this stage given that the individual look for information from people they trust.

The decision stage begins when one engages in activities that will lead to adaptation or rejection (Rogers, 2003). Some decision makers decide to have a test run if it is possible. Other innovations though cannot be tested beforehand and must therefore be adopted or rejected with greater uncertainty. It is no surprise that innovations that can be tested are usually diffused faster than innovations that cannot.

Implementation means that the individual put an innovation into use (Rogers, 2003). When a positive decision has been made implementation commonly happens right after but can be postponed due to regulations and availability. Last step the confirmation stage manifests when one seeks reinforcement for the final decision.

The time it takes an individual to go through all these five steps is called the innovation-decision period (Rogers, 2003). It can be from one hour up to several years long to go through depending on the decision maker.

2.3.1 Different Categories of Adopters

Rogers (2003) defines five different adopter categories that refer to the period of time it takes for an individual to adopt an innovation. First off are the (1) innovators, who are constantly seeking new information through mass media. The innovator's interpersonal channels are extensive and he/she is more willing than others to cope with uncertainty. Second are (2) early adopters. In this group we have opinion leaders who are individuals possessing an ability to influence other people. They have earned this position by their extensive technological knowledge and/or social status. An opinion leader is characterized by extensive exposure to mass media, frequent contact with change agents and participation in social gatherings. As a result of these characteristics, the early adopters have the most influence over the diffusion of the innovation and the adoption speed. The third group consists of (3) the early majority, who is the first half of the majority of adopters and play the role as a link between interpersonal networks. The members of the fourth group, (4) the late majority, do not rely on media channels for information. Instead they learn new ideas from interpersonal channels but stay skeptical throughout the process. The last group consists of (5) the laggards. They usually stay reluctant to change and are also the last group to adopt once they have seen the benefits of the innovation.

2.4 Entrepreneurship

Fagerson & Skogh (2011) point out that a business owner who stands behind a new way of thinking while implementing fresh creative ideas for his/her business and the market – engaging in what above has been called an innovation process – can be considered to be an entrepreneur. The concept of entrepreneurship, however, is not simple and warrants some discussion if it is to contribute to our understanding of innovation.

Westhead, et al. (2005) states that there is a considerable difference between first-time and experienced entrepreneurs, and point out three different groups: novice, serial and portfolio entrepreneur. The novice entrepreneur has no earlier experience in developing a new branch or business. The serial and portfolio entrepreneurs however have in common that they both have prior experience in starting a new business and in business development. They differ, however, in that a serial entrepreneur is a former business owner whereas the portfolio entrepreneur is involved in multiple businesses at the same time.

Moreover, in a study of farm-based businesses, Carter (1998) remarks that there are three different groups of entrepreneurs when considering the development of new ventures within existing businesses: the monoactive producer, the structural diversifier and finally the portfolio owner. First, the monoactive producer who is focused on having their business based

on traditional farming activities. Next, the structural diversifier also called the farmer-entrepreneur takes a step further and does not mind including non-traditional farming undertakings. Lastly, the portfolio owner owns more than one business outside of the rural firm and it is not necessarily within the same field.

Alsos et al. (2003) argues that there are three types of multiple venture farm entrepreneurs: the pluriactive farmer, the resource-exploiting entrepreneur and the portfolio entrepreneur. They are distinguished by their incentives to develop a new business. The first mentioned, the pluriactive farmer, develops new ventures so that his/her main business is cultivated (in this case farming). The resource-exploiting entrepreneur on the other hand looks for opportunities to use the farm's resources in a more efficient way. The third type, the portfolio owner, maintains a strong entrepreneurial drive from the overall satisfaction derived from the initial idea to the developed sustainable business. In the study, Alsos et al. noticed that farmers tended to show a combination of these different groups.

When discussing the reasons behind the development efforts of farmer entrepreneurs, Ferguson & Olofsson, 2010 note existence of push and pull entrepreneurs. The distinction is based on the source of the incentive for the individual to decide to develop a new venture. A common pattern is that the push entrepreneur, who acts out of dissatisfaction, responds reactive while the pull entrepreneur acts proactive. The pull entrepreneurs undertake change efforts because of dissatisfaction with his current situation while the push entrepreneur acts because he wants to pursue an opportunity. Consequently, depending on the incentives of the entrepreneur, an innovation decision can be stalled if a point of dissatisfaction is reached.

2.5 Summary

This chapter began with a definition of what an innovation is and its communication channels. We clarified that as long as something is being perceived as new it can be considered to be an innovation. Mentioned additionally was that in order for an innovation to occur it had to be diffused in some sort of communication channel or network like mass media or interpersonal channels. The overall diffusion process was defined as: an innovation that is communicated through certain channels over time among the members of a social system. The communication channels and the definition of the diffusion were important to discuss in order to understand the fundamental advantages and obstacles it is subject to.

We continued with an explanation of change organizations, their employees and the role they have in the diffusion process:

1. Develop a need for change
2. Establish an information exchange relationship
3. Diagnose problems
4. Create an intent to change in the client
5. Translate an intent to action
6. Stabilize adoption and prevent discontinuance
7. Achieve a terminal relationship (Rogers, 2003).

Rogers (2003) further explained the different rates of adoptions with five different requirements that should be met for a fast diffusion. These were:

1. Relative advantages
2. Compatibility
3. Complexity
4. Trialability
5. Observability (Rogers, 2003).

After looking at the overall picture followed by the organizational point of view, we continued on to the individual angle. The innovation-decision process explained the different stages the decision maker faces when in a decision situation.

1. Knowledge
2. Persuasion
3. Decision
4. Implementation
5. Confirmation (Rogers, 2003).

Roger's (2003) theory was used to distinguish different types of adopters which will be important to keep in mind later on in this report. There were five different categories:

1. Innovators
2. Early adopters
3. Early majority
4. Late majority
5. Laggards (Rogers, 2003).

The chapter ended with a section about entrepreneurship and contained a bundle of different classifications of an entrepreneur. Westhead (2005) identified three entrepreneur groups who differed in their previous and current experience in starting a business. These were:

1. The novice entrepreneur
2. The serial entrepreneur
3. The portfolio entrepreneur

Carter (1998) pointed out three groups of entrepreneurs when considering development of a new venture within the already existing business. These were:

1. The monoactive producer
2. The structural diversifier
3. The portfolio owner

The first group mentioned stayed true to traditional farming undertakings whereas the other two others did not mind branching out and include non-traditional farming activities. However, they differed in the sense that the portfolio owner owned more than one business outside the main field.

The theory chapter continued with Alsos et al. (2003) and described three types of multiple venture farm entrepreneurs:

1. The pluriactive farmer
2. The resource-exploiting entrepreneur
3. The portfolio entrepreneur

The first one mentioned developed new ventures so that he/she could continue with his/her main business. The resource-exploiting entrepreneur looked for opportunities to use his/hers farm's resources in a more efficient way. Lastly, the portfolio owner was driven by a strong entrepreneurial drive and the satisfaction change created. It was discovered that farmers usually showed a combination of these groups.

We ended this section with Ferguson & Olofsson (2010) who pointed out the pull and push entrepreneur. They differed in their incentives to develop a new business. The push entrepreneur had a reactive approach in contrast to the pull entrepreneur who acted proactive.

3. Method

This report is based on inductive qualitative semi-structured interviews with four rural firms that have developed biogas production. Interviews facilitate the understanding of complex problem formulations and provide the interviewer with a deeper comprehension (Sallnäs, 2008). Room is also given for additional questions which increase reliability and validity. By using an inductive approach, cases can be more thoroughly explored for empirical findings that can contribute to established theory. Accordingly, this method was chosen as the best way to proceed with this study. Qualitative approaches usually focus on an open empirical research focused on the interview object and not the interviewer (Alvesson & Sköldberg, 2008). Consequently it is important to mention that the interview and answers can be interpreted in several different ways depending on the interviewer.

The main focus for the questions has been based on the chosen farmers' experience when building their biogas facility such as process along with personal reflections. The main questions can be found in appendix. Though, follow-up and clarification questions have not been included.

In this study it has been essential to find individuals with different backgrounds and experience in order to facilitate the answer of the chosen problem formulation. Correspondences with different support organizations and agents have taken place but will not be presented in this report. This was made to determine initial understanding and knowledge for independent work later on. While reading, it is important to keep in mind that most owners of a rural firm with a biogas plant, in Sweden, are considered to be pioneers within the field. However, this does not change the fact that there can be differences among them, as the theories provided in this study have shown. To further understand the issues it was out of interest to investigate whether the interviewed firms received the support they needed and from what sources (if any) it came from. The interviews conducted provided an initial understanding of obstacles that came with this process. The findings can be crucial for individuals and organizations that are active within this field. They may also raise additional questions for further research.

It is important to mention that the choice of interview subjects was made solely based on their geographical location. The reader must therefore keep in mind that the group of four is not intended to represent all Swedish firms. Information regarding the farms' location was provided by the Swedish Board of Agriculture's website. Despite localization, efforts were made to ensure the interview subjects were situated relatively close to each other. This significantly reduced overall travel time. When identified additional research was made so that initial contact could be made. Phone numbers and email addresses were found online. Despite this, no further research was made regarding the farmers' business.

The interviews for the empirical findings took place in the timeframe of October and November 2011. The full interviews were voice recorded and hand written. Individual case reports were sent to the interviewed firms for confirmation. As a result, all data that are presented in the empirical findings have been read and approved for usage by the interviewees.

4. Empirical Findings

This chapter presents four interviews with owners of a rural firm with a farm-operated biogas plant. The first paragraph in each section declares the farmers' aims and goals for their respective businesses. This allows the reader to easily comprehend the main reason and incentive for the companies' existences. This is followed by a short background of the business and then the owner's story from initial idea to implementation.

4.1 Farm Bravo

Improving business conditions and having employees are the main objectives for Farm Bravo. As the owners strive to increase profit they still consider time off work to be more important. As result they educate their employees and make sure to give all support needed in case they need to leave the responsibility in the hands of their staff members.

4.1.1 Bravo's Background

Farm Bravo's owners live with their four kids in the south middle of Sweden that consists of 207 hectares of forest, 185 hectares of farm (140 is currently leased), and 80 hectares of pasture land. Mr. Bravo took over the farm in 1989 together with his two brothers who later decided to leave the business in 1996. Since then the Bravo couple has been running the farm by themselves and the business has grown into a high technological industry and by that increased production from 52 to 170 dairy cows. Currently, Bravo has four employees (one of them works halftime). In summary, their main operation consists of the 170 dairy cows along with recruitment and sale of young bulls.

Mr. Bravo is a third generation owner. He has no prior university education or knowledge from running a business except from skills he has obtained from personal experience and work. Mrs. Bravo on the other hand has a university degree nonrelated to agriculture but has obtained farming skills from growing up on a farm. She is as of now a full-time employee on the farm.

Bravo has been undertaking more changes to the farm than just increasing the number of dairy cows since the overtaking in 1989. For example, in 2000, Bravo built two robot milking machines. Through this they were able to employ two full-time workers and create a better working environment for themselves and their employees.

4.1.2 Bravo's Biogas, from Idea to Implementation

In 2005, Bravo participated in a meeting hosted by a nationwide agriculture focused organization, to increase their knowledge regarding farm-operated biogas plants. Bravo already knew that they had the necessary conditions, but back then building a biogas plant would not be profitable. It was not until 2010 when Bravo decided they had a good chance of acquiring investment support for building a facility that would continue their idea. During the information gathering period, Bravo used the Internet to look for companies that could provide them with the help they needed. Help in this case refers to aid with calculation, investment support application, power connection and so forth. After some research, Bravo decided to hire a small-sized Swedish company in the surrounding area that focused on this type of construction and expertise.

The original plan was to have the plant up and running with full capacity in June 2011. However, by October 2011 the facility was still not operating at full speed because of issues with the original pipe installment. At this point they were in a phase where the hired company of the product blamed their supplier (another Swedish company) and Bravo on the other hand blamed the hired company.

During this process Bravo has made attempts to contact another business owner close by who is currently in the same position as they without successful results. Farm Bravo has also reached out to a different company specialized in piping with the intention of learning more about their own issue.

Despite the problems that they have encountered, Bravo trusts their agent and support organizations. In fact, Swedish support organization offered them help in the form of a knowledge group and they accepted. Their experience will be put together with other farms so that their story can be of use for future adopters.

In Farm Bravo's experience, the installation seems to have caused the owners most problem. This was accompanied by issues with their chosen power company and the communication between them. In addition, as the process slowed down, Mr. Bravo found it hard to make time for other daily commitments. However, on the contrary, the non-problematic aspects were identified as the digging and communication between the Bravo's and their bank

4.2 Farm Charlie

Along with business growth Mr. Charlie's urge to give back to nature has increased. Charlie applies this mindset in every aspect of his business and strives to influence his surroundings to do the same. Mr. Charlie is driven by his ideological belief and believe that it can combined with economical prosper.

4.2.1 Charlie's Background

Mr. Charlie lives with his wife in the south middle of Sweden and has done so since taking over the farm in 1979. The farm consists of 240 hectare farm (60 hectares are leased), and 70 hectare forestland. 140 breeding sows are the primary activity. Besides Mr. Charlie, the farm has three full-time employees, all of them with different responsibilities over the daily operation.

Mr. Charlie is a fifth generation owner and has learned most of his skills through experience and observing friends/other people. He has though studied basic courses within management throughout the years serving as owner of the farm. Aside from running the daily operations, he is also a part-time employee at a company that builds and provides expertise within farm based biogas production. This company was founded and ran by Mr. Charlie for a few of years before it was put out for sale.

Mr. Charlie is a constant seeker of new knowledge and as a result he is active in numerous organizations, lobby groups and board of directors. He enjoys taking part of new ideas and having the opportunity to influence a person or a project. There is a wide variety in these groups and each differs in their aims, goals and existence.

The owner of farm Charlie has undertaken several new ideas and gone through just as many implementations. For example he has been involved in creating breeding contracts between producer and buyers. Also, Mr. Charlie was one of the first pioneers to adopt a model of keeping sows in groups. In his experience he has encountered both success and failures throughout the years and learned from them.

4.2.2 Charlie's Biogas, from Idea to Implementation

Mr. Charlie has known about farm-operated biogas plants for several years. In the early 1990s he traveled to Denmark and Germany to attain knowledge and skills regarding its functions. Still, it was not until 2005 that he built his own biogas facility without any investment support or help from supporting organizations. Some reasons for waiting were the lack of technology and the fact that energy was a lot cheaper up to that point. Since he did not have enough confidence for support organizations and lobbyists (because of their insufficient knowledge) he decided to build his own plant. Mr. Charlie initially used Internet and mass media as a forum to get ideas. This was later followed by discussion with his mentors and friends within the same field, one whom he later started a company with. Today, Charlie's plant works at full speed and the farm is almost electricity self-sufficient.

In order to build, Mr. Charlie had to try and evaluate different material's advantages and disadvantages and therefore found building arrangements to be the most problematic aspect. In Charlie's experience nothing was considered to be non-problematic.

4.3 Farm Delta

At farm Delta, daily undertakings are influenced by the owners' ideological mindset and motto "you can always make everything better". The Deltas' are constantly seeking new ways to improve their business and strive to make changes in accordance to their beliefs.

4.3.1 Delta's Background

Delta, who is 15th generation owner, lives together with his wife on a farm located in southern Sweden. Today their property consists of 125 hectares of farm, 130 hectares of forest, and 45 hectares of pastureland. Currently they have two part-time employees (one is an f-tax holder) and services are bought if needed. Dairy cows were previously the main business on the farm before Mr. Delta himself took over in 1995. This practice however was soon disbanded and today the primary operation consists of an organic hen laying production in a facility that was purchased in 2007.

Mr. Delta was an owner of a small scale farm in 1987 while working as a bank employee but decided to leave that career behind in 1995 when overtaking the family farm. Besides growing up on a farm, he has a university degree within agricultural engineering which required two years of hand on experience. Mr. Delta has also participated in a "how to run a business" course.

Delta is not active within any networks, but through different courses held by nationwide change organizations, he has been able to get in contact with people in the same business. Mr. Delta is however a member of a nationwide egg promoting organization. Since the building of

his biogas plant he has hosted study visits for interested organizations and individuals for education purposes.

4.3.2 Delta's Biogas, from Idea to Implementation

Several years ago, Mr. Delta was interested in alternative energies and biogas. Ten years back he travelled in Denmark and Germany to get a further understanding of the construction and process. Back then the reason for not building a biogas plant of his own was the lack of Swedish suppliers and the fact that Delta did not find the Danish or German constructions to be well suited for his farm and needs. Despite this, he kept on attaining knowledge and was granted an investment support for a biogas plant in 2010 and started building in June of same year. When it came to choosing a supplier, Mr. Delta decided to go with a Swedish business (located only 25 minutes away) from his farm. The hired company is a growing small business operating in Sweden using both Swedish and foreign components. The plant started running in February 2011 and is still in the start-up phase but working at greater speeds as time goes by.

Mr. Delta found the permission handling and legal framework to be the most challenging aspect. In search for assistance, he reached out to concerned authorities, but was often faced with the problem of not talking/reaching the right person. Despite this, when it was time to build, Delta found the delivering of the plant to be non-problematic and uncomplicated.

4.4 Farm Echo

Echo's business stems from both economical and sustainable reasons and the interaction between them two. In addition, Mr. Echo enjoys change and takes pleasure in making improvements and staying busy.

4.4.1 Echo's Background

Farm Echo's owners took over management of the family farm in the mid 1980s, and have since increased tilled acreage by 50 percent to 260 hectares. Production is focused on potatoes and oil crops, with about 10 percent organically grown. Farm Echo is a relatively large operation, and currently has more than 15 employees.

Mr. Echo has an extensive experience in the agriculture sector, having grown up on the farm and in addition to holding a university degree in agricultural production. Furthermore, Mr. Echo has had a full off-farm business career, culminating as head of an agricultural processing business. Interest in focusing on his farm business and its growth led to retirement from the off-farm work however.

While no longer employed outside of the farm business, Mr. Echo maintains active contact with the general agricultural sector, giving lectures and courses for agricultural organizations, on top of being a member of an agricultural promotion organization.

In addition to the growth in acreage, a number of diversified enterprises have been developed since Mr. Echo took over management. In the early 1990s, after explorative visits to countries all over the world, Farm Echo entered the industry of renewable energies. He began

developing and producing bio energy equipment. The farm business also produces biological pesticides, and has a small shop where customers can buy farm-grown produce.

4.4.2 Echo's Biogas, from Idea to Implementation

After a couple of years in the renewable energies industry, Mr. Echo saw biogas production as a natural step to extend his business. In the early 1990s, support organizations lacked the knowledge to provide help to individuals interested in building a biogas plant of their own. However, in 2010, after years of intensive article and literature studies, a small scale production test was run on the farm. The test run turned out successful. When investment support was granted the same year, Echo started building a full scale biogas plant.

Echo's successful construction of a biogas plant has led to a subsequent business idea to build plants for others. Currently Farm Echo provides services throughout Sweden, and more than half of the firm's employees are occupied within the biogas operation.

Mr. Echo faced issues in the beginning of the process and found the difficult part to be paperwork. He also struggled when attempts were made to get assistance from concerned authorities. In Echo's experience nothing was considered to be non-problematic.

5. Analysis

5.1 The Innovation

In section 2.1 of this report, it was established: “Whether the idea is new on the market or not, as long as it is being received as new, by the individual or unit it is considered an innovation”. This can be seen as a vague interpretation. Nevertheless, it has been chosen for this study. Therefore it can be confirmed that biogas and building a plant in a rural firm can be considered an innovation.

5.2 Biogas’ Communication Channels and Networks

It is not difficult to confirm that each and every one of the studied subjects has used some sort of communication channel in order to move forward in their idea to actual implementation. A clear approach of the problem can be seen starting with the usage of mass media such as newspapers, articles, TV and later on Internet. Back in the early 1990s interactive communication (Internet) was not available for everyone which might explain the focus on other mass media tools. This might also explain the extensive travelling that Charlie, Delta and Echo engaged in. Traveling seemed to be at the time crucial for interested individuals to gain more knowledge and ideas. The three farms mentioned above all implied that it was due to the agricultural organization’s insufficient knowledge that made them wait to proceed with their idea. Bravo, on the other hand, did not experience this issue since it was not until a lot later (2005) they discovered biogas, its functions, and actually started to engage in it. They were invited to participate in a meeting regarding farm operated biogas plants (held by a change organization) which shows much has changed in the last 20 years.

As theory stated, it is common to gain initial knowledge regarding an innovation through mass media channels which proves to be the case even here. This is later followed by usage of interpersonal channels and can therefore also be verified. However, it is still important to see the differences between each and one of the case studies which will be presented later on in this chapter.

Twenty years ago the Swedish market lacked any type of network connecting interested individuals together or to a principal. As the empirical findings reveal this is no longer the case. Swedish support organizations and agents have increased their knowledge and today they provide interested rural firm owners with their expertise if needed. Both radial and interlocking networks can be identified. Though, it has clearly been implied by farm Charlie that there is still more for support organizations to do for easier development.

5.2.1 The Change Organizations Reforms & Modification

We can now discuss the change organizations, its agents, development and compare them to the interviewed farms. Their contributions toward a successful implementation will be presented in this section.

Even though Farm Charlie, Delta and Echo knew about farm-operated biogas plants long before the support organizations started, to engage in it does not necessarily mean that they have not been in contact with them. Today, Mr. Charlie despite his reluctance towards change

agents is very active within all different kinds of networks and change organizations. Farm Delta for instance, who claims to not be a part of a network has hosted groups (both organizations and individuals) for education purposes in affiliation with a local change organization. Echo on the other hand has held lectures and different courses for education purposes sponsored by nationwide change organizations. This implies that the change organizations have been able to reach out to those individuals in a later stage of the process and are now using their expertise.

Theory stated that in order for a fast innovation diffusion process to occur there should preferably be a homogenous network. Though it was also mentioned that individuals within this group should possess different knowledge and skills regarding the innovation. The support organizations' however, seems to focus on individuals that share the same interests and goals with their business.

Bravo's experience shows that the change organizations are using different tools to provide the decision maker with the necessary knowledge and skills to develop a need for change. It is not hard to identify that they fulfill Roger's first two bullets (1) creating a need for change and (2) establishing a relationship between them and other individuals. By hosting meetings they try to motivate the decision makers' interests (4). Also, by inviting Bravo to participate in a group where their experiences can be shared an attempt is made to act as an opinion leader (5). The same pattern can be seen for the other three farmers who are all involved in educational purposes of some sort hosted by different change and lobby organizations.

So far, four out of Roger's bullets have been confirmed. For memory purposes, Rogers list of the change organization and agent's goals and objectives shown below.

1. Develop a need for change
2. Establish an information exchange relationship
3. Diagnose problems
4. Create an intent to change in the client
5. Translate an intent to action
6. Stabilize adoption and prevent discontinuance
7. Achieve a terminal relationship

The diagnose problems, stabilize adoption/prevent discontinuance and achieve a terminal relationship bullets (3, 6, 7) cannot be confirmed to exist from the empirical findings of this study. The most common critic toward change organizations has been explained as their tendency to focus on common knowledge (like mass media) and not the usage of the innovation. This can be proven to be right to a certain degree according to what has been discovered. However, in this specific case it would be contradictive to say that change organizations are trying to create a terminal relationship (7) while using the individuals as opinion leaders and educators. Though, it is too early to say whether their relationship might lead to an increased willingness to approach an idea without their support in the future.

Below is an extensive table of all the easier and difficult aspects the farmers' faced in their innovations-decision period.

Table 1 Extensive table of all problematic and non-problematic aspect of the implementation.

	Digging	Bank cont.	Finishing	Power cont.	Building arr.	Perm. handl.	Auth. cont.	Legal frnw.
Problematic			X	X	X	X	XX	XX
Non-problematic	X	X						
Total	1	1	1	1	1	1	2	2

Before this table is analyzed the reader needs to understand why there are so many more difficulties in the innovation-decision process. As previously stated, all farms interviewed for this report are considered to be pioneers despite the categorizing. This might explain all challenges they were faced with. Second of all, this can also explain why there were so few non-problematic parts of the process.

Mr. Bravo, who hired a company to help him, found the least strenuous part to be the digging. However, he faced problems with finishing the project due to complications with the original installment and difficulties with the power company. Mr. Bravo made attempts to contact an individual who was in the same position as him but without any results. This implies that there is a weak foundation for interpersonal channels to exist.

For farm Charlie, who built his own biogas plant, it is understandable why building arrangements were the biggest obstacle; and therefore no need for it to be discussed any further. The same reasoning is applied to the fact that he did not find anything to be easy in the process. Without any qualified expertise to help him it is no surprise he encountered many challenges.

Delta and Echo seemingly shared the same troubles in the process. This might stem from the knowledge or expertise they were given. Delta did mention that their contact with the bank was valid. This though is not considered to be a major part of the decision-making due to the lack of correlation between bank and actual proceeding. It is of course crucial to get a loan in order to build. However, the connection to the actual implementation and the support structure behind is small.

5.2.2 Biogas' Diffusion Process

Rogers (2003) recognized five requirements that should be met for a fast diffusion. These were:

1. Relative advantages
2. Compatibility
3. Complexity
4. Trialability
5. Observability

The four cases studied confirm that building a biogas plant in a rural firm to some extent meet the fourth and fifth requirement. It is rather hard to do a test run when the innovation is complex. Though one of the farms (Echo) proved it is possible, the degree of difficulty is

quite high. The trialability can therefore be easy or hard depending on the farm owner's resources. Differences can be recognized in the observability aspect and much has changed in the last couple of years. Three out of four farms interviewed did not have the possibility to observe a farm-operated biogas plant in Sweden. Instead they had to travel abroad to get visual knowledge of the product. Today the earliest adopters act as mentors and can use their own biogas development production for tutoring purposes.

Change organizations put efforts on education in regards to the relative advantages (1). As far as bullet two and three go it is up to the decision maker and the innovation itself. Three out of four farms studied had implemented innovations to their business before with positive results which goes in compliance with theory.

The biggest flaws, despite efforts, are the economic aspect (which is a part of the relative advantages 1) and the project's complexity (3). It has been established earlier that change organizations put focus on increasing knowledge and promoting change. Accordingly the change organizations cannot guarantee a profitable outcome as a result despite its relative advantages. What also is important to add is that in most cases lack they the technical expertise which goes back to the complexity issue.

5.3 The Farmers' Innovation-Decision Processes

It is time to discuss each farmer's innovation-decision process. Five different stages were distinguished in order for the innovation-decision period to occur (Rogers, 2003). These were: (1) knowledge, (2) persuasion, (3) decision, (4) implementation and (5) confirmation.

5.3.1 Farm Bravo's Innovation-Decision Process

The Bravos' became aware of farm-operated biogas plants in 2005. They had access to Swedish expertise, though it took them five years to move forward in the innovation-decision process. In comparison to the three other farmers five years is a short period of time. However, Bravo differs in the sense that they had the advantage to use professional knowledge throughout the process. In this case most time was spent between knowledge (1) and persuasion (2). Though, as they faced problems with the original installment significant amount of time was spent between implementation (4) and confirmation (5).

5.3.2 Farm Charlie's Innovation-Decision Process

Mr. Charlie's innovation-decision process began in the early 1990s. Back then he gained initial knowledge but it was not until several years later that he continued with his idea. Mr. Charlie did however increase his understanding for the construction throughout the years and was later persuaded by his surroundings to take action. It did not take long before Mr. Charlie decided to implement. Walking through all steps of the innovation-decision process (also known as innovation-decision period) took almost 15 years. Most time was spent in the beginning of the process, in this case between the first (knowledge) and second (persuasion) stage.

5.3.3 Farm Delta's Innovation-Decision Process

The owner of Farm Delta gained initial knowledge of farm-operated biogas plants in the early 2000s. Despite increased awareness of the product it was not until ten years later that he

decided to move forward in the innovation-decision process. However, when he was persuaded to develop biogas production it did not take long before the innovation-decision period was over. A clear resemblance can be seen compared to Farm Charlie where most time spent was in the beginning of decision process.

5.3.4 Farm Echo's Innovation-decision Process

Mr. Echo had been involved in the renewable energy industry for many years and through that he was introduced to farm-operated biogas plants. He attained knowledge in the early 1990s but waited until 2010 to move forward. Farm Echo's innovation-decision period is the longest one observed (almost twenty years long). However, as soon as he was persuaded to continue with his idea it did not take long before he developed biogas production on his farm.

5.4 Types of adopters

5.4.1 Farm Bravo

The Bravos' started to engage in farm operated biogas plants later than the rest of the interviewed farm owners. Because of it, they were able to receive expertise and knowledge from Swedish change agents and organizations. It is important to remember that it was not until a support organization invited them to join them for an information meeting that Bravo took the idea into account. This was back in 2005 which is rather late when compared to the other farms studied. Even though Bravo engaged later than the other three farms they are considered to be a part of the early majority group. The market for farm-operated biogas plants was still an up and coming business and had not yet fully reached its audience when the implementation took place.

5.4.2 Farm Charlie

Farm Charlie differs vastly from the other interviewed farms in the sense that he built his biogas plant without any investment support or help from support organizations. What also differ are the extensive networks he engages in and the variety within them. Mr. Charlie possesses a strong entrepreneurial drive and an urge for change. Therefore, he can be considered an innovator/early adopter according to Roger's different categories of adopters. It is harder to distinguish which group he belongs to. Mr. Charlie can be categorized as an innovator to an extent, but possess all characteristics mentioned for being an opinion leader, which is a feature specific to the early adopter group.

5.4.3 Farm Delta

Moving on with Farm Delta, who attained knowledge more than ten years ago but waited until 2010 to develop because of the absence of Swedish suppliers. As mentioned earlier, Mr. Delta is not involved in any networks. Instead he keeps himself updated by attending some meetings held by a large nationwide agricultural support organization. For the reasons mentioned above in this paragraph Mr. Delta end up in the early majority group.

5.4.4 Farm Echo

The third farm that engaged early on within the sustainable energy field, Echo is harder to categorize than the other three mentioned above. Back then Mr. Echo searched and engaged in a variety of actions to increase his knowledge within this field. However, it was not until

2010 after a test run he decided to move along with his idea. This could imply that Mr. Echo should be in the late majority group. Extensive research and travelling made before implementing indicates that there were more reasons for not building sooner. It has been mentioned earlier that the investment support established by The Swedish Board of Agriculture in 2009 tripled the amount of biogas plants in two years. This might have been the deal maker. Even so, in this case, Mr. Echo ends up in the early majority group keeping in mind the communication link he creates through his business (trade network).

5.5 Entrepreneurship

5.5.1 Farm Bravo

Bravo is a serial monoactive producer. He shows a combination between being a pluriactive and resource-exploiting entrepreneur which seems to be the case with most rural firms according to this study. Distinguishing whether Bravo is a pull or push entrepreneur is not as clear and cannot be recognized. Though it does seem like he is more of a proactive individual than a reactive.

5.5.2 Farm Charlie

According to Alsos, et al. (2003) remarks Mr. Charlie is a portfolio entrepreneur and a serial monoactive producer staying true traditional farming undertakings (taking care of manure). This goes hand in hand with theory that farmers usually show a combination of the different groups. Mr. Charlie also possesses the traits of being a resource-exploiting entrepreneur and therefore acts proactive in most of his activities.

5.5.3 Farm Delta

In the aspect of the characteristics of an entrepreneur, Mr. Delta is a novice with no major earlier experience in implementing a new business within the already existing one. This doesn't include the switch from dairy cows to egg production. It is a fine line whether it should be considered a business created within an already existing one since the first business was discarded. In this specific case it has been decided that it should not be considered. Just like farm Charlie, farm Delta is considered to be a resource-exploiting entrepreneur because he before the implementation fulfilled the necessities needed for successfully building a biogas plant. Therefore, it can also be established that he acts proactively.

5.5.4 Farm Echo

Mr. Echo shows proof of a strong entrepreneurial drive as he has implemented various changes to his farm, all of them related to agriculture. This proves that he is a portfolio entrepreneur with a monoactive approach and proactive point of view.

6. Conclusions

This report's aim was to investigate success factors and challenges farmers faced when building a farm-operated biogas plant. It was also out of interest to see (in case a system was identified) whether the support was adequate to allow future owners a successful implementation. The problem formulation for this report came down to:

- 1. What are the success factors and challenges when developing biogas production in a rural firm?*
- 2. When identified, what are the supporting advocates' contributions for successful implementation?*

This was later accompanied by three research questions that seemed to be out of interest for further understanding.

1. Do farmers get the support needed to facilitate implementation?
2. What are the significant obstacles farmers face in the development process from original idea to finished result?
3. Has the implementation process changed from the time the farmers decided to adopt compared to today?

Several things have changed in the last couple of years within the biogas field in Sweden. According to the empirical findings, a few years ago an extensive support culture could not be identified for owners of rural firm. The result of this study shows that Sweden today has both knowledge and trade networks. Presently several change organizations (national /local and related/non-related to agriculture) engage in the diffusion of farm run-operated plants. The support provided is mostly concentrated on common knowledge and do not for the most part include technical aspects. This answers questions one and three of the research questions. The analysis has shown that the farmers did not get all support needed for the implementation. Also, as table 1 showed, the farmer is faced with a whole variety of different issues when building a biogas plant. It ranges from building arrangements to contact with authorities and legal framework. Through this the significant obstacles have been discovered. This is crucial and important to acknowledge for concerned change organizations and agents.

Are there companies and change organizations focusing on this type of construction and expertise? Of course, the industry seems to be growing more each day. When taking everything into consideration it is clear that it is under development. However, there is still plenty to be done before a point is reached where a standard solution can be used for easier implementation.

Has the implementation process changed? Up to this point, according to the Bravo case, the support organizations' contribution was increasing knowledge and getting started in the implementation. Bravo differed from the other three farms in that they had the possibility to use the change organizations' expertise throughout the innovation-decision process. The experience for Charlie, Delta and Echo, the contributions have been different, even though they have taken a part of the change organizations in a way or another. It is obvious that a change has been discovered.

Up to this point the success factor for developing biogas production in a rural firm seems to correlate with the adopter's personal features. Their characteristics and level of interest are the determining factors that have driven these farmers to take action. This study has shown that farmers stay true to traditional farming undertakings and see biogas production as a possibility to use their farm's resources more efficient. The study also showed that a majority of the farmers interviewed acted proactive in their undertakings which might explain their early adoption.

Lately a change has been recognized and the support organizations engage more. Accordingly, they play a bigger part of the implementation process compared to before. Yes, the implementation process has changed and still continues to change for the better. Developing biogas production in a rural firm is still in the beginning of its lifecycle and it is impossible to know when the innovation will become self-sustaining. However, the change organizations' focus on general knowledge and expertise will not help the process moving forward anymore than it already has. Though, the role they play today as an engaging and educating organization is still crucial for the knowledge to be spread.

The diffusion process is currently in a stage where the majority has not yet picked up on the innovation. According to the results of this study, it seems like it is a matter of time before the diffusion becomes self-sustaining. Even though things have changed in the last couple of years there is still a need for improvement. The improvement would be addressed to the change organizations that have an operation within this field. In turn, the innovation-decision process would run more smoothly with an efficient, successful implementation of a farm operated biogas plant as a result.

7. Discussion

It has been mentioned many times before but it is worth mentioning again that numerous changes have taken place within this field in the last couple of years. The conclusions clearly revealed a gap between what support the farmers received, looked for, and needed compared to what the change organizations provided. The same issue was recognized today but was not as severe previous times.

So what can/needs to be done? According to the results of this study it seems to be out of interest for farm owners to take part of a standard solution. Clearly there are organizations that increase knowledge. They can provide professional expertise for companies that focus on building the plant. This study's focus has been on the farmers' experience and from those, conclusions have been made. It is important to remember that little attention has been paid to all different change organizations and what they actually offer their members and customers. This could make a good foundation for a report regarding the change organization and its work process to see where the problems reside. However, according to the results of this study it seems to be a need for the change organizations to:

1. Create a standardized, working, technical solution
2. Improve transparency of legal aspects including permit process
3. Provide individuals with adjustable information
4. Offer more observability possibilities

With the acquired information, my suggestion would be for the change organizations to conduct a survey of farm owners that have shown interests in biogas. With the answers in hand it would help them to unravel who decided to move forward in their decision and who decided not to after their first introduction to the option. It should also be of interest for change organizations to see whether their expertise is used later in the process or not. It might be that such organizations (as described in this report) are not interested in providing a complete solution. In my opinion, they should offer more detailed information of the support they can provide if they engage in the first place. Even so, the conclusions might raise questions within other organizations or companies within the biogas field.

Taking this report into account combined with further research over the market in the future may contribute to creating an organization that offers a more complete, start-to-finish solution. Maybe that would speed up the process if an interested farm owner could contact one company who takes care of the process from start to finish. This company could be educational, hands on, and would require a well-diversified workgroup. Better yet, why not think nationwide and create a template over the application process? Today the set of regulations are different from each province and cause difficulties when hiring a company further away.

As the analysis shows, farm-based biogas production is an emerging industry in Sweden. As we experience a change in global warming, the diffusion of green technologies can be expected to continue to increase. For farm entrepreneurs with the right skills and connections biogas may be the foundation for a new business idea.

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9. Appendix

1. Questions for interview subjects

Talk about yourself and your farm

- main operation
- number of employees
- earlier experience of innovations (related/non-related to agriculture)
- education
- number of years within the business

Reasons for building a biogas plant

- survival, continuation of daily undertakings
- use the farms' resources
- make the current situation better
- pursuing a opportunity

When and where did you get the information and idea to build a biogas plant?

When did you decide to move forward?

- right away
- later on

When and where did you obtain the information that made you adopt?

- Mass media
- networks communication
- interpersonal channels

Who did you turn to for advice (name three individuals or organizations)?

Where did you meet/find these individuals/organizations?

Who in the system influenced you and to what degree?

Have people asked you for help and advice?

Do you share communication platforms/networks?

Are you active within a change organization?

- What do you do for them?
- How do you interact with adopters?

Are you a part of network community?

How do you think it will look like in the future?

Have you trained/educated someone within this field?

How did your original thought of “how it is supposed to be done” change during the process?

Influenced by change agents or opinion leaders?

Who makes the decision in your household?

Do you trust your change agent/agency?

Have a change agency asked to a spokes person for biogas?

Have you adopted anything else within your agricultural business?

2. List of farms that have been granted investment support

Biogas Gotland AB
Gudings Alva Hemse

Ulf Andersson
Hammarvägen 42 Olpers Färila

Lars-Inge Gunnarsson
Värestorp 70 Karl-Påls Laholm

Högryd Lantbruk AB
Högryds gård Tvååker

Joakim Olsson
Torstorp 120 Falkenberg

Lars Paulson
Hässlås kvarngården 237 Långås

Gösta Paulsson
Nya Skottor, Laholm

Salltorp Lantbruk AB
Salltorp 105 Vessigebro

Nils Tolversson
Hede 110 Vessigebro

Wapnö AB
Wapnö gård 215 Halmstad

Monica Eriksson
Rönningberg 117 Trångsviken

Dan Gustaf Gustafsson
Yttergårde 282 Oviken

Dan Waldermarsson
Långhult Västergården Habo

Alviksgården Lantbruks AB
Alviksgården Luleå

AB Widtsköfle
Vittskölevägen 100 Vittskövle

Sven Norup
Norups Gård AB Knislinge

Glenn Oredsson
Gård 4145 Hässleholm

Wanås Gods AB
Box 67 Knislinge

Säffle Bioenergi HB
By Bäcks gård, Säffle

Näfsta Gård AB
Näfsta 103 Sundsvall

Bergs Suggpool AB
Erikstad Berg 3 Mellerud

Anders Gustafsson
Brunsbo Gård Skara

Horshaga Lantbruk AB
Vedum Stora Horshaga 1 Vedum

Vadsbo Växtodling AB
Löjtnantsgården 2 Jula Mariestad

Lars Gunnar Åslund
Österplana Högebo Gård Hallekis

Bo Sundström
Frötorp 144 Örebro

Sven Göransson
Ölmetorp 149 Rejmyre

Hulterstad Ekoproduktion AB
Hulterstad Mjölby

Magnus Johansson
Bleckenstad Krongård Mjölby