

Swedish Pig Farming from a Degrowth Perspective

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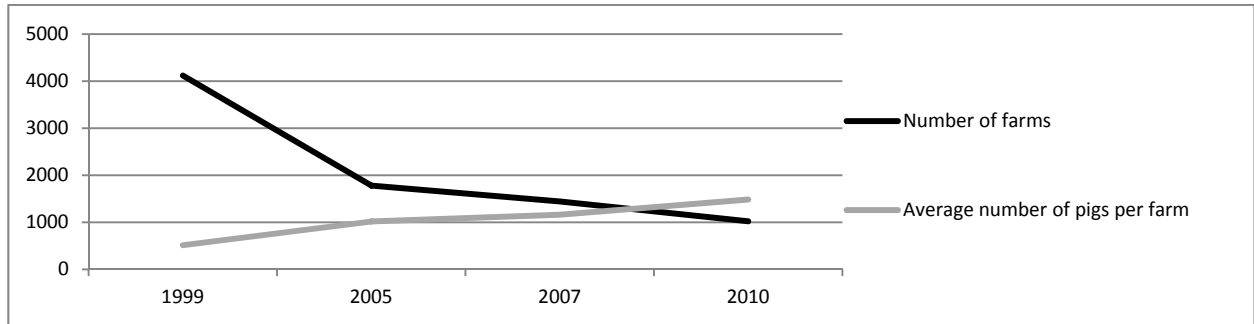
Abstract: This paper analyzes Swedish pig farming from a degrowth perspective. Primary (two farmers) and secondary (two LCAs) sources serve as representatives of different types of pig farming systems, and their activities and attitudes are assessed related to three keywords in Latouche (2009)'s degrowth utopia, namely *Re-evaluate*, *Reduce* and *Relocalize*. It is found that the LCAs and the conventional farmer do not show any signs of any of the three keywords, except from one LCA that discuss a possible shift from extreme specialization towards mixing different types of animals in one farm, and the keyword *Relocalize* where the two farmers agreed on a need for *Relocalization* of agriculture towards more local production and consumption. The LCAs and the conventional farmer shared views on *Reduction*, stating that emissions should be minimized within the current large scale farming system, but not touching upon the issue of *Reducing* pig production or consumption. The organic farmer called for *Re-evaluation* of the role of pigs in the farming and food systems, where his attitudes and methods were different from the other examples in that he did not focus on measuring and optimizing his production, but rather on what seemed suitable for the ecosystem and his farm.

Keywords: degrowth, agriculture, pig farming, LCA, Sweden

Introduction

Agriculture is one of the main sources of several environmental problems, such as global carbon cycle disturbance and biodiversity loss (Foley et al. (2011); Rockstrom et al. (2009)). It is necessary for sustainability to change towards more agro-ecological methods in agriculture and thus decrease the exploitation of resources (Pretty (2005); Bjorklund et al. (2012)). Meat is the category of food that, in high income countries, requires the most resources to produce and also has the largest environmental impact (Pimentel & Pimentel, 2003). This study focuses on pig farming as pork is the most common type of meat consumed in Sweden (SCB, 2013). The reform of the Swedish agricultural sector starting in 1947 aimed for increasing the mechanization and size of farms (Andersson, 1991), was aided by the availability of cheap energy, pesticides and chemical fertilizers (Bjorklund et al., 1999), and has changed the structure of the pig farming substantially. Previously, a Swedish farm typically held a few pigs, perhaps along with some cows and chicken, and the pigs were fed with household leftovers and harvest waste. The pigs thus functioned as converters of waste to high quality protein. Since 2002 it is not allowed to feed pigs with household food waste, for food safety reasons (Anonymous (2002)). Since 1980, the number of farms holding pigs in Sweden has decreased with 95% (SCB, 2013), while the average number of pigs per farm has increased from 500 to 1,500 between 1999 and 2010, see Figure 1. The most common way to raise pigs today is to keep them in large stables, feed them with a fodder mix that is optimized for conversion to meat at as high rate as possible (Stern et al., 2005).

Figure 1 : Number of pig farms and average number of pigs per pig farm and year (a snapshot on one day of the year), in Sweden, 1999-2010 (SCB 2013).



This paper analyzes pig farming in Sweden from a degrowth perspective, i.e. questioning that GDP growth is desirable in high income countries and suggesting a change in the human mindset, focusing on societal prosperity instead of income levels (Latouche (2009); Martinez-Alier et al. (2010a)). What could this degrowth approach mean for Swedish pig farming? Can I find any aspects of degrowth thinking in the existing Swedish pig farming systems?

The paper is structured as follows: Section 2 describes the methods and empirical material that was used. Section 3 develops the theoretical framework. Sections 4 and 5 go through the empirical findings. Section 6 relates the empirical material to the theoretical framework, and section 7 concludes.

Method

The methods of this paper comprise of two farm visits and assessments of systems analyses of Swedish pig farming found in literature.

Semi structured interviews with two pig farmers and site visits on their farms were performed. One farmer had conventional large scale pig production and the other had organic small scale pig production. The farmers were selected to capture as diverse production methods as possible, i.e. a diverse case selection method (Gerring, 2007). I compiled lists of two groups of farmers; conventional and organic; by asking the pig farmers' organizations *Sveriges Grisföretagare* (The Swedish Pig Farmers), an organization where mainly conventional farmers are members, and *Ekologiska Lantbrukarna* (The Organic Farmers), as well as searching for farms at the organizations' websites and asking around in my network. The reason for the categorization was that I identified organic/conventional as being the main difference between pig farming systems. These particular two farmers were chosen because they represent two extremes in pig farming; one is conventional, specialized and very large scale in a Swedish context, while the other is organic, has diversified production and is small scale when considering the pigs. The interviews were made in November 2013. They were partly recorded on tape and transcribed, partly transcribed from notes on paper. The farmers have seen and approved the parts of the interviews that are used in the paper.

Furthermore, two Life Cycle Assessments (LCA) of pig farms in Sweden were analyzed from a degrowth perspective. LCA is the most common type of environmental systems analysis of farming systems, and the reasons for including them in this paper were to broaden the representation of farming systems in my study and to see what role the LCA methodology could have in a degrowth analysis. These particular LCAs were chosen since they were the most recent studies that compared different types of Swedish pig production.

Theoretical framework: degrowth

Economic growth (GDP growth) is the overall goal in practically all countries in the world, and usually is seen as something indisputably positive for a country's prosperity (Jackson (2009); Kubiszewski et al. (2013)). However, GDP growth has several negative environmental consequences. Historically, there has been a positive correlation between natural resource use and GDP growth, as well as between emissions of e.g. greenhouse gases and GDP growth (Krausmann et al., 2009). If this relation continues, it can be argued that everlasting growth is not possible on a finite planet (Georgescu-Roegen (1971); Jackson (2009)). It is sometimes argued that a decoupling of growth from use of natural resources and emissions might be possible, since consumption can change from products into services and thus have a lower use of natural resources (Ausubel, 1996). Others however argue that decoupling is quite unlikely since, using the terminology of Odum and Odum (2001), services are high in the so called embodied energy hierarchy, i.e. a lot of energy is necessary to produce a service, and it is from this perspective thus unlikely that a society can be based on services and at the same time not use a lot of energy and resources (Odum and Odum (2001), pp65). Furthermore, increased efficiency is often counteracted by increased use of the product, the so-called rebound effect or Jevon's paradox (Sorman & Giampietro, 2013).

Furthermore, numerous studies conclude that after a certain income level, prosperity or happiness levels among a country's citizens cease to correlate positively with GDP (Easterlin (1974); Daly (1977); Jackson (2009)). Thus, if the goal of an already enough wealthy society is to increase the prosperity for its citizens, policy should focus on other things than increasing GDP.

However, as Jackson (2009) points out, there is a dilemma to GDP growth in most countries of today that is not easily solved. Because if the economy stops growing or contracts, no matter for what reason, this will lead to increased unemployment, which will lead to decreased demand for consumer goods, which will lead to lower incomes and more unemployment, more need for unemployment support, but lower tax incomes since fewer people are working – in the end there will be a deep recession. However, looking at this dilemma is not the scope of this paper (see Victor (2008)). Instead, this paper focuses on if aspects of what Serge Latouche (2009) calls a *degrowth utopia* can be found in the studied farming systems.

Although growth critique has been present in economics and related subjects at least since the 1960s (Boulding, 1966), the term degrowth was launched in international academia through a conference in 2008. Several attempts have been made to define degrowth since then (Latouche (2009); Schneider et al. (2010); van den Bergh (2011); Kallis (2011)). I have chosen to use the most recent definition, by Demaria et al. (2013), that is twofold and highlights both the ecological limits and the social mindset:

“On one side, degrowth is the reduction of energy and material throughput, needed in order to face the existing biophysical constraints (in terms of natural resources and ecosystem's assimilative capacity). On the other side, degrowth is an attempt to challenge the omnipresence of market-based relations in society and the growth-based roots of the social imaginary replacing them by the idea of frugal abundance.” Demaria et al. (2013) p 209

It is important to stress that degrowth does not mean decreasing GDP for the sake of decreasing GDP. On a global level, the throughput of energy and material needs to be decreased, but that does not mean that each sector or each country have to decrease in the same pace or by the same share. Contrary, several low income countries would probably benefit by increased incomes, and to give them the ecological space to do that, high income countries will have to decrease their throughput (Martínez-Alier, 2012). The prefix “de-” should, especially in the second part of the definition, be seen as notifying a change of focus, a relinquishment of “economic growth” when

defining prosperity (Kallis, 2011). It is not about decreasing the size of the economy for its own sake, but rather a way to increase our imagination of relations and purposes of activities, from narrow self interest and profit maximization towards other aspects of prosperity and wellbeing, and other types of relations than market relations. (Martinez-Alier et al., 2010)

In his book from 2007 (in English 2009), Serge Latouche develops what he calls a *degrowth utopia*. The utopia is made concrete through what he calls the virtuous circle of eight transformations that need to be done on all levels of society. These transformations will help implementing a sustainable degrowth society, and they are represented by eight words starting with ‘R’s (Latouche 2009, pp 33). Three of these words are of central importance, according to Latouche (2009, p 43-44), namely *Re-evaluate*, *Reduce* and *Relocalize*³⁰⁰, and these are the terms I will use to analyze my empirical material in this paper. I interpret *Re-evaluate* as corresponding to the second part of the degrowth definition above, while *Reduce* relates to the first part of the definition. *Relocalize* is a spatial concept that I find useful in analyzing agriculture, which is one of the most common land uses in the world (Foley et al., 2005). To specify *Re-evaluate*, Latouche (2009) suggests a number of values that he says should be changed in order to reach his degrowth utopia:

“Altruism should replace egotism, and unbridled competition should give way to cooperation. The pleasure of leisure and the ethos of play should replace the obsession with work. The importance of social life should take precedence over endless consumerism...”
Latouche (2009) p 34

Concerning pig farming, it could be a *Re-evaluation* of the role of pigs in the agricultural system, the role of the pig farmer in society, and of pork in people’s diets. *Reduce* refers to decreasing the effects on the ecosystems from production and consumption. In the context of pig farming, it could be interpreted as a reduction in resource use in pork production, and perhaps a reduction of pork consumption towards foodstuffs with lower demand of energy and material. Latouche (2009) defines *Relocalize* as making production and distribution of goods more local, closer to where it is consumed. Related to pig farming, it could imply that the pork consumed in Sweden and its inputs should be produced in Sweden.

Systems analyses of pig farms

Life Cycle Assessment is one of the most commonly used environmental assessment methods (Cederberg, 2002). In this section, two LCAs comparing different types of pig farming in Sweden are described. In the following sections, they will then be related to the farmer interviews and analyzed from the perspective of the three R’s.

The first LCA, by Stern et al. (2005), set up three hypothetical scenarios for pig farming and compare energy use, N and P emissions, pesticide and land use as well as greenhouse gas emissions from the three scenarios. The first scenario focused on what they defined as “high animal welfare”, including partly outdoor rearing and adding synthetic amino acids to the fodder to decrease nutrient leakage; “low environmental impact”, meaning an indoor system that was as closed as possible; and “high product quality and safety”, implying a technically advanced system with detailed monitoring of perfect ventilation, temperature, preventive use of antibiotics, etc. The aim of formulating these scenarios was to identify conflicts between different environmental goals, and the data used was from statistics and previous studies, extracted into the future.

The “low environmental impact” scenario should not be confused with the current organic (labeled with the Swedish environmental label KRAV) pig farming, since KRAV require outdoor rearing and does not allow synthetic amino acids to be added to the feed (Wallenbeck, 2012). The “high animal welfare” scenario is perhaps more similar to KRAV, although it had less outdoor rearing than required by the regulations for KRAV certification. The “high product quality and

³⁰⁰ The three keywords will be written in italics with capital R’s to be clearly distinguished in the text.

safety” scenario is most similar to today’s conventional Swedish pig production. The reason why the “high animal welfare” scenario is not considered as having low environmental impact is that some studies have shown that nutrient leakage can be high in KRAV systems (Jongbloed & Lenis, 1998). Stern et al. (2005) conclude that the “low environmental impact” scenario has the lowest emissions in all the studied parameters.

The second LCA, by Carlsson et al. (2009), studies the life cycle of organic pig farming in Sweden, using data from real farms and focusing on the activities within the farm gate. When comparing the results to conventional Swedish pig farming, they conclude that greenhouse gas emissions, eutrophication and acidification potential are on similar levels in organic as in conventional pig production. One of the main differences between the systems is that organic pig farming uses considerably more land, since organic pigs have to be reared partly outdoors, on land that does not produce much feed. They also conclude that manure from organic pigs usually have a higher content of N than conventional pigs’ manure. Carlsson et al. (2009) suggest similar improvement possibilities as in the Stern et al. (2005) scenario for low environmental impact, namely to add synthetic amino acids to the fodder and decrease the outdoor rearing.

Carlsson et al (2009) however go beyond the quantitative LCA methodological limits in their discussion, and note that although the quantitative land use is higher in organic pig production than in conventional, the qualitative land use is more positive in organic pig production since it includes more crop rotation and thus contributes to e.g. biodiversity. They also suggest an introduction of cows on an organic pig farm to make better use of the ley where the pigs graze. This would decrease the land needed for the pigs according to the LCA methodology, since the land would then be allocated between both cows and pigs.

Results from farm visits

This section describes the two visited farms and how the farmers viewed their activities. The two visited farms were situated between 40 and 200 kilometers from the Swedish capital Stockholm. The conventional farm consisted of around 120 hectares of fields, while the organic farm was 175 hectares. Both farmers only had slaughter pigs, i.e. they bought 12-week-old piglets from other farms and kept them until they were ready for slaughter (15 weeks for the conventional farmer and slightly longer, 4-5 months, for the organic farmer).

The organic farmer

The organic farmer raised around 100 pigs per year, alongside with some cows and sheep, and he grew most of his pig feed on his own land. He bought pre-made concentrate and sometimes wasted vegetables from an organic vegetables merchant. His production was certified with the Swedish environmental label KRAV and EU Organic.

He kept his pigs outdoors with small huts for weather protection. All pigs were in the same field from when they arrived at his farm until slaughter in his own slaughter house on the farm, and he kept pigs of different ages in the same field. He usually kept a few cows in the same field, since his experience was that if the grass is too long, the pigs will root instead of graze on it. The cows keep the grass short enough for the pigs to eat it. He did not monitor very carefully how much food his pigs eat.

When he started raising pigs, he used to have an integrated production, with his own sows that littered outdoors. But due to bad harvest one year he decided to quit with sows and decrease the production from around 900 to around 100 pigs per year. Another reason for decreasing the number of pigs was that he thinks that we should not eat very much pork. He returned to this issue when talking about that many pig farmers in Sweden have been quitting during the latest years: He said that he might not be sorry that there is a decrease of pigs raised indoors on concrete floors, because pigs do not have good lives when they are raised like that. He said that we should

not eat as much pork as we do today, since “cereals should not go through the animals” but be eaten by humans directly.

His pigs decided themselves where in the field they leave their manure. He said he could not imagine that the concentration of N or P would be too high since he had so few pigs.

As the farmer saw it, the pigs’ role in the farm system was being part of the crop rotation, adding manure to the fields. Their main contribution to the farm, he said, was however that they make new customers find their way to the farm. Ham is the traditional Christmas dish in Sweden, and there is an increased demand for organic Christmas ham. Many customers thus find the farm when searching for organic ham, and some of them return to buy other products as well.

The organic pig farmer said that he saw his task as a farmer as very important for the environment as well as for food security. He believed that national self sufficiency of food is an important issue that should be prioritized in policymaking. He said that it is difficult for individual member states to have a different policy with harder environmental regulations than other member states of the EU, and that this is a problem.

The organic farmer expressed the following thoughts about the focus on economic growth in high income countries:

“We have a society that is dependent on constant expansion and increased welfare, more all the time, otherwise there will be a crisis. But perhaps it is enough now, perhaps we can be satisfied and work less? But how? To say stop, it’s enough now, we don’t need more. At least take a break and wait so that other countries can catch up. But no politicians are suggesting anything like that.”

The conventional farmer

The conventional farmer had 4,700 stable places for pigs, meaning that he raised around 15,000 pigs per year. He grew some of his feed on his farm, bought some from neighbor farmers and had agreements with a brewery, a dairy and a bakery to receive food waste from them. He also bought pre-made concentrate. He participates in a project that develops models combining environmental and economic sustainability on conventional farms.

The farmer had invested heavily in the pig production during the latest years. His pigs were surveyed through an advanced computerized system that regulates ventilation, temperature, feed, etc. The feed composition was calculated according to a model by Swedish agronomy researchers for optimal conversion from feed to meat. The liquid feed was transported from large containers through pipes to each of the ten pig departments, three times per day. He had approximately three batches of pigs per year in each department, and the stables were cleaned automatically by cleaning robots between each batch of pigs. The manure distribution system was sophisticated with large covered tanks that could store manure for a year and pipes to distribute the manure on the fields. He was not planning to invest more in the pigs during the coming years, since it is difficult to get profitability in pig farming. If he would be forced to close down his pig production it would mean a huge economic disaster, he said, since the recent investments have no alternative use than raising pigs.

Before the structural change starting from 1947 (see section 1), most Swedish farms had a few pigs that were fed with household food waste. According to the conventional farmer, the system has not changed very much since then, since industrial food waste is still a significant share of many pigs’ feed. He thought that it is important to highlight that pork has a low climate impact compared with e.g. beef. He said that this is often ignored in environmental analyses of food production, and if it would be included the climate impact might be practically as low as for chicken, since food waste has almost zero climate impact.

He thought that his farm was a good example of efficient pig farming. His pigs had a high weight growth per day and a high growth per kilo feed, which were the main indicators by which he measured efficiency. The farm could perhaps become even more efficient by increasing the number of pigs, he said, or by integrating sows on the farm as well, but he did not have any plans to do that for the time being.

He said that Swedish pig farmers are not able to compete on equal conditions with producers in e.g. Denmark and Germany, since Sweden has stricter animal protection laws that make the production more expensive. A solution would be to remove the stricter Swedish laws so that the competition would be fairer, he said. That would however probably not improve the profitability to any large extent, since consumers view pork as a cheap type of meat according to the farmer – “a pig is not worth much, neither here nor in Europe”. He said that Swedish politicians should support Swedish farmers more. Since Swedish pig production becomes more expensive because of the stricter laws, Swedish municipalities and counties should not be allowed to buy foreign pork produced with methods that are prohibited in Sweden.

Consumers’ attitudes towards food have changed during the latest 10-15 years, he said. Nowadays, food has to look perfect to be possible to sell in a shop.

“I assure you, you will see on a potato if it’s bad – then it’s rotten! It is not bad just because it has a little spot! Consumers are hypersensitive. Just peel a few extra peels and it will look fine again. Soon it will be dangerous to eat. The problem is that consumers are totally disconnected from the farms today, so they don’t know what a product is like when it’s bad. Everyone live in cities now. The grocery stores have an important role to play here. They are the ones who meet the customers, and they should inform them about food quality and waste. But instead, they are reinforcing the trend with spotless food.”

Discussion

In this section, the results from my analysis of the LCAs and farm visits are discussed in relation to the three R’s of Latouche (2009).

Re-evaluate

The LCA by Stern et al. (2005) is an example of a systems analysis that aims to optimize the environmental sustainability within the current system, without questioning whether specialized indoor pig farms are sustainable in the first place. The study thus has no sign of *Re-evaluation* of the farming system in Latouche’s meaning.

Carlsson et al. (2009) however do touch upon a *Re-evaluation* of the current Swedish agricultural system in their LCA, when suggesting that cows could be introduced on pig farms. The agricultural policy has for decades focused on increasing specialization and size of farms, so that farmers would have only one type of animals or only cereals, which has led to an oversupply of manure in the animal intensive regions and a deficiency in cereal producing regions (Larsson & Granstedt, 2010). A practical example of this type of *Re-evaluation* was also seen in the organic farmer’s combination of cows and pigs in the same field.

Both interviewed farmers brought up the difference in regulations between Sweden and other EU countries. The organic farmer viewed conventional production as being bad for the pigs and for the environment, and argued that we should not eat as much pork as we do today. The conventional farmer, on the other hand, said that if all pigs would be raised according to Swedish organic KRAV regulations, it would be a disaster for the environment because the nutrient leakage would increase. The organic farmer’s perspective might be seen as a change of values from to-

day's focus on large scale production, while the conventional farmer's analysis is further enforcing the current dominant view that efficient pig production is large scale production with low emissions per kilo meat, and that farmers should raise as many pigs as consumers demand.

The conventional farmer focused on measuring and optimizing his system to achieve as high production as possible, while the organic farmer did not monitor his pigs very closely. He kept pigs because he thought they were fun animals to have around, and because they contributed with ecosystem services such as manure to his fields. The organic farmer's attitude can partly be interpreted as an example of *Re-evaluation* of the aim of pig farming, away from measuring and profit maximization. However, another of the organic farmer's reason was to make customers find his farm, which is a market based focus.

Reduce

The main focus of the study by Stern et al. (2005) is to *Reduce* the effects from pig farming on the ecosystems, such as emissions of N and P. The solutions they suggest focus on making the system closed in order to control the emissions. However, a *Reduction* of the number of pigs raised is not considered as a likely measure to decrease emissions:

“Pig production per se will probably not decrease globally because pig meat is a rather efficient method of producing meat compared with beef, although it is not as efficient as chicken.” Stern et al. (2005) p 407

In the quote, “efficient” is referring to converting feed to meat, i.e. that pigs need less feed to produce a kilo meat than cows do.

Carlsson et al. (2009) have a similar approach to pig farming and take the demand of pigs as given. Also the conventional farmer expressed thoughts that could be interpreted as *Reducing* emissions within the given demand of pork, i.e. producing the number of pigs that customers want to eat, using the same example as Stern et al. (2005), comparing climate impact from pigs with that from cows and chicken. The organic farmer expressed a broader aim than stopping climate change, when talking about *Reducing* economic growth in Sweden to enable other countries to catch up.

Common for the surveyed LCAs is that organic pig production has lower emissions than conventional per hectare, because of the lower density due to the larger land use per pig, but higher emissions when calculating per kilo. If it is considered that there are specific un-negotiable limits of certain emissions (such as N and CO₂) in an area (such as suggested by e.g. Rockstrom et al. (2009)), a solution to stay within those limits would be to keep fewer animals in that area. The question then arises; should the animals be raised with conventional or organic methods? If fewer but conventional pigs were kept, the emissions would be lower than for fewer and organic pigs, according to the conclusions of the surveyed studies. However, as pointed out in Carlsson et al. (2009), land use in organic pig production is qualitatively better since it implies cyclical flows of nutrients, higher biodiversity because of crop rotation, etc. Furthermore, a small conventional farm would still have higher animal density than a small organic farm, given that the farmer follows the regulations and builds stables that are no larger than required. Animal density is in itself a problem from an environmental sustainability point of view and need to be *Reduced*.

Relocalize

None of the LCAs suggested *Relocalization* of pig farming. Both farmers, however, expressed similar thoughts about *Relocalization*. The conventional farmer's assessment, that the consumer is too distant from the food production and does no longer have the knowledge to judge if a potato is eatable or not, can be seen as wish to *Relocalize* the agri-food sector and bring production and consumption closer to each other. The organic farmer's slaughter house and farm shop can be seen as a practical example of such *Relocalization*, since his customers do see where and how the

animals they eat live, and are able to talk directly to the farmer about the quality of the food they buy.

Both farmers saw the common market and regulations of the EU as a problem for national integrity and independence, and thought that self sufficiency of food should be higher on the political agenda. Certainly, as Swedish food producers, they would personally gain from such a change.

Conclusions

This paper has shown that the farmers' approaches to their work differ in many aspects, but were similar in one: Both farmers were concerned with *Relocalization* of farming in general. This was not a view that was found in the LCAs.

The LCAs and the conventional farmer had similar views considering *Reduction* of emissions from pig production to be important, and their view that conventional farming had lower emissions than organic showed a narrow system boundary that does not question the farming system as such. The organic farmer's attitude differed from the others: he meant that pig production and consumption need to be *Reduced*, and also talked about *Reduction* on a larger scale when stating that the Swedish economy should not grow further.

The analyzed LCAs were mainly taking the demand of pork as given and not containing many aspects of degrowth thinking. These LCAs might thus be able suggest environmental improvements on the margin, but perhaps not solve the environmental challenges that might require systemic transitions. The conventional farmer had a similar approach, seeing as his task to produce as much pork as the customers want in the most cost-efficient manner from the farm perspective. The organic farmer, however, show signs of *Re-evaluating* the system by questioning how much pork that should be produced and consumed, and by having partly non-market focused aims with his pigs.

References

- Andersson, Å. (1991). Lantbruket och Lantbruksstyrelsen åren 1890-1990. In Statens jordbrukspolitik under 200 år. J. Myrdal. Stockholm, Nordiska Museet: 65-77.
- Anonymous (2002). Regulation (EC) No 1774/2002 laying down health rules concerning animal by-products not intended for human consumption. 1774/2002. E. Parliament and E. Council.
- Ausubel, J. H. (1996). The Liberation of the Environment. *Daedalus* 125(3): 1-17.
- Bjorklund, J., Araya, H., Edwards, S., Goncalves, A., Hook, K., Lundberg, J. & Medina, C. (2012). Ecosystem-Based Agriculture Combining Production and Conservation-A Viable Way to Feed the World in the Long Term? *Journal of Sustainable Agriculture* 36(7): 824-855.
- Bjorklund, J., Limburg, K. E. & Rydberg, T. (1999). Impact of production intensity on the ability of the agricultural landscape to generate ecosystem services: an example from Sweden. *Ecological Economics* 29(2): 269-291.
- Boulding, K. E. (1966). The Economics of the Coming Spaceship Earth. In *Environmental Quality in a Growing Economy*. H. Jarrett. Baltimore, MD, Resources for the Future/Johns Hopkins University Press: 3-14.
- Carlsson, B., Sonesson, U., Cederberg, C. & Sund, V. (2009). Livscykelanalys (LCA) av svenskt ekologiskt griskött. SIK Institutet för Livsmedel och Bioteknik.

- Cederberg, C. (2002). *Life Cycle Assessment (LCA) of Animal Production*. Göteborg, Göteborg University, Department of Applied Environmental Science
- Demaria, F., Schneider, F., Sekulova, F. & Martinez-Alier, J. (2013). What is Degrowth? From an Activist Slogan to a Social Movement. *Environmental Values* 22(2): 191-215.
- Easterlin, R. (1974). Does Economic Growth Improve the Human Lot? Some Empirical Evidence. In *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*. P. A. R. David, Melvin W. New York, Academic Press.
- Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., Chapin, F. S., Coe, M. T., Daily, G. C., Gibbs, H. K., Helkowski, J. H., Holloway, T., Howard, E. A., Kucharik, C. J., Monfreda, C., Patz, J. A., Prentice, I. C., Ramankutty, N. & Snyder, P. K. (2005). Global consequences of land use. *Science* 309(5734): 570-574.
- Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., Mueller, N. D., O'Connell, C., Ray, D. K., West, P. C., Balzer, C., Bennett, E. M., Carpenter, S. R., Hill, J., Monfreda, C., Polasky, S., Rockstrom, J., Sheehan, J., Siebert, S., Tilman, D. & Zaks, D. P. M. (2011). Solutions for a cultivated planet. *Nature* 478(7369): 337-342.
- Georgescu-Roegen, N. (1971). *The Entropy Law and the Economic Process*. Cambridge, Mass., Harvard University Press.
- Gerring, J. (2007). *Case Study Research. Principles and Practice*. New York, Cambridge University Press.
- Jackson, T. (2009). *Prosperity without growth: economics for a finite planet*. London, Earthscan.
- Jongbloed, A. W. & Lenis, N. P. (1998). Environmental concerns about animal manure. *Journal of Animal Science* 76(10): 2641-8.
- Kallis, G. (2011). In defence of degrowth. *Ecological Economics* 70(5): 873-880.
- Krausmann, F., Gingrich, S., Eisenmenger, N., Erb, K.-H., Haberl, H. & Fischer-Kowalski, M. (2009). Growth in global materials use, GDP and population during the 20th century. *Ecological Economics* 68(10): 2696-2705.
- Larsson, M. & Granstedt, A. (2010). Sustainable governance of the agriculture and the Baltic Sea — Agricultural reforms, food production and curbed eutrophication. *Ecological Economics* 69(10): 1943-1951.
- Latouche, S. (2009). *Farewell to growth*. Cambridge, Polity.
- Martínez-Alier, J. (2012). Environmental Justice and Economic Degrowth: An Alliance between Two Movements. *Capitalism Nature Socialism* 23(1): 51-73.
- Martinez-Alier, J., Pascual, U., Vivien, F.-D. & Zaccai, E. (2010). Sustainable de-growth: Mapping the context, criticisms and future prospects of an emergent paradigm. *Ecological Economics* 69(9): 1741-1747.
- Odum, H. T. & Odum, E. C. (2001). *A Prosperous Way Down*. Boulder, University Press of Colorado.
- Pimentel, D. & Pimentel, M. (2003). Sustainability of meat-based and plant-based diets and the environment. *American Journal of Clinical Nutrition* 78(3): 660S-663S.

- Pretty, J. (2005). Sustainability in Agriculture: Recent Progress and Emergent Challenges. In Sustainability in Agriculture. R. M. Harrison and R. E. Hester, RSC Publishing.
- Rockstrom, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sorlin, S., Snyder, P. K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R. W., Fabry, V. J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. & Foley, J. A. (2009). A safe operating space for humanity. *Nature* 461(7263): 472-475.
- SCB (2013). Yearbook of agricultural statistics 2013.
- Schneider, F., Kallis, G. & Martinez-Alier, J. (2010). Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue. *Journal of Cleaner Production* 18(6): 511-518.
- Sorman, A. H. & Giampietro, M. (2013). The energetic metabolism of societies and the degrowth paradigm: analyzing biophysical constraints and realities. *Journal of Cleaner Production* 38: 80-93.
- Stern, S., Sonesson, U., Gunnarsson, S., Öborn, I., Kumm, K.-I. & Nybrant, T. (2005). Sustainable Development of Food Production: A Case Study on Scenarios for Pig Production. *AMBIO: A Journal of the Human Environment* 34(4): 402-407.
- Wallenbeck, A. (2012). Foder till grisar i ekologisk produktion. Uppsala,
- van den Bergh, J. C. J. M. (2011). Environment versus growth - A criticism of "degrowth" and a plea for "a-growth". *Ecological Economics* 70(5): 881-890.
- Victor, P. A. (2008). *Managing Without Growth. Slower by Design, not Disaster*. Northampton, Edward Elgar Publishing, Inc.