Learning as changes in activity systems: the emergence of on-farm biogas production for carbon credits

Marco Antonio Pereira-Querol[a], Laura Seppänen[b]

[a]University of Helsinki, Center of Activity Theory and Developmental Work Research, Helsinki, Finland; [b]The Finnish Institute of Occupational Health, Helsinki, Finland - marco.pereira-querol@helsinki.fi,

Abstract: *On-farm biogas production has many environmental benefits for agricultural systems. In this paper, we describe an evolution as a learning process within biogas production, the outcome of which is the development of a program of sustainable swine production. According to the cultural-historical activity theory, learning is understood as transformations of the motivating object of an activity system and its structure. First, we present the theoretical concepts of an activity system, contradictions and expansion, following by the methods of data collection and data analysis. Second, the historical data and its analysis are presented in temporal phases. We proceed by presenting the results of what triggered learning and expansion during the process, and how the nature of the activity changed. Finally, we reflect on what an activity theoretical analysis can bring to the notion of social learning.*

Keywords: *social learning, activity theory, environmental management, biogas production*

Introduction

During the last decades, agricultural and rural activities have been under increasing pressure to consider the environment. This paper is part of a discussion about social learning in environmental management towards sustainability. In this context, social learning is understood as the collective action and reflection that occurs among different individuals and groups as they work to improve the management of human and environmental interrelations (Keen et al. 2005:4). Within this social learning discussion, there is a tendency to move the analysis of learning from an individual towards a more collective social process (Leeuwis and Pyburn, 2002; Keen et al. 2005). It is agreed that a more collective change view is needed (Röling, 2002; Keen et al, 2005; Blackmore, 2007, Sterling, 2007) to deal with sustainability and environmental problems. Recently, many studies have been conducted with theories that take into account the collective and social interaction in managing environmental problems (Wals, 2007). According to our knowledge, the historical dynamics, motivating objects and material artefacts are not often dealt with in the research on environmental management. The present study aims to show how the activity theoretical approach as a social and collective theory is used for analysing learning processes that take place in environmental management.

To illustrate the theories, we will present an emergence and scaling up case of biogas production (later on, BP) that took place in a swine production chain from the West region of Santa Catarina State in Brazil. First, we will present the theoretical concepts of activity systems, contradictions and expansion. Second, we will show the historical data of the evolution of the activity of biogas production from 1998 until 2007 and its theoretical interpretation. Then, we will present a trajectory of the transformation of the activity under study, presenting its developmental phases. Finally, we will discuss the contribution of activity theory, especially the concepts of the object-motive and historical analysis to the study of learning processes and social learning within environmental management.

Biogas production as an emerging activity system

The main idea of activity theory is that human activity is culturally mediated. Human beings do not fulfil their needs directly from the environment but through culturally evolved joint productive activities in which various given objects are transformed to meet specific human needs. A need does not give direction and motivate to human action. Motivation and direction to activity emerges only when an object –motive is found that seems to meet the need (Leontiev, 1978).

The term object-motive, or just object, refers to anything that is being collectively produced, and to what human actions is directed to. An object is realized and reproduced in projects involving the construction of material things, artefacts (Miettinen, 2005). In different activities, it assumes different forms, e.g. it can have the form of advisory services or a product. The concept of object in activity theory is based in four principles. The first principle is that "***the object of one activity is its true motive***" (Leontiev, 1978:62). People participate in collective activities to satisfy at least one of their needs (Leontiev, 1981: 210). A second principle is that the object is twofold, **epistemic and objective** (material). The object of one activity is not only composed by its objective, material, and concrete character, but also for its subjective psychological reflection.

The third principle of the **object is that it is in constant change**. Activities are directed towards objects that can satisfy some needs. When an object meets a need, the need is extinguished as a result of its satisfaction, and it is produced again, perhaps on other, changed conditions (Leontiev, 1978, 62). The forth principle is that the object **can only be achieved collectively**. In modern societies objects can not be produced individually, but individuals have to joint collective activities. Leontiev (1978:51) proposes that activity has to be understood in its social relations, from 'the life of society'. For example, to understand the activity of farming we should not only look to farmers as isolated individuals but rather as a system of material things, other people and ideas. Collective activities are carried out by individual's actions. Farmers can not produce alone the swine; they need employees, feed suppliers, technicians, veterinarians and even the food industry that buys their products. Moreover, the activity of farming has to be understood as a system of social relations that is part of a larger system, e.g. the system of food supply.

Engeström (1987, 78) has combined the ideas of object-orientedness, social and tools mediation into a general model of an **activity system**. The activity system model highlights the multiple relationships of mediation of subject's interaction with the object of the activity through instruments, community, rules and division of labour. Because a joint activity is based on collaboration between many actors, each actor has his own perspective to the object of the joint activity. It can be analyzed from the perspective of the different actors involved. Thus the subject in the model is the actor, the perspective of whom has been taken in the analysis. In this study, we focus in the transformation of the BP for carbon credits, the outcome of which is the new activity of BP for sustainability. BP as an activity can be understood here as "generating income, profitable solutions and environmental benefits from swine manure". This activity is motivated not only by societal questions such as reducing the emission of greenhouse gases that contribute to climate change, and reducing local pollution of water sources, but also personal motivation, such as producing energy to be used in agricultural activities. The objects are material and non-material entities that are transformed in the activity, such as the manure into biogas and carbon credits, and piglets into hogs. The tools are not only material artefacts, but also the theoretical models and knowledge used to implement the activity.

According to Engeström (1987), the dynamics of an activity system are created through inner contradictions in the system. *Contradiction* is used to indicate misfit within elements, between different activities or between different developmental phases of a single activity. Engeström (2001) argues that "contradictions are not the same as problems or conflicts, but rather they are historically accumulating structural tensions within and between activity systems. In activity theory, development is an attempt to reorganize an activity system in order to solve its pressing contradictions (Engeström, 2005). As the activity develops and conditions for carrying it out change, contradictions emerge between elements of the activity system that, if no solution is found, lead the activity into a crisis. This threat of crisis creates a need to find a new object that would meet the need and make it possible to overcome the contradiction.

According to Engeström's theory of expansive learning (Engeström 1987) such a crisis can be overcome by expanding the object-motive of the activity. The concept of *expansion* is understood as a qualitative socio-spatial transformation and re-organization of the object. An expanded object means that it involves a wider motive as well as a wider community. The creation, mastery and maintenance of an expanded object are a demanding and contradictory challenge to the actors involved. In order to deal with these challenges created by expanded objects, the participants often have to create new instruments. Expansion includes not only human but also material dimensions. In activity theory, the practical domain needs to be involved when we apply theories of learning (Seppänen, 2004, p.40). The occurrence of expansive learning needs to be seen in a historical context and conditions of a local activity. To start with, we consider **Sadia company's changes towards sustainability as learning**. We will investigate the expansion of the object and the changes in the activity as how learning took place in biogas production.

The data and methods of analysis

The study is about the evolution of the activity of biogas production from swine manure in the chain of food industry 'Sadia' in Brazil. In order to narrow in time and space, we will restrict the data to the events that are related to the BP from swine manure from 1998 until 2007. The main theoretical ideas for the analysis are: a) BP is considered an object-oriented collective activity system, and b) historical changes and learning are driven by contradictions caused by changes in the elements of the activity system. The idea of activity as an object-oriented system leads us to follow the object of BP, e.g. carbon credits, digesters and manure. In the data, it means paying attention to what kind of needs Sadia managers and others expressed towards BP. It also means to pay attention to the elements that composed the activity systems, such as tools, division of labour, community, rules and the subject. The idea of historical changes as developmental phases implies to identify the qualitatively different developmental periods and the mechanisms that lead to new phases.

The data are composed by interviews with four key actors (2 engineers, a consultants and a manager) and documents, which were collected from December 2006 until December 2007. In the interviews, I asked for what the main events were and why they happened. The documents are composed by 10 Annual reports of the company, 2 Project Design Documents, the description of the 3S Program, 8 power point presentations, several public news, letters, public interviews and reports from 1998 to 2007. The method of historical analysis was adapted to the data. First, we have read through the transcripts of the narratives told by the 4 key participants. The events were identified and entered into a **data file** in chronological order as they appeared in the narratives. An event is understood as an action that the interviewee considered relevant to shape the actual activity. Not all the events from the narrative were selected. The criteria for selection were: a) the actors had to say explicitly that the event was important or b) the event was mentioned by more than one actor. As the dates of the events in the narratives were hardly exact, varying from months to years, we searched for documents related to each event that could give more detail on the event. By combining the description of events given during the interviews, and documents, we constructed a sequence of events. For some events, we could not find any documents that confirmed that it happened, e.g. the financial director had the idea of obtaining carbon credits and contacted the engineer of energy projects. However, their veracity is confirmed as they are repeated in the narratives of more than one actor. We put in parenthesis the source of data in those events that we considered more important in order to show to the reader from which data they are based on. The aim of this data file is to identify the events that contributed to form the actual structure of the program.

Once the events were entered in the data file, they were elaborated in a logical order, what we will call a **sequence of events**. Thus, the narrative bellow is not the raw data but rather a logical and chronological organization of the events told by the actors. Here, the events are qualitatively explained by using the descriptions given by the actors. Once the sequence was ready, it was periodized in **phases**. Each phase was characterized by a different object-motive related to the events. The objects were found from the data by analysing the motives, importance, reason and interest toward biogas in different period of time. The phases are the result of the actors and the researchers' interpretation. A new phase starts when a new object emerges. In order to increase the validity, the logical sequence of events and the phases were presented to relevant actors, who gave feedback on it.

The development of biogas production from 1998 until 2007

Because of the limitation in space in this paper, it is not possible to show the complete sequence of events but only what we consider relevant to understand the development of the activity. In each period, the first paragraphs show the events, while the last one of each section shows our theoretical interpretation of the phase.

Biogas production for treating swine manure (1998 – 2001)

The manure treatment system used in Sadia's own units of sow production before the digesters was anaerobic lagoons. Among outsourced farmers, the technology was similar: open tanks. Although these technologies were complying with the Brazilian environmental legislation, it had many disadvantages: it demanded a huge spatial area, it was difficult to remove the accumulated sludge, a lot of nitrogen got lost (*document, 06/2004),* and it emitted odour. According to Padilha et al. (2006), at the end of the 1990's, the environmental responsibility became a competitive differentiation among the

Brazilian leading food industries. The management of the environment became a valuable issue in the relationship with the market consumers and investors. Aware of the market demand to reduce the environmental impact of its activities, what included swine production, Sadia had already in 1998 a project for treating the swine manure in its own unit of swine production in Faxinal dos Guedes, SC. In 2001 the company presented to the investors its efforts in searching for technologies that could also solve the problem of their outsourced farmers to reduce such impact as showed in the Annual Report of 2001:

"The Toledo unit, in partnership with the Paraná Institute of Technology (Tecpar), the Banco do Brasil Foundation and the Toledo city government, is developing a pilot project for the economic use of pig manure. After processing in a digester, the polluting element of the material is reduced by 60% and reverts to a biogas that has a number of applications, including substituting bottled gas for heating chicken houses. With high nutritional value, the solid wastes from the biodigestor are transformed into natural fertilizer for agriculture while liquid wastes are used as fish feedstock in algae tanks. Besides the elimination of water table risk factors, the program will generate a new source of revenues for farmers, helping to ensure the economic sustainability of their operations (Annual Report 2001)."

This phase represent the previous stage of biogas production, before it be transformed into BPCC. Although biogas production and digesters are useful, they did not expand to the whole activity of swine production but remained in few units of Sadia (Faxinal dos Guedes and Toledo). In this phase, it is also clear the contradictions that Sadia was suffering: a) between the market rules that were imposing reduction of the environmental impact of Sadia's activities, and the actual pollution that was caused by the swine production; and b) between the cost of implementing bio-digesters and the benefits that this generated. BP was an attempt to solve such contradictions.

Biogas for carbon credits *(2003 - 2004)*

According to the interviewed actors, a central activity that gave "birth" to the 3S Program (Sadia Sustainable Swine Production Program) was the 'carbon project'. The project for applying to carbon credit started in 2003, when the chief financial officer from Sadia, member of the executive board, started to listen about the Kyoto Treaty and had the idea of obtaining carbon credits from the company's forests. The forests were already used as a source of fire-wood to the boilers of the food processing units. The initial idea was to use the mechanism of the Kyoto Treaty to increase the company's areas of forests of eucalyptus as efficient as possible *(interview 22/12/2006)*. In the first semester of 2003, Sadia signed a contract with a consultant company for doing a diagnosis and to elaborate a project design for applying carbon credits. In the diagnosis, around 20 projects were evaluated. Among these, only three were considered viable for applying to carbon credits, which were three projects of BP for treating swine manure. *(interview 22/12/2006 and 16/05/2007)*.

In this phase, the activity of BP for carbon credits – BPCC emerges as an idea to use the carbon credits as a way to increase the area of forests of the company. The forests had already a use-value, as it was used as wood-fire. However, it obviously also had a cost of implementation and maintenance. This tension between these two forces, the usefulness and the cost of the forests is interpreted as a primary contradiction of the forest as a commodity. This contradiction was a first force to initiate the search for carbon credits. As the search continues, Sadia discovered that the forest was not an option for obtaining carbon credits anymore, but BP from swine manure was. At this point in time, the activity of carbon credits met the activity of BP, forming a larger activity, the biogas production for carbon credits - BPCC. The interests of Sadia toward the object were biogas as a source of carbon credit as extra financial revenue.

Biogas for reducing greenhouse gases emissions and treating swine manure (2004)

As the project design document was elaborated, the team perceived the several economic and environmental benefits from producing biogas for carbon credits. The project was presented to the executive board, which was surprised with the large amount of potential tons generated in the project, 242.000 ton in 10 years. The executive board decided that the project should be implemented and also expanded to all the 24 Sadia's units of sow production, what gave start to a second 'carbon project', *(presentation 30/05/2005)*. In January 2004, the three digesters were implemented and started to operate (PDD1). In 2003, parallel to the carbon credit projects, Sadia's director of marketing and sales was contacted and invited to join an international learning platform called Sustainable Food

Laboratory – *Food Lab (document 01/06/2004)*. The aim of this platform was to bring together entrepreneurs seeking change in the direction of sustainability. Sadia's director accepted the invitation because "sustainability" was seen as a trend and more knowledge about it was needed. At the same time, the carbon project started to appear in the meeting of Sadia executive board. As the PDD1 was being written, it was perceived as an instrument for showing evidences of Sadia as a sustainable company. The term sustainability appears for the first time in the Annual Reports of the company in 2003. There is plenty of evidence showing that investors and consumers appreciate companies that show evidences of sustainability. Sadia was aware of this market 'appreciation' as the carbon project is presented in its Annual report from 2004.

Parallel to the 'carbon project' in Sadia's units of sow production, and the Food Lab, another event happened in 2004 that affected its activity BPCC. In June of 2004, an agreement called TAC was signed between several representatives of the swine production, including Sadia and its outsourced suppliers, in West part of Santa Catarina State. The reason for TAC agreement was the increasing contamination of rivers and underground water sources by the local swine production. Such agreement was a compromise between the participants (e.g. food industry, environmental organizations, research institutions) to adjust the swine production to the national and regional environmental law. In practice, it would mean that environmental licenses would be required for farmers in order to transport the pigs to the food industry. The main limitations for obtaining environmental licenses were the lack of agricultural fields for spreading the effluent, and the insufficient storage capacity of the open tanks. The TAC was evidently a challenge for Sadia as it: a) threats the supply of raw material to the food industry, and b) compromises the image of the company as sustainable.

To sum up, in 2004, Sadia discovered that BPCC was more than just a financial return from a project, but rather a way to show sustainability by reducing the pollutant potential of the swine manure and reducing greenhouse gases emissions. Therefore, carbon credits were not anymore the object of the activity but rather a tool for achieving a larger object. Although the object is materially the same (biogas), its epistemic character (the meaning) to the company changed. It started to be seen as a market opportunity to show to consumers and investors that Sadia was a sustainable company. Such additional use of BPCC is interpreted as an expansion of the object, as the motivation is now the result of biogas reducing green house gases emission and improving the swine manure effluent. In this phase, also emerged a disturbance related to the environmental problem within the swine production chain. The problem is interpreted as a contradiction between the new object of BPCC (lower greenhouse gases emissions and reducing the environmental impact of Sadia production activities), and the object of swine production (a swine production that emits greenhouse gases and pollutes local water sources). The structure of the carbon activity is illustrated in Figure 1. The lightning-shaped arrow marked with the number one represents the contradiction between the object of the carbon project activity and the object of the swine production activity.

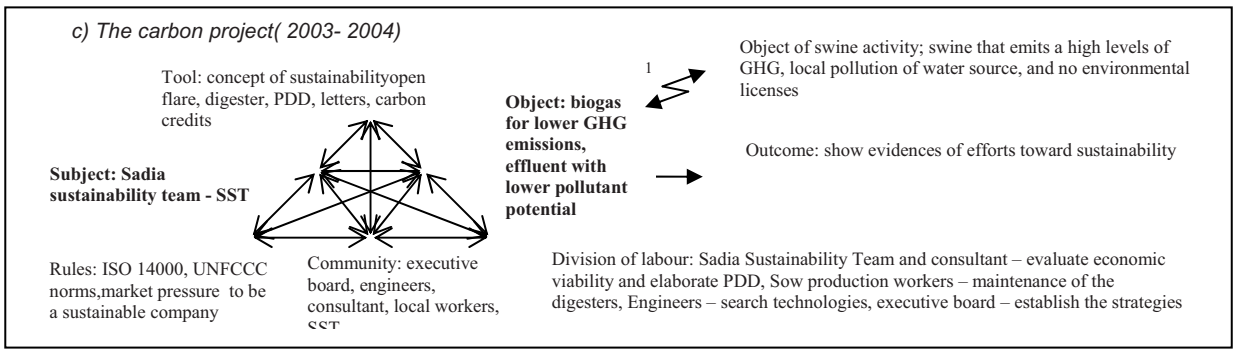

Figure 1. The structure of the 'carbon project' in the period between 2003 and 2004.

Biogas for achieving sustainability in the swine production chain (2004 - 2006)

In the context described above, in which Sadia's outsourced farmers had environmental problems with environmental institutions, Sadia got the idea of expanding the BP for carbon credits also to 3500 outsourced farmers. The digesters would be implemented also among outsourced farms for producing biogas and carbon credits that would be sold in the market. The money from carbon credits could then

be used to adjust outsourced farms to the environmental law, and improve their social and economic conditions. This idea was proposed by Sadia to the executive board and approved. In order to clarify the idea, Sadia started to draw a program called 3S Program (document, 05/2007).

Between the end of 2004 and 2005, Sadia staff's main task was to design the 3S Program, a program aimed to extend the implementation of digesters, BP and carbon credits to outsourced farmers, and to solve the challenges that emerged during their implementation. A first challenge that emerged in this period was related to the legal structure of the company. A mediating institution was needed for implementing the infrastructure and commercializing the carbon credits, and then transferring the money to farmers. To solve this challenge, in December 2004, Sadia founded an independent non-governmental institution called Sadia Institute (document 05/2005). The biogas technologies (digesters and flares) available at that time were adapted to big farms, being too expensive to be implemented in small farms. This led Sadia engineers to search for a cheaper model of digester to include all Sadia's outsourced farmers in the program (interview 22/05/2007).

At the beginning of 2006, once the new cheaper digester technology was found, its implementation started in a large scale creating new operational tasks that demanded coordination at the local level, e.g. presenting and signing the contracts with farmers. The managers of the Sadia Institute requested the cooperation of Sadia's industrial department, but the productive sector initially resisted as the digesters were not part of the goals established by its directory. After some negotiation between the Institute staff and the industrial directory, it was agreed that it would be part of the advisors' task to present the contracts and to check the digesters during their farm visits. In addition, one technician would work full time for the implementation of the 3S Program. Another challenge was in relation to the maintenance of the digesters. The outsourced farmers were not doing the maintenance as expected, what caused obstruction of the equipments and perforation of the plastic covers. These problems required training the outsourced farmers as well as controlling and solving practical problems. According to the technicians, this may be related to the fact that farmers' main motivation was to use the biogas as energy source instead of only reducing greenhouse gases emissions. According to engineers and coordinators, it may be a lack of instruction. With regard to the rules, in May 2006, the methodology AM006 entered in hold, causing uncertainty. In practice, the new methodology required the implementation of new extra monitoring-equipments. It almost doubled the implementation costs and reduced the number of farmers that could benefit from the program. Before continuing the digester implementation new cheaper technologies would have to be searched and adapted to the conditions of Sadia's outsourced farmers.

To sum up, the inclusion of outsourced farmers in BP is interpreted as both social and spatial expansion of the activity, as it involves a larger community and larger number of digester. The main logical reason that led to the expansion of the activity was the emergence of a disturbance in the chain of swine production. During the implementation of the program, several disturbances emerged. First, the new object of the 3S Program was not compatible with the aims of Sadia as a profit-making food industry, requiring the creation of a new non-profit organisation, the Sadia Institute. This mismatch is interpreted as a contradiction between the object of the profitable Sadia and the non-profitable Sadia Institute. The contradiction is presented in Figure 2 with lightning-shaped arrows with number 2. With the creation of Sadia Institute, the activity of biogas production had a character of being specialised in sustainability issues. The second disturbance was the lack of co-operation with the industrial department, which is interpreted as a contradiction between the object of the 3S Program (digester, reduction of greenhouse gases emissions, etc.) and the object of industrial department of Sadia (advisory services fro swine producers), shown in Figure 2 with the lightning arrow number 3. The third disturbance was the lack of a cheap digester that allowed the inclusion of all the farmers in the program. It is interpreted as a contradiction between the object and the tools (Figure 2, lightning arrow 4). The fourth disturbance was a change in the UNFCCC methodology that increased the cost of the tools, excluding many farmers from the program. It is as a contradiction between the rules and the tools (lightning arrow 5 in Figure 2). The fifth disturbance was with the maintenance of the digesters. Apparently, it may be that farmers are not directly motivated to reduce greenhouse gases emissions and also a lack of training in how to do the maintenance. It will be hypothesized as a contradiction between the community and the object (lightning arrow number 6 in the Figure 2). In general, the situation presented above was not satisfactory for Sadia Institute and Sadia executive board, because it was leading to problems and disturbances that slowed down the implementation of the 3S program, requiring solutions.

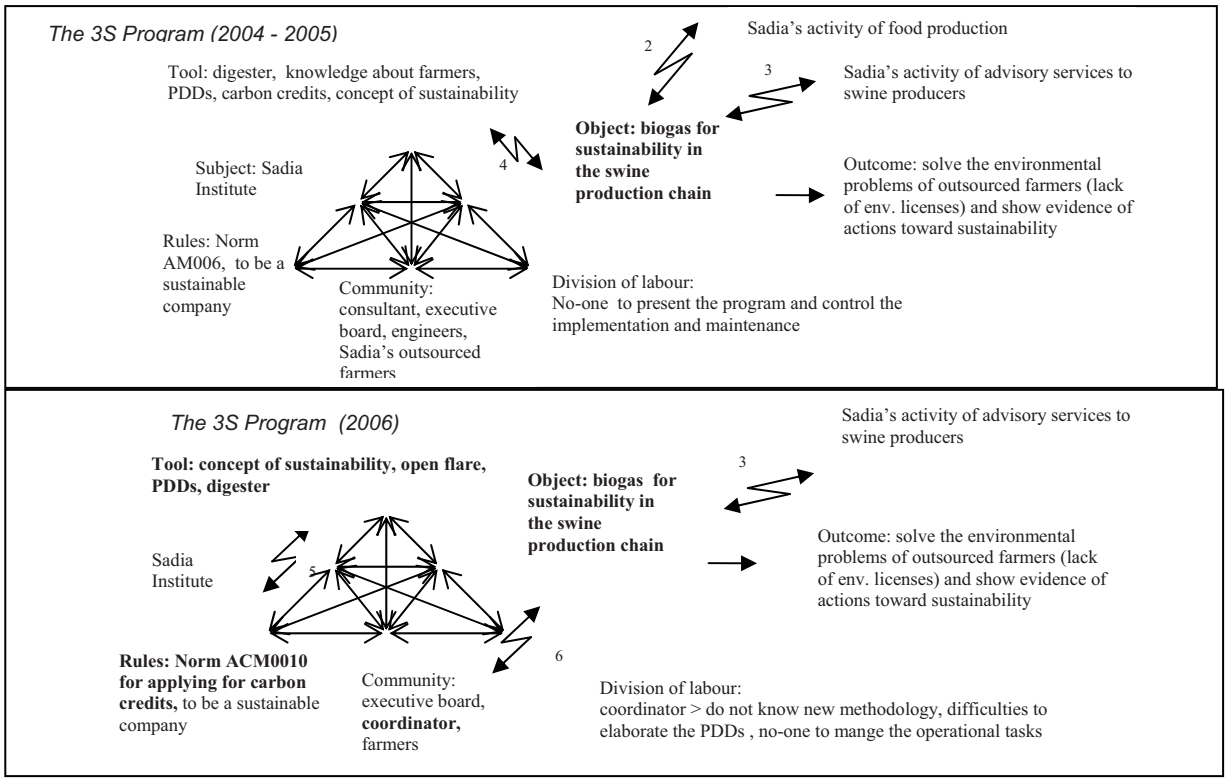

Figure 2. Tthe structure of the 3S program in the period between 2004 and 2006

The actual situation of the 3S Program

At the beginning of 2007, to deal with the challenges brought by the new methodological and the operational challenges, the Institute staff organised a meeting with the Sadia executive board. During the meeting, it was recognized that the program coordination was being unable to conduct operational tasks and a rearrangement in the division of operational tasks was necessary. Finally, new technologies started to be developed and tested in 2007 to deal with the technological challenges brought by the new methodology. Until the last data collection, in May 2007, the technologies were still under test. The Sadia Institute staff also perceived that it was necessary to make possible the biogas use for farmers in order to improve the maintenance of the digesters.

In 2007, although the object has not changed, the structure of the activity had changed significantly. Several solutions such as re-division of labour, hiring new staff, providing training courses to farmers and developing new tools were created. The new structure of the activity system is represented in Figure 3. All these changes are considered an expansion because they contribute to the continuity, the sustainability of the program.

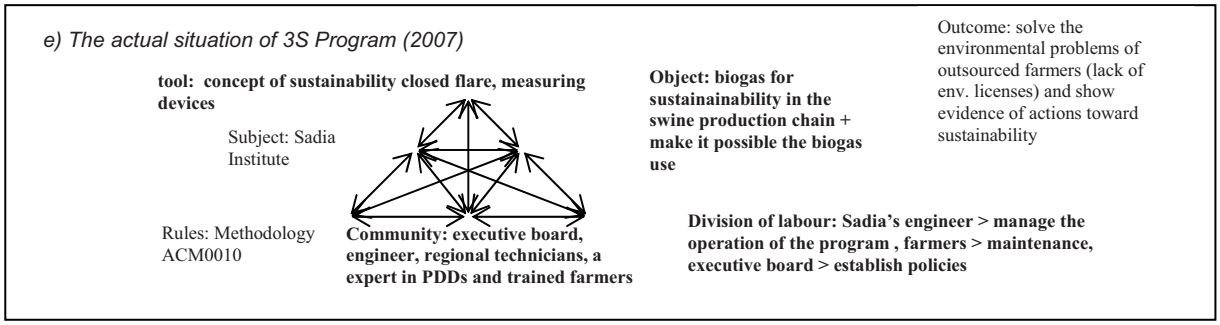

Figure 3. The structure of the 3S Program in 2007

The evolution and learning within biogas production

In this section, we will discuss first the nature of changes in BP, following by showing what had changed in structure and object of BP. Finally, we will show which of these changes are considered as expansive learning.

How has the nature of BP changed? The BP in Sadia emerged and scaled up through 4 periods, in which 3 are considered as phases. The phases were constructed with the help of the theoretical concepts of object, expansion and contradictions. In the previous stage of BPCC, "biogas production for swine manure treatment" (1998 – 2003), biogas was seen mainly as manure treatment system. During this period biogas production did not expand but stayed as experimental in few units of sow production. The first phase of BPCC, the "biogas for carbon credits" (2003 – 2004) is characterized by the emergence of biogas production for carbon credits. The initial idea was to produce carbon credits as extra income for the company. The next period, "biogas for reducing greenhouse gases emissions and treating swine manure (2004), biogas is seen as a solution to the contradiction between been a profitable company and being an environmentally sustainable company. The possibility for carbon credits again changed the character of BP, allowing the company to expand the digesters to all its 27 units of sow production, theoretically interpreted as a socio-spatial expansion. Moreover, the concept of sustainability started to mediate the actions of BP. In 2004, Sadia experienced a threat to its supply of raw material and its image of sustainable company. The problem is interpreted as a contradiction between the object of BPCC and the object of swine production. In the forth phase, "biogas for achieving sustainability in the swine production chain" (2004 – 2006), Sadia decided to expand the activity of BPCC to outsourced swine farmers as a way to solve the contradiction described above. It is interpreted as a socio-spatial expansion of the biogas activity to Sadia's 3500 swine outsourced farmers. During the implementation of the new object several disturbances emerged. Maybe the most important one was that a new non-profitable institute would have to be created in order to manage the sustainable development projects and programs. Again the activities acquired a new character due to the separation of sustainability from profit-making. In addition to the need of a non-profitable organization, other operational demanding changes in the structure of BP activity had to be made, e.g. the tasks were redistributed, the technology changed, and the community appeared.

What has changed? In general the material aspect of the activity does not change much in time, mainly new participants in the community and the tools, such as the digester, measures and flare. The main changes on the activity and the object were epistemic; it means that rather than material changes, they were changes in the meaning of the things. Figure 4 illustrates the different qualitative objects of BP between 1998 and 2007.The figures, 1, 2 and 3 illustrate the structure and the object. By comparing the figures, it is possible to see that many changes occurred.

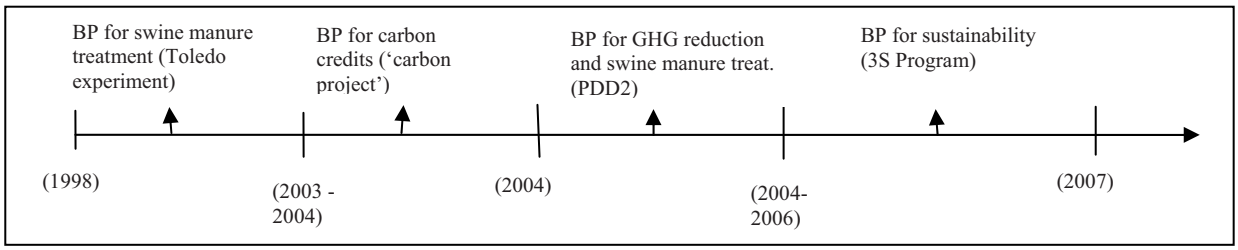

Figure 4. The different objects of BP in the case of study between 1998 and 2007.

As already mentioned in section 2, not all the changes can be classified as expansive learning. The definition of expansive learning has to be determined according to the practical domain, in order to adapt to the context of the activity that is being studied. In this paper, we have defined as learning: Sadia company's changes toward sustainability. We assume that BP is an attempt toward sustainability when a) the structure (tools, rules, division of labour, etc) allows the inclusion of outsourced farmers in the BP, or b) the motivation toward the object involves also the improvement of environmental conditions. In the case, the activity of BP started to expand at the moment that Sadia Institute was created and the 3S Program started to be designed. Since then, new tools were developed and the division of labour re-distributed in order to produce biogas among outsourced farmers. The new expanded structure is illustrated in figures 2 and 3. The object-motive of the activity expanded when 3S program started to be implemented among outsourced farmers, improving their swine manure treatment, reducing green house gases emission, odour, etc.

Conclusions

The analysis done here takes the perspective of Sadia Sustainability Team and later, that of the Sadia Institute. With this, we have on purpose studied biogas production on the activity level, where also some of the company's rhetoric about environmental sustainability is involved. Besides the learning and changes shown on this activity level, it is of outmost importance to analyse the actions and their changes. With regard to the generalization of the results, we conclude that the historical analysis of the trajectory of an activity has to be followed by further analysis of the everyday actions and interactions of participants to confirm whether and how the historical contradictions are manifested the everyday actions of actors. Such analysis is justified by the fact that collective activities are executed by actions conducted by individuals (Leontiev, 1978). Thus, for understanding learning, it is necessary to see how the findings obtained at a collective activity level are manifested at very local action level (Engeström, 1987). The actions of engineers, managers and the executive board seem to support the activity of BPCC. However, it is not possible to affirm that the same happen among technicians and outsourced farmers. It is possible that the object-motive of technicians and farmers is different from the object-motive of managers. We have to investigate if their actions support the BPCC activity.

As to the notion of social learning, this study shows how BP was directed by a motivating object. The trajectory shows a qualitative change in the object-motive of the BP activity from 1998 until 2007. While in 1998 the main object-motive was biogas for treat the swine manure, in 2007, the object included also the swine manure from outsourced farmers and the greenhouse gases emissions. Comparing the properties of the objects in different phases, it is possible to affirm that the expanded object of 2007 involves a larger community, a larger space and is more oriented towards the environment than the object from 1998. Moreover, it is not only the object that changed but also other elements of the activity, new tools (concepts and technologies), new organization structures and new division of labour were constructed.

The historical analysis using the proposed concepts was useful to show the dynamics of change that took place over time in the activity of BP; in other words, how the activity changed. The result from the case study confirmed the idea that contradictions are important forces that lead activities to change (Engeström, 1987; Engeström, 2001). By solving contradictions, new objects, new instruments and new organizational structures are created, changing the structure of the activity. The analysis also showed the concrete changes that took place in the activity. Such analysis is especially useful to identify the historical contradictions and problems that were affecting the activity in the past and may still be affecting at the present. Contradictions are important findings that could be used as a starting point in future interventions, e.g. learning platforms, in order to plan ways to solve them.

In the analysis, we have assumed that by producing biogas, the company automatically become more sustainable. However, the question of sustainability is much more complex than a simple biogas production. Further analysis is needed to asses if biogas production is or not a sustainable solution in swine production. Such question will be analysed in other studies. Other options than BP may be considered as attempts towards sustainability.

We finalize by hypothesizing that any profitable organization aiming to change their practices towards sustainability have to learn how to solve a basic contradiction between profitability and sustainability. To change actions towards sustainability implies to learn to change not only the object-motive of the activity but also the structure of the object production.

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