Will Poland Make the Same Mistakes as Sweden?

Opportunities and challenges for a transition to Ecological Recycling Agriculture to save the Baltic Sea environment

Artur Granstedt, Sheshti Johansson, Maria Micha and Małgorzata Lekan

Will Poland Make the Same Mistakes as Sweden?

Agriculture and the Baltic Sea with a special focus on Poland

‘

Artur Granstedt, Sheshti Johansson, Maria Micha and Małgorzata Lekan

Cover photo: Sofi Gerber

Printing: Kringel-offset AB, Södertälje
1st edition, August 2017
SBFI-rapport nr 3, ISBN 978-91-639-4478-9

SBFI
SWEDISH BIODYNAMIC RESEARCH INSTITUTE

Abstract

The overall aim of this study was to identify obstacles and to find the missing links of e.g. education, access to knowledge, market oriented efforts and agricultural policy changes to change current development and realize Ecological Recycling Agriculture in the Baltic Sea region with special focus on Poland. Despite the BSAP agreement, nitrogen and phosphorus loads from agriculture have not decreased according to goals. According European Court of Auditors this is due to weak implementation of BSAP commitments. In addition, the BSAP measures mainly address symptoms, not underlying causes as described in the BERAS publications and in this report. Poland increased agricultural nitrogen surplus from 33 kg N per ha in 1995 to 52 kg per ha in 2010. Currently, Poland is the largest polluter of both nitrogen and phosphorus to the Baltic Sea. Emissions of greenhouse gasses generated by agriculture are almost 80 % higher in Polish agriculture compared Ecological Recycling Agriculture and also higher than Swedish agriculture. We have investigated what is needed for the individual farmer to decide to transition to an agricultural system based to a greater extent on local and renewable resources to save the environment, climate and to produce high quality food without toxic substances. Suggestions for policy changes were put forward by the BERAS project and presented in more detail for more effective recycling agriculture based on local integration of crop and animal production and diversified crop rotations including perennial grassland with nitrogen fixing crops on all farms.

Acknowledgements

We are taken by all efforts by wonderful people to provide the help we needed during travelling in Poland as well as in writing this book. First, we want to direct our warmest thanks to Dr. Jarosław Stalenga for co-ordinating case studies, translating interviews and even leading the group discussion in Pokrzydowo in our place, as we do not speak Polish. He booked our hotels, picked us up on train stations, ordered food, and most importantly – generously shared his knowledge, expertise and network of farmers, researchers and policymakers in Poland. Maria Staniszewska has also been a key person, as she organized our first case study, translated the interview and even returned to the farmer and helped fill in data required for making a nutrient balance on the specific farm. We cannot thank her enough for how she open-heartedly shared her knowledge and long experience from being an active representative of the ecological movement in Poland. We are very grateful as well to Dr. Jerzy Kopinski, the main expert in Poland delivering data to the bureau of national statistics, for sharing data on nutrient flows in Polish agriculture and checking our results of the calculations of regional nutrient balances in Poland. He participated in our case studies near Puławy and his input to the discussions was very valuable. Another most important person to us in this project is Justyna Lesiewicz. She organized a case study in the Minikowo region so that we could have an interesting discussion with advisor Bożena Blaszyńska and Agnieszka Dobosz-Idzik, she interpreted for us with during our visit and her warm manner made this co-operation heartfelt and memorable. She also organized a meeting with the Director Ryszard Kamiński at the Kuyavian-Pomeranian Agricultural Advisory Centre in Minikowo (KPODR). Aleksander Banasik and Katarzyna Jasińska organized our case study visit near Gdańsk, picking us up at the train, following us to the farm, helping us with interpretations as well as sharing their own knowledge as we interviewed the two of them at the Pomeranian Agricultural Advisory Centre in Luban. Very special thanks also to Professor Józef Tyburski, who met up with us in Szezcinek the day before our case study at the Juchowo farm close to the German border in western Poland. Józef shared his deep knowledge in crop production with humour and friendly sarcasm, and his presence in the study visit, the farmers meeting in Pokrzydowo, as well as at the final seminar in Puławy has been very important for our findings. Thanks to Eva Johansson M.Sc., for editing, layout and contributions to the final version of this project.

We gratefully acknowledge funding support from the Axel and Margaret Ax:son Johnson Foundation. Without this support, we would not have been able to realize this urgent project for the Baltic Sea.

Last, but definitively not least, we owe our greatest thanks to the farmers we visited for taking their time and sharing their experiences, inviting us to their homes and generously giving us delicious pastries and coffee or lunch.

Dziękujemy!

Artur, Sheshti, Maria and Małgorzata

Contents

Summary

Artur Granstedt

The overall aim of this study was to identify obstacles and to find the missing links of e.g. education, access to knowledge, market oriented efforts and agricultural policy changes to change current development and realize Ecological Recycling Agriculture in the Baltic Sea region. This report is a follow-up study of research conducted within two previous partly EU-financed projects BERAS (Baltic Ecological Recycling Agriculture and Society), carried out 2003-2006 and BERAS Implementation, 2010 – 2013.

Agriculture contributes about half of total waterborne nitrogen and phosphorus inputs to the Baltic Sea. This nutrient leaching is responsible for eutrophication, algal blooms, reduced water clarity, changes in species composition, and finally reduced oxygen concentrations in bottom waters and increased areas of dead sea bottoms. According the latest HELCOM assessment of eutrophication in 2007 to 2011 almost the entire open Baltic Sea was assessed as being atrophied (HELCOM 2017). Dead zones have increased 10-fold over the last 115 years, growing from approximately 5 000 km² in 1900 to more than 60 000 km² in recent years.

Baltic Sea Action Plan (BSAP), signed by all Baltic Sea countries' governments in 2007, is the basis for work within HELCOM (Baltic Marine Environment Protection Commission, also known as Helsinki Commission) to save the environment in the Baltic Sea and restore the environment to a good ecological status by the year 2021. Despite the BSAP agreement, nitrogen and phosphorus loads from agriculture have not decreased according to goals. According European Court of Auditors this is due to weak implementation of commitments. In addition, the BSAP measures mainly address symptoms, not the underlying causes as described in the BERAS publications and in this report.

Ways to enable this essential transition, involving improved farm advisory services, changed eating patterns and agricultural policies, were presented by the BERAS Implementation project. Advice on how to implement Ecological Recycling Agriculture and how to convert a farm to this system was published in the languages of the countries included in the BERAS Implementation project. We have identified parameters that prevent the transition process we see as necessary in the Baltic Sea region. We have followed up of the current environment status through analysis of statistics, a review of scientific literature regarding agricultural development in the Baltic Sea region; and present interviews with farmers and other important actors in the agricultural sector to try to find possibly ways for a conversion of the Polish Agriculture.

Poland increased the surplus of nitrogen from 33 kg N per ha 1995 to 52 kg N per ha in 2010 and is total the highest polluter of both Nitrogen and phosphorus to the Baltic Sea. Emissions of greenhouse gasses generated by agriculture are almost 80 % higher in Polish

agriculture compared Ecological Recycling Agriculture and also higher than Swedish agriculture.

Sales of plant protection products (pesticides) in Poland have increased significantly since 2005. And are now the highest in the EU countries in the Baltic Sea drainage area, and twice as high compared to Sweden. We found a decline in the organic farming sector which might imply that there is limited institutional and economic support for this type of agriculture.

While cereal farms are dependent on purchases of artificial fertilizers, an ever-greater excess of nutrients in the form of animal manure accumulates on the specialized livestock farms – leading to two unclosed loops with linear flows. Intensive livestock production farms tend to be localized in the same areas and it is from these regions losses of nutrients to streams, lakes and oceans are the greatest. These farms are dependent on fodder from specialized crop farms, with both regional and international imports, especially soya beans from South America with deforestation as one of the environmental consequences. For this reason, we use the term of linear flows of nutrients: Input of nutrients in form of artificial fertilizers → crop production → animal production → surplus of nutrients in manure → output in form of emissions nitrogen and phosphorus to the environment. Phosphorus and nitrogen compounds from manure flow to rivers, lakes and seas leading to eutrophication; excess nitrogen also affects the climate in the form of nitrous oxide emissions (N_2O, known as laughing gas). Emission of greenhouse gases (both nitrous oxide and carbon dioxide) takes place in the beginning of this chain through fertilizer production. Emissions of nitrogen, in the form of ammoniac (NH_4) oxidized to nitrate (N_2O), become acid rain.

In the Baltic Sea region, the specialization process was initiated mainly during the latter part of the 20th century in the industrial agricultural regions, first in Denmark and then in Sweden and Finland, and also in Estonia, Latvia and Lithuania already during the communist regime. In Poland, agriculture was bound in a traditional, pre-industrial structure connecting farm family use and local markets with low inputs of external resources and low emissions of plant nutrients and pesticides. After Poland and the Baltic countries joined the European market, agriculture was forced to the open market economy and the European agriculture policy with new alternatives for the future.

As a consequence of a market oriented agriculture, a structure rationalization to more economical size of the farms took place after 2003. The 2.5 million farms with an average farm size of 6.6 ha in 2005 were reduced to 1.4 million farms with an average size of 10,5 ha in 2013 (even this is relatively small compared to EU average of 16.1 ha). During the same time, the number of stockless farms has increased from 39% to 56%, integrated farms have decreased from 37% to 29% and 14% of the farms specialize in cattle production. This structural rationalization was done by repeating the mistakes of the "early industrialized agricultural economies". Instead of learning from these countries mistakes and from the

BERAS project results, with integration and recycling of plant nutrients between crop and animal production, the opposite happened.

The greatest increase of fertilizer use has been in Poland after 2005 and Poland has gone from being a low polluter to being a high polluter per agricultural land unit. This has far-reaching consequences because Poland has more agricultural land draining into the Baltic Sea than any other country. Almost 40% of farm land draining into the Baltic Sea is in Poland. The future of agriculture in all the countries around the Sea, and particularly in Poland, will have consequences for the future of the Baltic Sea.

Agriculture is at a crossroads. One direction is the continuing current trend – intensive crop farms dependent on imported mineral fertilizer and pesticides and specialized livestock farms dependent on imported feed – which will inevitably lead to increasing damage in the Baltic Sea catchment area. The other direction is the long-term solution for reducing eutrophication as well emissions of greenhouse gases from agriculture by balancing crop and livestock production, to close the loops according to the principles of Ecological Recycling Agriculture. Nitrogen load could then be reduced by 70% and phosphorus losses reduced to a level that would prevent further eutrophication from agriculture in the Baltic Sea region. There are model farms that demonstrate the feasibility of this farming system in eight countries surrounding the Baltic Sea.

In contrast to conventional agriculture, ERA-production reduces use of fossil resources by eliminating artificial fertilizers and pesticides, instead enhancing carbon sequestration through relatively large areas of semi-perennial grasslands that include legumes on all farms. Preliminary studies indicate that on a farm by farm basis, methane gas emissions from animal husbandry are compensated by grassland carbon sequestration. A total conversion to Ecological Recycling Agriculture combined with a diet with less meat, should make it possible to reach the goal to reduce the emission of greenhouse gases from the food sector with 80 % from the food sector and reach the goal for the agreement in Paris 2015.

We have investigated what is needed for the individual farmer to decide to transition to an agricultural system based to a greater extent on local and renewable resources to save the environment, climate and to produce high quality food without toxic substances.

Suggestions for policy changes were put forward by the BERAS project and presented in more detail here for more effective recycling agriculture based on local integration of crop and animal production and diversified crop rotations including perennial grassland with nitrogen fixation crops on all farms.

A new, further developed CAP-reform needs to include the following conditions

1. **Coupling crop production and animal production for recycling of organic biomass and nutrients**: This is realized through a requirement for all animal farms to not have more animals than can be fed from own produced fodder (or from a farm in close cooperation in an exchange of fodder and manure). We propose that the maximum amount of fodder that can be imported to a farm is 20% of the total requirements, according to Granstedt et al. (2008).
2. **Crop rotation for rebuilding the soil organic matter and biological support of nitrogen:** There should be a requirement for all farms to have a diverse crop rotation with, at minimum, a third of the area with grassland including sufficient amounts of nitrogen fixating legumes (so the farm can be independent of artificial nitrogen fertilizer)
3. **Protection of the living organism and biological diversity in soil and landscape:** This is realized by adding a requirement to stop use of chemical pesticides - namely the current organic standards.

Chapter 1. Introduction

Artur Granstedt, Sheshti Johansson & Maria Micha

We are four researchers, connected by our interest in the interactions of humans and nature and the questions of why we have gone so wrong that all the current global environmental challenges have arisen. We come from varied backgrounds but arrived at the same conclusion: agriculture is a key issue for future sustainability. We believe that agriculture must be an activity shared between species from the kingdoms of both plants and animals, and that our role is to direct these co-operations so that they interact in a positive feedback loop.

In the Baltic Sea region, we've seen how modern agriculture has contributed to a host of problems including creating dead sea bottoms and extensive algal blooms. Professor Artur Granstedt has investigated the potential impact of a large-scale transition to agriculture according to ERA-principles within the Baltic Sea region and concluded that transitioning to ERA-principles to would contribute significantly to improving the state of this dying sea, reduce the global warming effect from the food sector and protect nature and humans from the use of pesticides (Artur Granstedt, 2012). Artur Granstedt has spent a large part of his life as a researcher establishing the concept of ERA – Ecological Recycling Agriculture. ERA describes a collection of agricultural recycling principles, including crop rotations with leguminous leys and a balance between animal and crop production; ensuring manure and nutrient recycling and sufficient fodder production at each farm. Sheshti Johansson, Technologie licentiate, has worked with questions of food versus biofuels, and food production in a future with less access to fossil fuels. Her research has shown that biofuel production may have negative impacts on crop rotation but that co-operation with draught horses better balances the whole farm system (Johansson, 2013). Her conclusions also led

to support for the ERA principles mentioned above. Maria Micha, Master of science, contributed to spreading the ERA concept through the BERAS-project: *Building Ecological Recycling Agriculture and Societies*, by interviewing and documenting farm cases around the Baltic Sea region (Micha, 2013). These projects included partners and associated organisations from all countries around the Baltic Sea, and the idea was born to work with some of these contacts in Poland to focus a project on agricultural development in the country with largest agricultural area next to the Baltic Sea. Małgorzata Lekan studies how policies can be used to stimulate more sustainable food production with a special interest in EU Common Agricultural Policy (CAP) (Lekan, 2017). She has special interest in, and understanding of, Polish agriculture.

Background

"Please do not repeat the mistakes of the early industrialized agricultural economies" was the strong message to Poland and the Baltic states that came out of the Baltic Sea Region projects BERAS and BERAS Implementation. When comparing national data on surplus nitrogen and phosphorous leaching from agriculture with the historical trajectories of agricultural development it was clear that the road of specialization embarked on by Denmark, Germany, Finland, Norway and Sweden had led to increasing pressure on the environment within the Baltic Sea region (BSR) and ultimately the Baltic Sea. Current implementations of markets and policy for agriculture point toward increasing specialization in the entire region. By using agricultural development of Sweden as an example, we hope to shed light on the unsustainability of this trajectory.

In the Baltic region, the greatest increase of fertilizer use has been in Poland and Poland has gone from being a low polluter to being a high polluter per agricultural land unit. This is one reason why we in this follow-up study have a special focus on Poland. The other reason is that in the Baltic Sea drainage area, Poland has more agricultural land draining into the Baltic Sea than any other country. Almost 60 % of farm land draining into the Baltic Sea is in Poland. The future of agriculture in Poland will have consequences for the future of the Baltic Sea. Poland is also the focus of other projects working to develop environmental knowledge among farmers, see e.g. Drangert et al (2017).

Suggestions for policy changes were put forward by the BERAS project for more effective recycling agriculture based on local integration of crop and animal production and diversified crop rotations including perennial grassland with nitrogen fixation crops (Granstedt et al 2008, Granstedt, 2012, Einarsson, 2012). Yet, instead of following these suggestions, the very same mistakes are being repeated in Poland like in the other Baltic Sea countries with increasing damage to the environment (Granstedt and Seuri, 2012). Why is this knowledge disregarded? A survey of the driving forces behind the agricultural discourse was needed. Furthermore, it is important to investigate what is needed for the individual farmer to decide to transition to an agricultural system based to a greater extent

on local and renewable resources to minimize negative impacts on the environment and climate and to produce high quality food without toxic substances.

We wanted to identify parameters that prevent the transition process we see as necessary in the Baltic Sea region. We pursued a follow-up of the current environment status through analysis of statistics, a review of scientific literature regarding agricultural development in the Baltic Sea region; and interviews with farmers and other important actors in the agricultural sector.

The overall aim of this study is to identify obstacles and to find the missing links of e.g. education, access to knowledge, market oriented efforts and agricultural policy changes to change current development and realize Ecological Recycling Agriculture in the Baltic Sea region.

To provide a background for this study and report we now turn to describing the status of the Baltic Sea and the impact of agriculture on the Baltic Sea and the BSR. We also present our agricultural model, which has been scientifically evaluated for its capacity to alleviate current problems and which is our point of departure. We also describe the two BERAS projects, to which this is a follow-up study, and their main conclusions.

Agriculture and its impact on the Baltic Sea

At present, rivers, lakes and ultimately the Baltic Sea marine system are strongly disturbed by eutrophication. This has led to extensive algal blooms (Figure 1). When algae decompose during autumn and winter, oxygen is consumed, leading to a so called “dead seabed” – a growing problem in the Baltic Sea. Deposition of nutrients causing eutrophication in the Baltic Sea is largely caused by agriculture. Modern, large-scale industrial agriculture is further problematic in that it contributes to loss of biodiversity in the entire landscape and depletion of humus in soils (Artur Granstedt, 2012, 2016). Food is responsible for approximately 30% of the emissions of gasses that cause global warming (Naturvårdsverket, 2017).

Figure 1 Image acquired by Envisat's Medium Resolution Imaging Spectrometer (MERIS) on 11 July 2010.
Image source: European Space Agency. Labelled by: BBC 2010 [Image belongs to Wikimedia Commons - the free media repository]

The Baltic Sea Action Plan (BSAP), signed by all Baltic Sea countries' governments in 2007, is the basis for work within HELCOM (Baltic Marine Environment Protection Commission, also known as Helsinki Commission) to save the environment in the Baltic Sea and restore the environment to a good ecological status by the year 2021. The special report "Combating Eutrophication in the Baltic Sea: further and more effective action needed" issued by the European Court of Auditors (European Court of Auditors, 2016) is critical of measures so far employed to improve the status of the Baltic Sea, specifically focusing on nutrient overload to the sea from agriculture and urban waste water. Many countries are criticized in the report for not following through on their commitments to the BSAP. As of July 2017, the Polish government has not yet adopted the national implementation program (NIP) for the Baltic Sea action plan (BSAP) and its nutrient reduction targets.

Despite the BSAP agreement, nitrogen and phosphorus loads from agriculture continue to increase. The reasons are both weak implementation of commitments, but also that the proposed measures address symptoms, but not the underlying causes as described here.

A possible long-term solution for reducing eutrophication as well as direct and indirect emissions of greenhouse gases from agriculture is to balance crop and livestock production, to close the loops according to the principles of Ecological Recycling Agriculture (ERA) (Figure 2). Nitrogen load could then be reduced by 70% and phosphorus losses reduced to a level that would prevent further eutrophication from agriculture in the Baltic Sea region. There are model farms that demonstrate the feasibility of this farming system in eight countries surrounding the Baltic Sea. The EU project BERAS (Baltic Ecological Recycling Agriculture), www.beras.eu, outlines implementation of research from the Biodynamic Research Institute in Järna, Sweden describing a transition to ERA and makes policy proposals that could save the Baltic Sea environment.

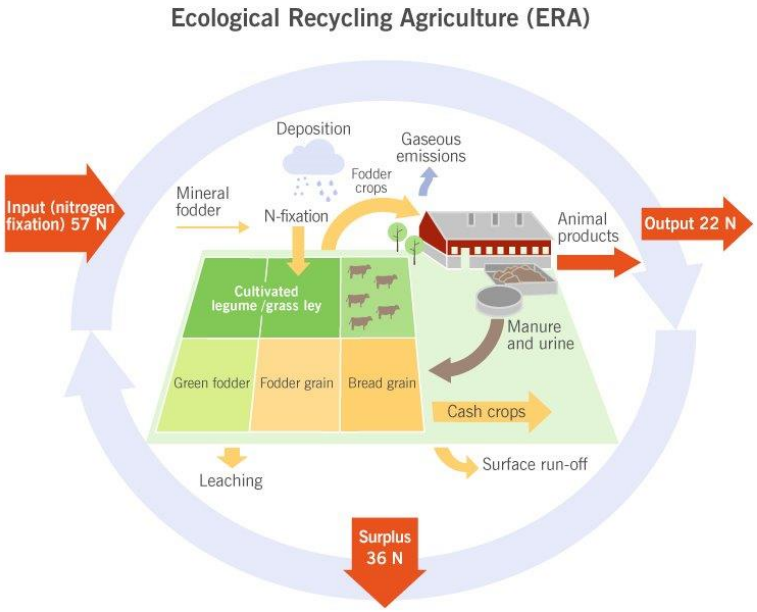


Figure 2 Simplified ecological cycle of the farm: small supply and maximum reuse of nutrients (recycling) with the least possible losses. This is realized by adapting the farm to self-sufficient feed production and a legume-based forage crop rotation. The result is a 50% lower nitrogen surplus and 70-75% less nitrate leaching compared to the average conventional farm and no surplus of phosphorus. The higher proportion of perennial grassland further contributes to reduced leakage losses and increased soil humus formation (Artur Granstedt, 2012; Artur Granstedt, Schneider, Seuri, & Thomsson, 2008).

Following up BERAS I & II

This report is a follow-up study of research conducted within two previous partly EU-financed projects BERAS (Baltic Ecological Recycling Agriculture and Society), carried out 2003-2006 and BERAS Implementation, 2010 - 2013. This study was coordinated by Artur Granstedt, who also coordinated and initiated the BERAS projects, which were primarily based on his PhD thesis from 1990 regarding the principles of nutrient flow in on Biodynamic Farming compared to conventional agriculture. In the BERAS project, all EU-countries within the Baltic Sea catchment area were studied. Agricultural system failures leading to the present environmental disorder in the Baltic Sea were identified. Additionally, practical solutions were suggested.

To show how a transition to a more sustainable agricultural system could save the environment in the Baltic Sea region, case studies were carried out on 48 farms demonstrating these systems. Farms were chosen to represent various conditions from each of the countries. The proposed farming system involves integration of crop and livestock production, which is a major difference compared to current trends in agricultural development, yet familiar in a historical context (and still practiced in many parts of the world). Integrated crop and livestock farming facilitates nutrient recycling as composted manure is spread on the fields instead of being accumulated on specialized farms, where a large part of the nutrient surplus either leaks to the sea contributing to eutrophication or is emitted as greenhouse gases into the atmosphere.

It is possible to reduce nitrogen runoff from agriculture by half by changing from current, conventional agriculture to organic, recycling focused farm systems based on local renewable resources and free from chemical pesticides (Granstedt et al., 2008; Granstedt 2012). The suggested farming system involves more complex crop rotations with nitrogen fixing leguminous leys. This makes the farm self-sufficient in nitrogen, and builds up the humus in the soil, hence contributing to large-scale carbon sequestration. A larger utilization rate of various ecosystem services has also proven to reduce the farms' fossil fuel requirement (Johansson, 2013).

The BERAS project (2003-2006) showed that agriculture is at a crossroads. Continuing current trends – intensive crop farms dependent on imported mineral fertilizer and pesticides on the one hand, and specialized livestock farms dependent on importing feed on the other, will inevitably lead to increasing damage in the Baltic Sea catchment area. A transition to Ecological Recycling Agriculture is necessary to save the marine environment and reduce the agricultural impact on climate and biodiversity.

Ways to enable this essential transition, involving improved farm advisory services, changed eating patterns and agricultural policies, were presented by the BERAS Implementation project (Artur Granstedt & Seuri, 2013). Advice on how to implement Ecological Recycling Agriculture and how to convert a farm to this system was published in the languages of the countries included in the BERAS Implementation project. This material is also presented in peer-reviewed reports and papers (www.beras.eu). The consumer aspect is an important factor for enabling a change of agricultural development. Public procurement and school meals could be included in this transformation. BERAS partner, Södertälje municipality in Sweden, is a successful example in that they managed to incorporate mostly organic, vegetarian school meals into their budget without an increase in costs. This knowledge has been introduced to other, similar initiatives in several parts of Sweden as well as internationally. Positive results from a transition to ERA are well documented.

In this report,

1. We provide an update of data on agricultural nutrient surplus, nutrient leakage, climate loading and pesticide use in the Baltic Sea region. The analysis is carried out for all EU countries in the Baltic Sea catchment area, and compared to the situation in 2003 when the BERAS project was initiated.
2. We investigate which underlying reasons are responsible for current agricultural development through interviews with farmers and other actors.
3. We offer policy recommendations to counter current negative trends and realize the goals of the BERAS project, the goals from HELCOM for protecting the Baltic Sea and the goals put forward by the climate negotiations in Paris, December 2015.

To cover these issues, we used different sources and methods, including data on agriculture, environment and food provided in national statistics; and scientific literature. We collected information in more detail for Poland where factors such as distribution of land within agriculture, structures of land ownership and farming, reforms before, during and after collectivisation, the impact of globalization and current situation, policy at national level and in the Common Agricultural Policy (CAP) in EU were studied. We conducted qualitative interviews with Polish farmers, agricultural advisors, researchers, representatives from policy makers and NGOs.

List of interviewees

Policymakers
Senator Jerzy Chróścikowski, Senate of Poland
Minister Michal Rzytki, Ministry of Agriculture

Agricultural advisors
Aleksander Banasik and Katarzyna Jasińska, Pomeranian Agricultural Advisory Centre in Luban
Agnieszka Dobosz-Idzik, Bożena Blaszyńska, Justyna Lesiewicz and director Ryszard Kamiński at the Kuyavian-Pomeranian Agricultural Advisory Centre in Minikowo (KPODR) Minikowo

Farmers
Wiesław Dekondy, Niedrzwica Duża, 40 ha, 40 pigs
Witold Durak, Lubelski, 14 ha, 14-15 milking cows
Jan Goryl, Nowy Wiśnicz, 140 ha, 80 milking cows
Juchowo Farm, Szezcinek, biodynamic farm - 2,000 ha and 300 milking cows
Jacek Plotta, Trzciński, 136 ha
Piotr Zdziarski, Łabiszyn, over 100 ha, pigs, cattle, poultry production integrated with crop production

Researchers
Professor Jerzy Kopinski, Institute of Soil Science and Plant Cultivation in Puławy
Professor Marianna Pastuszak, Sea Fisheries Institute, Department of Fisheries Oceanography and Marine Ecology
Dr. Jarosław Stalenga, Institute of Soil Science and Plant Cultivation, Puławy, Poland
Professor Józef Tyburski, Faculty of Environmental Management and Agriculture, University of Warmia and Mazury in Olsztyn, Poland

NGOs
Maria Staniszewska, Polish Ecological Club
Anna Sosnowska and Marta Kalinowska, WWF Poland

Experts from other countries in the Baltic Sea region
Leif Bach Jørgensen, Danish Ecological Council
Dzidra Kreišmane, Latvia University of Agriculture
Pentti Seuri, National Resources Institute in Finland
Karin Stein-Bachinger, Leibniz Centre for Agricultural Landscape Research (ZALF)
Airi Vetemaa, Estonian Organic Farming Foundation

Interviews by Małgorzata Lekan (2017)
A total of 28 interviews were carried out among farmers including 14 farmers specialized in organic production and 14 in conventional production.

Chapter 2. Nutrient Flows in the Baltic Sea Region

Artur Granstedt

The present situation in the Baltic Sea

Since the establishment of the Convention for the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention) in 1974, the Commission for the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Commission or HELCOM for short) has been working to reduce the inputs of nutrients to the sea. In 2007, the HELCOM Baltic Sea Action Plan (BSAP) was adopted by the Baltic Sea coastal countries and the European Community (HELCOM 2007). The BSAP has the overall objective of reaching a Baltic Sea in good environmental status by 2021, by addressing the issues of eutrophication, hazardous substances, biodiversity and maritime activities.

Agriculture contributing about half of total waterborne nitrogen and phosphorus inputs nitrogen and phosphorus to the Baltic Sea. The nutrient leaching are responsible for the eutrophication, algal blooms, reduced water clarity, changes in species composition, and finally reduced oxygen concentrations in bottom waters and increased areas of dead bottoms. According the latest HELCOM assessment on eutrophication in 2007 to 2011 almost the entire open Baltic Sea was assessed as being atrophied (HELCOM 2017). Dead zones have increased 10-fold over the last 115 years. They have grown from approximately 5,000 km² in 1900 to more than 60,000 km² (Figure 3) (Carstensen, 2011). Hypoxia is a result of eutrophication, in turn caused by increased nutrient flows to the sea from land and air. Reducing these nutrient flows would reverse hypoxia.

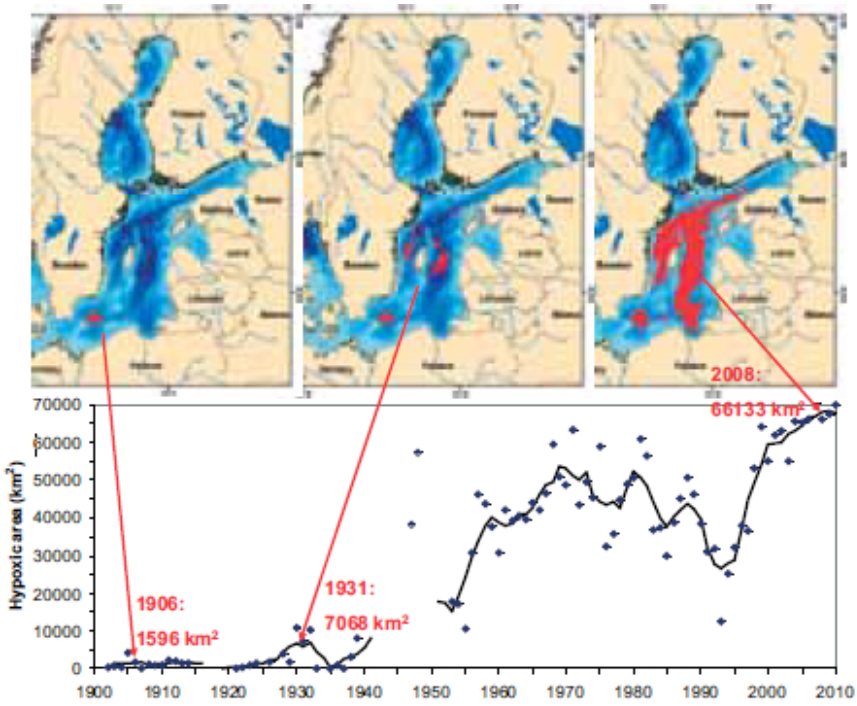


Figure 3 Expansion of hypoxic areas (oxygen depleted) is one of the most profound effects of eutrophication

in the Baltic Sea. Figure from Carstensen (2011).

Agriculture at the crossroads

Results of the BERAS project included three scenarios (described in Figure 4) 1) the average nitrogen (N) load per hectare in 2000 for the Baltic Sea watershed area as a whole, which was deemed as demanding immediate action to save the marine environment in the Baltic Sea; 2) expansion of the conventional agricultural practices in Sweden into the Baltic states and Poland, which would mean a > 50 % increase in total N load; 3) conversion to Ecological Recycling Agriculture in accordance with the results from the 48 farms that participated in the BERAS trial studies would mean a 50 % reduction in N load and no surplus of phosphorus. (Granstedt et al 2008).

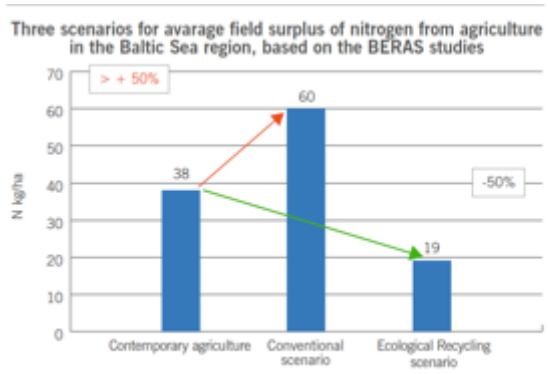


Figure 4 The first bar shows the average field surplus of nitrogen per hectare in the Baltic Sea region in the year 2000. The second bar shows a scenario of all agriculture in the countries around the Baltic Sea, i.e. Estonia, Latvia, Lithuania and Poland reaching the level of nitrogen surplus of Swedish agriculture. The third bar shows a scenario where all agriculture around the Baltic Sea is converted to Ecological Recycling Agriculture.

The concept of Ecological Recycling Agriculture (ERA) is production of food and other agricultural products using basic ecological principles:

1. Diversity of life
2. Renewable energy
3. Recycling of plant nutrients

An ERA farm is defined as an ecological (organic) farm (or farms working in close cooperation as one farm unit together) without use of artificial nitrogen fertilizers and pesticides; with a high rate of nutrient recycling based on organic, integrated crop and animal production; with an animal density 0,5 – 1,0 au*/ha and with a self-sufficiency level of at least 85 % of fodder produced on the farm.

*1 au (animal unit) corresponds to one dairy cow, two young cows, three sows, 10 fattening pigs or 100 hens.

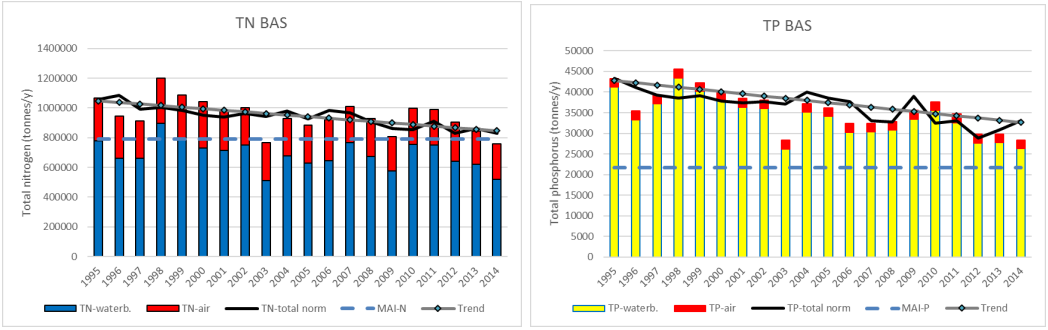


Figure 5 Trend analyses show that total inputs of nitrogen to the Baltic Sea from 1995 to 2014 decreased statistically significant with 22% and phosphorus with 24 %. Figure source HELCOM 2017.

Trend analyses show a statistically significant decrease of total inputs of nitrogen to the Baltic Sea from 1995 to 2014 with 22% (HELCOM, 2017). Total phosphorus inputs to the Baltic Sea also decreased statistically significant with 24% (

Figure 5). This decrease can be explained by improvements to the human waste sewage system and airborne pollution reported by HELCOM (2017). In agriculture, we cannot see the same trend as in the other sectors if we study the potential decrease in the form of plan nutrient balances and use of external resources as artificial fertilizers and imported fodder to the agriculture in the Baltic Sea countries respectively.

Plant nutrient balances for agriculture can be done for an individual field, farm, country, and watershed or for a larger drainage area as the whole Baltic Sea and are normally calculated per year. Data for all agriculture fields is collected in the countries within EU and included in the official EU statistics (European Union, 2016). On the field level the balance is based on nutrient input with applied fertilizers, (both organic and inorganic) and nutrient exported from the field in form of harvested products. The difference between input and output can be positive or negative. A surplus of nitrogen and phosphorus can accumulate in soil or been lost from the field through emissions to the water system (surface water or ground water) or to the atmosphere. This surplus is also called potential emissions of plant nutrients (Figure 6).

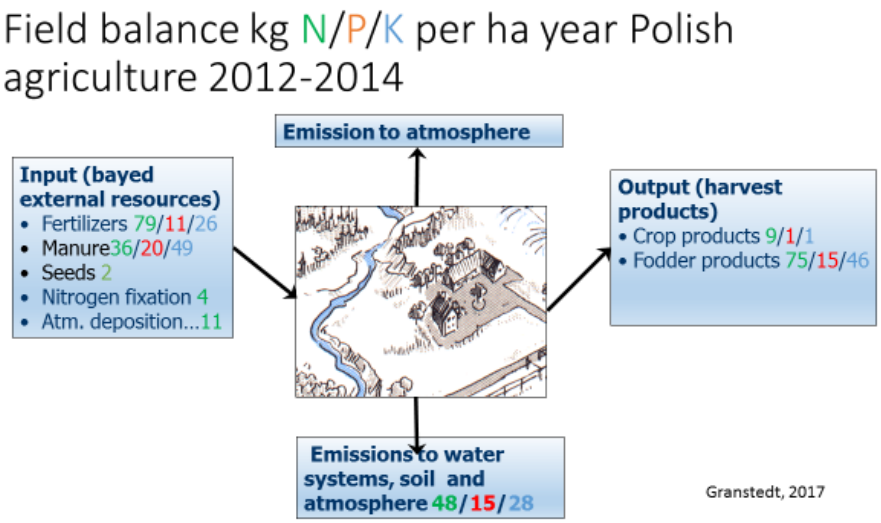


Figure 6 Field balance kg N, P, K per ha and year Polish Agriculture 2012-201

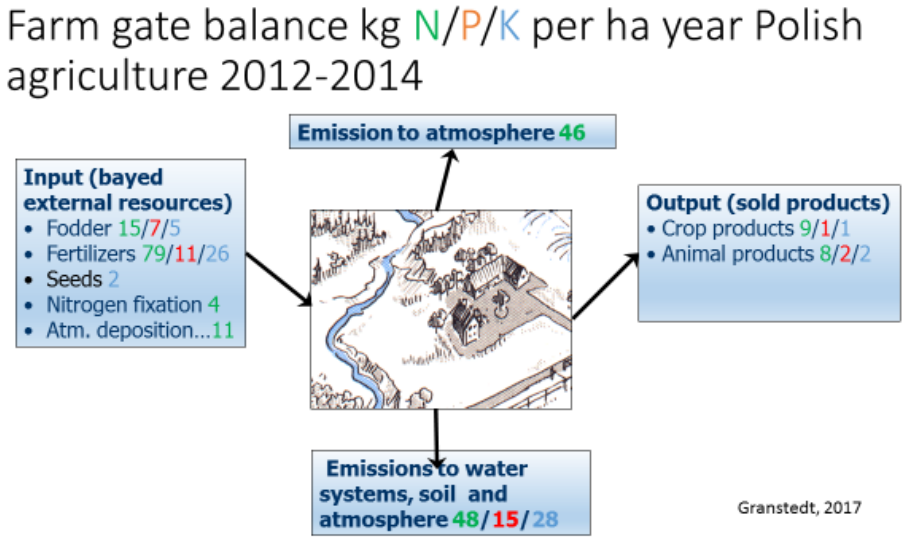


Figure 7 Farm gate balance kg N, P, K per ha and year Polish Agriculture 2012-2014

In addition to field balances, we have so called animal balances with inputs fodder and output of animal products. Using the difference between fodder and animal production, including animal bodies, it possible to theoretically calculate nutrients in manure and urine as well as emissions to the surroundings of nitrogen and phosphorus from the animals. In addition, there are so called farm gate balances which include both crop and animal husbandry (Figure 7). If Poland were to convert to Ecological Recycling Agriculture farm gate balances would altered as shown in Figure 8, with significantly lower emissions to water systems and soil.

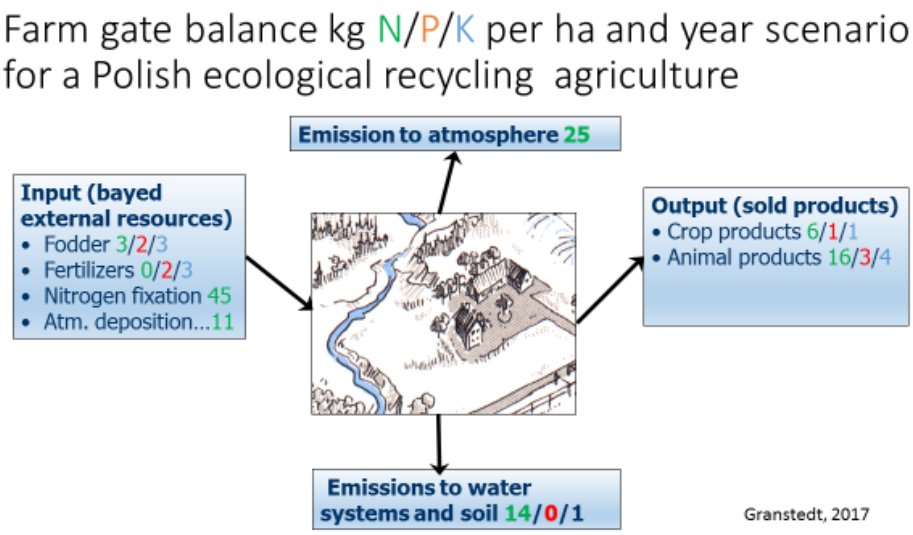
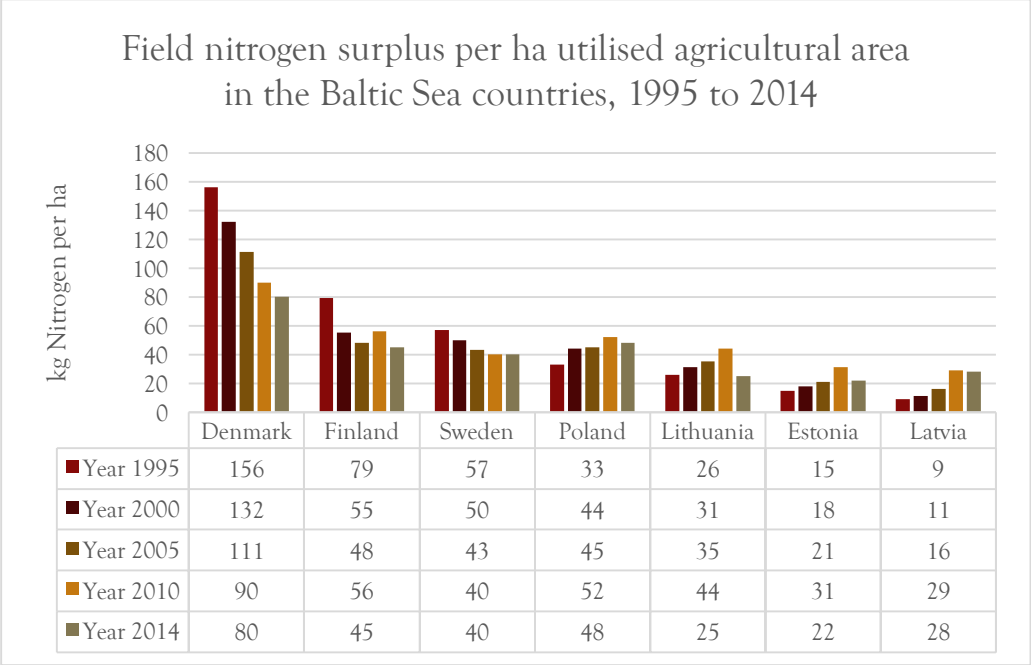


Figure 8 A possible scenario if all Polish agriculture converted to ERA as described in Figure 2.

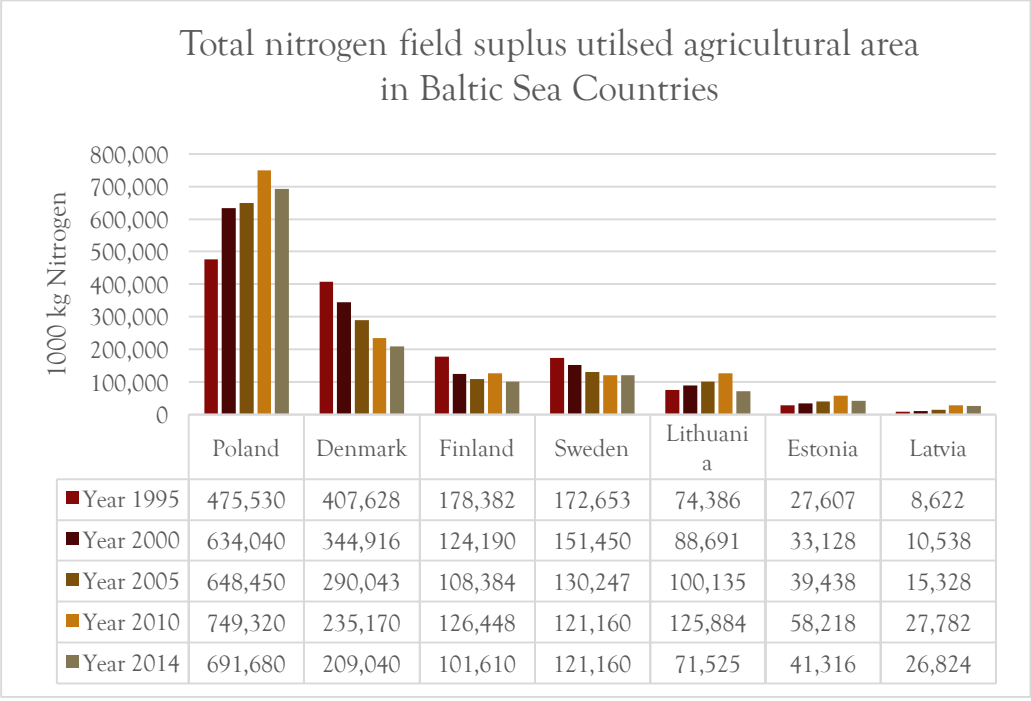
In Figure 9 field nitrogen surplus per ha of utilized agricultural area is depicted for each of the EU-countries surrounding the Baltic Sea (except Germany with only a small part of the agricultural area in the Baltic Sea catchment). Between 1995 and 2014, surplus N per ha decreased in Denmark from 156 to 80 kg, in Finland from 79 to 45 kg, and in Sweden from 57 to 40 kg. In Lithuania, there was a small increase from 26 to 25 kg, after a peak notation of 44 kg N in 2010. In Poland, the increase was from 33 to 48 kg N per ha in the same years, but also with a peak notation of 52 kg N per ha in 2010. Estonia increased from 15 to 22 kg N per ha in the same period, yet they as well had a peak notation of 31 kg N per ha in 2010. In Latvia, there was an increase from 9 to 28 kg N per ha in the same period. Figure 10 depicts the total surplus from the entire agricultural area in each country in the Baltic Sea region. In 2010, Poland had the largest surplus - approximately 750 thousand tonnes nitrogen (European Union, 2016).



	Denmark	Finland	Sweden	Poland	Lithuania	Estonia	Latvia
Year 1995	156	79	57	33	26	15	9
Year 2000	132	55	50	44	31	18	11
Year 2005	111	48	43	45	35	21	16
Year 2010	90	56	40	52	44	31	29
Year 2014	80	45	40	48	25	22	28

Figure 9 Field nitrogen surplus per ha utilised agricultural area in the EU Baltic Sea countries except Germany.

By studying the year 2014 compared to 1995 in Figure 9 we see that worst-case predictions have partly come true for Estonia, Latvia and Poland where potential emissions of nitrogen measured as field surplus has increased with 25, 155 and 9 % respectively. Until 2010, total nitrogen load to the Baltic Sea increased with 4 % despite the decrease in Denmark, Finland and Sweden. It remains to be seen if the small decrease between 2010 – 2014 will continue.

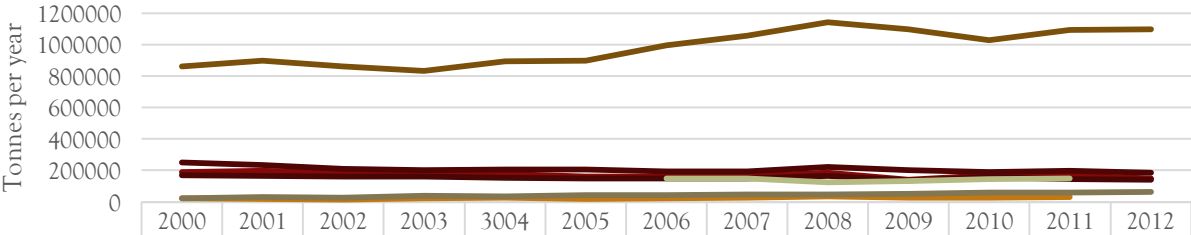


	Poland	Denmark	Finland	Sweden	Lithuania	Estonia	Latvia
Year 1995	475,530	407,628	178,382	172,653	74,386	27,607	8,622
Year 2000	634,040	344,916	124,190	151,450	88,691	33,128	10,538
Year 2005	648,450	290,043	108,384	130,247	100,135	39,438	15,328
Year 2010	749,320	235,170	126,448	121,160	125,884	58,218	27,782
Year 2014	691,680	209,040	101,610	121,160	71,525	41,316	26,824

Figure 10 Total nitrogen field surplus per utilised agricultural area in Baltic Sea countries.

Surplus nitrogen originates from of total input of nitrogen in form of artificial fertilizers and imported fodder which ultimately generates manure.

Figure 11 illustrates the use of artificial nitrogen in the Baltic Sea region from 2000 to 2012.



	2000	2001	2002	2003	3004	2005	2006	2007	2008	2009	2010	2011	2012
SE	189500	197000	185000	180000	177000	161500	160500	167000	186500	142500	168000	170000	148000
FI	167500	165500	160500	159500	154500	149500	148000	149000	163000	136000	156500	146000	139000
PL	861500	895500	862000	831500	895000	895500	996500	1E+06	1E+06	1E+06	1E+06	1E+06	1E+06
EE	22500	19500	16500	23500	25000	20000	22500	25000	35500	27500	28500	30000	
LV	23000	31500	27500	37500	35000	41000	42500	46000	47500	52000	59500	60000	65000
LT							147000	147000	123500	134500	144000	147000	
DK	252000	234000	211000	201000	207000	206000	192000	194500	220500	200500	190000	197000	187000

Figure 11 In Estonia, Latvia and Poland use of artificial nitrogen fertilizers has increased. This means that despite the decrease in other countries, total use of nitrogen has increased with more than 30 % between 2000 and 2012 (European Union, 2016).

Agricultural nutrient surplus in countries that were industrialized early: Denmark, Finland, Germany and Sweden

In Sweden, between 1950 to 1990 there was a trend towards agricultural specialization and intensification with an increasing surplus of plant nutrients (both nitrogen and phosphorous) leaching into the Baltic Sea. The situation was similar in Finland and Denmark with the highest surplus per ha in Denmark. After 1995, there was a tipping point in this trend, partly due to the increase of organic farming, especially in Sweden, and partly due to an ambitious program for effective utilization of manure and fertilizers, especially in Denmark, which has resulted in a decrease from a very high level. This is presented in form of the field nitrogen balances for the Baltic Sea countries according to the official EU statistics (Figure 9). But even after this decrease the nutrient surplus is too high to reach the goal of protecting the Baltic Sea.

The decrease of surplus nitrogen from Denmark from over 150 kg N per ha and year 1995 to 80 kg per ha and year 2014 seems remarkable. But 80 kg surplus nitrogen per ha and year is 30 to 40 kg more than any other of the Baltic Sea countries. The country with the next largest field nitrogen surplus is Poland with 48 kg ha and year but due the large agriculture area Poland is the biggest polluter according to Figure 10.

Leif Bach Jørgensen, at the Ecological Council in Denmark, tells us that Denmark made good progress in reducing the loss of nitrogen and phosphorus from mid-1990's until 2010,

but since then the reduction has faded out. The worst change was the 'Agricultural package' from the new government in 2015. They rolled back current regulation – e.g. the limitations in nitrogen norms. The wording was "Stop over-implementation of the EU-directives" – meaning don't do more than the member state that is doing the least. This has led to an increase in nitrogen surplus, which is not yet visible in official EU statistics.

Only a small area of Germany in the Baltic Sea drainage basin, and about 4 % of N emissions to the Sea are from Germany. In Germany, Karin Stein-Bachinger, researcher at Leibniz Centre for Agricultural Landscape Research (ZALF) and country coordinator in the last BERAS-project, reports that there is a revised fertilizer rule with a few stricter regulations, e.g. biogas residues are integrated into the 170 kg N/ha regulation for manure according the Nitrate directive. But it is still not known how this regulation will be controlled and what sanctions will be used. An additional comment is that the Nitrates Directive (European Commission, 1991) accepts high amounts of nitrogen in organic manure and slurry from biogas plants compared to amounts used in an ecological recycling agriculture.

Pentti Seuri, researcher at the National Resources Institute in Finland, tells us that in Finland grassland based animal farms have no open land which results in large input of concentrated, surplus liquid manure which must be spread on grassland, no clover and significant use of artificial fertilizers. This explains why grassland has the highest surplus of nitrogen and that Finland, despite lower yields has higher surplus of nitrogen. This is, according to Pentti Seuri, similar to the situation in Norway with lower yields and higher surplus.

Surplus nitrogen per ha and year in the Baltic Sea catchment is described in Figure 12.

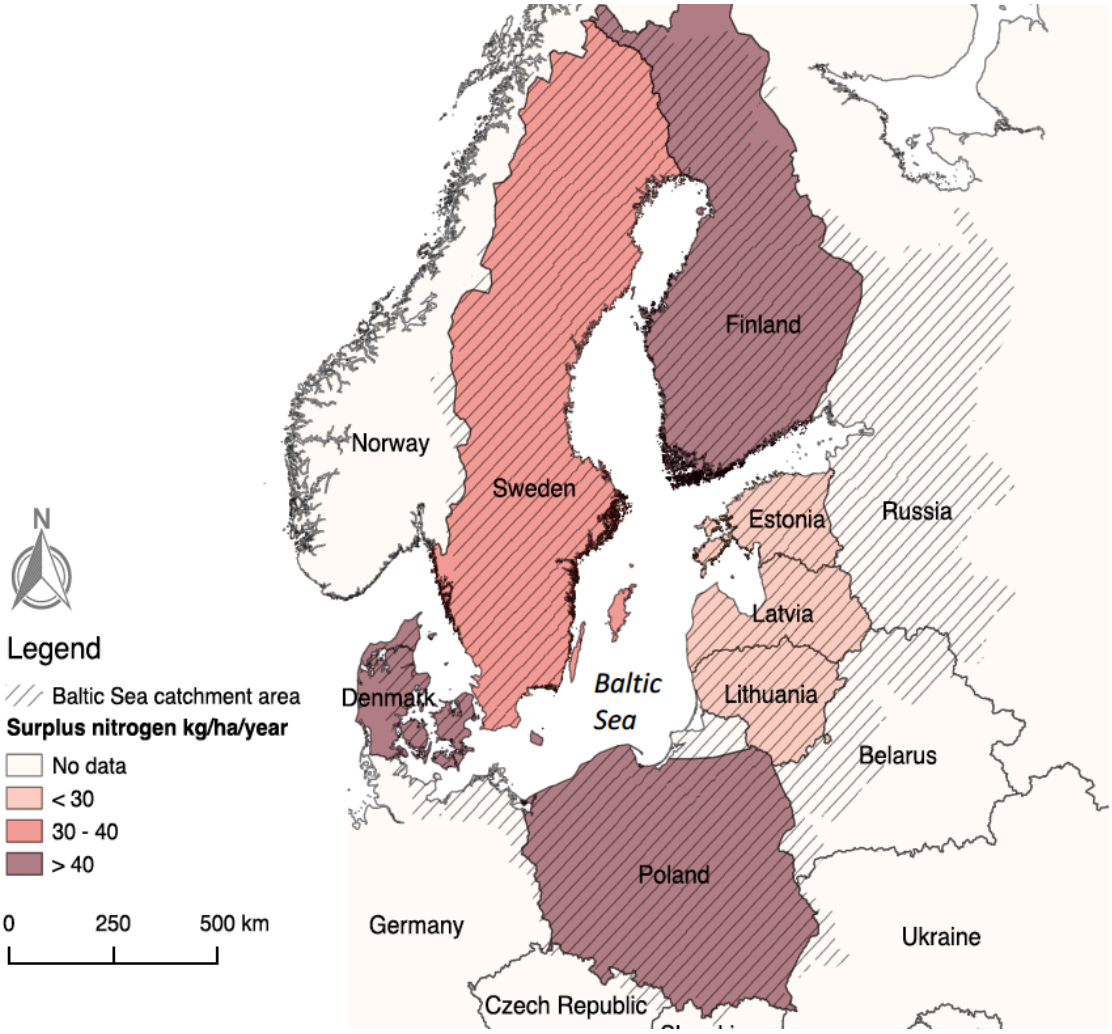


Figure 12 Surplus nitrogen kg/ha/year in the Baltic Sea catchment area. Map by E. Johansson.

Agricultural nutrient surplus in the new EU countries: Estonia, Latvia, Lithuania and Poland

The increased surplus Estonia is a consequence of increasing use of artificial fertilizers illustrated in Figure 11. This fact was confirmed by Airi Vetemaa, Estonian Organic Farming Foundation, who shared that agriculture in general is intensifying, with increased use of fertilizers and pesticides as an effect of this (Estonian Organic Farming Foundation, 2016). Also in Latvia, there is an increase in organic farming while agricultural industrialization continues with an increase in the use of artificial fertilizers on conventional farms and specialized animal farms, according to Dzidra Kreišmane, associate professor at Latvia University of Agriculture. She notices how the use of both artificial fertilizers and pesticides increases despite the increase of organic farming.

The history of agriculture in Poland is different from other former communist countries in that the system of small-scale family based farms continued in large parts of the country until EU accession. This entailed agricultural production oriented toward the local market and with limited use of artificial fertilisers and pesticides. Large-scale state-run agriculture

was only present in the previously German regions Silesia and Gdańsk with vicinity. We will describe the case of Poland further in chapter 3.

Nutrient surplus: a consequence of specialisation

A large part of the nutrient surplus is a result of continued separation of crop and livestock production. In all Baltic Sea countries, we observed specialisation not only among farms, but also regional specialisation. Regional specialisation leads to distances too great to efficiently transport manure from specialised animal farms to specialised crop farms and fodder in the opposite direction, making efficient recycling impossible (Figure 13).

When we asked our national experts around the Baltic Sea if they have observed increased agricultural specialization (by specialization we specifically intend a separation of animal and crop production) the answer was yes. Karin Stein-Bachinger told us that in Germany specialization and production intensity in conventional crop- and livestock production has increased also in the past ten years, with an increase in farm machinery weight, reduced tillage and increased pesticide application. Airi Vetemaa said that animal farms, especially dairy farms, produce their own fodder, but there is a trend towards more and more specialization in crop production.

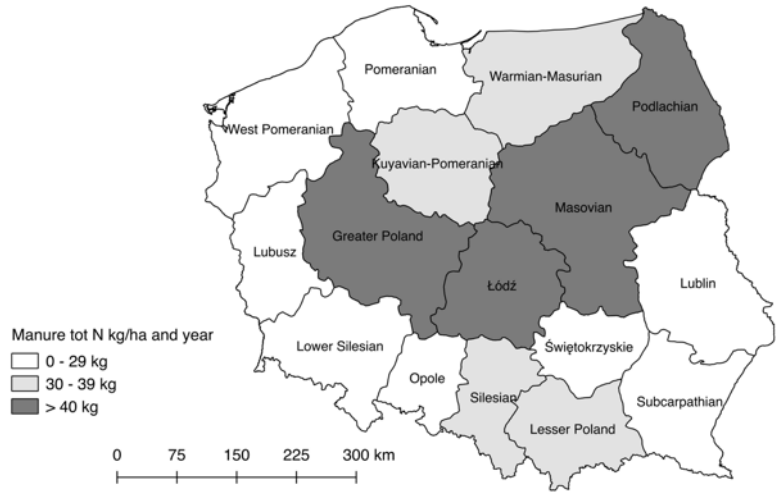


Figure 13 Animal density in Poland, dark grey indicates >10 % greater than average animal density, light grey indicates at least 30 % lower than average animal density. The numbers show manure total N kg per ha and year/surplus N kg per ha and year. Map by E. Johansson.

Table 1 Manure total and manure surplus N kg/ha and year

	Manure tot N kg/ha and year	Surplus N kg/ha and year
Greater Poland	57.4	76.4
Kuyavian-Pomeranian	39.5	71
Lesser Poland	31.5	15.8
Łódź	41.5	61.7
Lower Silesian	12.8	34.1
Lublin	22.8	38.9
Lubusz	20.8	35.5
Masovian	44.6	49.6
Opole	23.6	39.6
Podlaskie	57.8	42.4
Pomeranian	13	41.5
Silesian	37.8	48.6
Subcarpathian	20	12.8
Świętokrzyskie	28.2	41.6
Warmian-Masurian	38.5	37.7
West Pomeranian	28.2	51

Nitrogen surplus from manure (

Table 1) was the highest in Greater Poland (76.4 kg/ha), Kuyavian-Pomeranian (71 kg/ha) and Łódź (61.7 kg/ha), and the lowest in Sub-Carpathian voivodship (12.6 kg/ha). However, the livestock density per voivodships is the highest in Podlaskie first (0.79 LU/ha) and then in Greater Poland (0.76 LU/ha), Kuyavian-Pomeranian (0.59 LU/ha) and Lodzkie voivodship (0.57 ha) (Kopiński & Jurga, 2016). The relatively low level of nitrogen surplus in comparison with manure inputs in Podlaskie voivodship (42.4 kg/ha vs. 57kg/ha), which has the highest livestock density/number of livestock heads in the entire country stems from the fact that in Podlaskie voivodship the dominant type of livestock is beef and milk cattle, which is usually grazed on grasslands, thus being 'naturally' more sustainable. In contrast, the dominant type of animal production in Greater Poland voivodship are pigs, which are raised in high concentrations in confined feeding facilities.

Overall, even though Granstedt's calculations are concerned with average values for each voivodship, and thereby are highly generalized (they don't show where the key point sources of pollution are), they help to approximate the scale of the problem related to manure surplus. These calculations do not show the spatial distribution of farms within any given region and Greater Poland, Kuyavian-Pomeranian and Łódź voivodships have also a larger crop production. It could be argued that there is a potential to establish a cooperation between those intensive, livestock-oriented production farms with crop-specialist farms in these regions.

Greater Poland and some other voivodships use large amounts of artificial fertilizers despite high animal density and corresponding manure production. More cooperation should be possible between crop and animal farms where distances between farms not is too great. This would work towards ERA and reduce nitrogen surplus. But generally animal density too high on individual farms in these regions compared to other regions with less animals to establish a more effective recycling of plant nutrients via manure.

How did we get here?

In Sweden, agriculture underwent a fundamental change in 1950-80 with farms diverging to specialize in either animal or plant production – each a direction with negative consequences. Specialised crop farms focused on grain production with simplified crop rotation without perennial grassland and nitrogen fixing legumes. A specialised crop farm is highly dependent on chemical inputs based on fossil energy and consumes non-renewable nutrient reserves in the soil (Figure 14). The other farm orientation, with highly specialized animal production is based on imported fodder with an increasing surplus of nitrogen and phosphorus compounds which contaminates water systems (Figure 15).

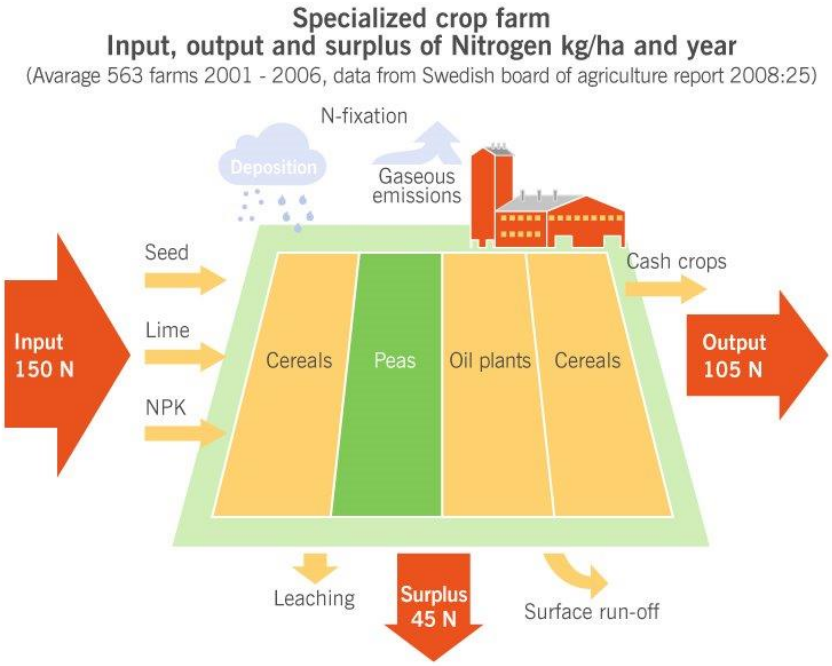


Figure 14 Nutrient balance on an average specialized crop farm. The supply (input) of nitrogen consists mainly of nitrogen fertilizers but also of the smaller quantities added with purchased seed and atmospheric nitrogen. Of the added nitrogen at 150 kg N per ha per year 105 kg in the form of cereal is removed (output) while the surplus of 45 kg sooner or later is lost to the air and water. Approximately 80% of crop production consists of fodder crops sold to specialized livestock farms via the feed trade.

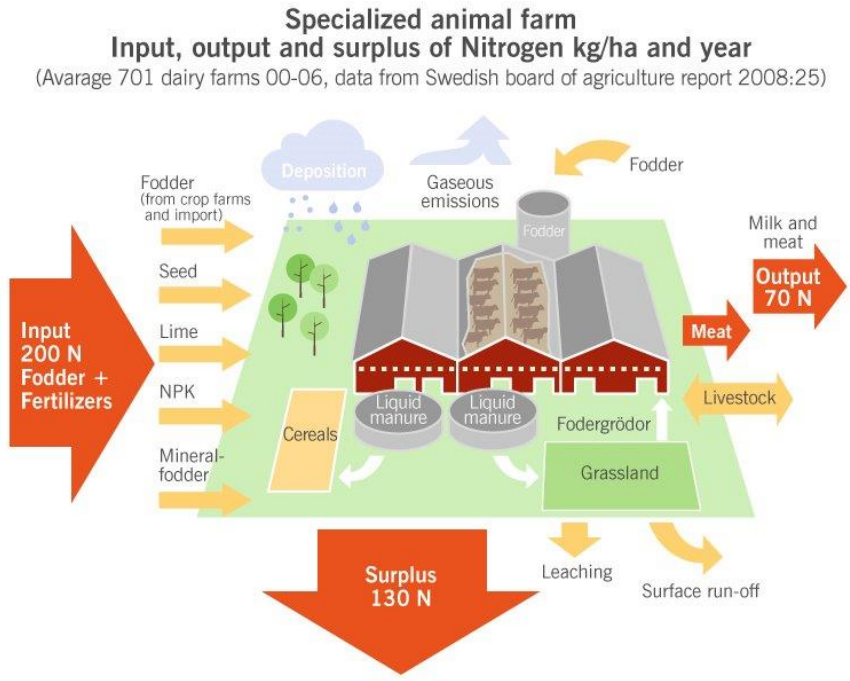


Figure 15 Nutrient balance on an average specialized animal farm. Nitrogen input consists mainly of feed from grain farms, but also imported feed. Moreover, nitrogen is added from the atmosphere and through nitrogen fixing plants on farms with grass cultivation and fertilizers. Of the total added nitrogen at 200 kg N per ha and year, 70 kg is removed in the form of livestock (meat and dairy), while the surplus of 130 kg sooner or later is lost to the air and water. Surplus phosphorus is in part accumulated in the soil but ultimately leads to increased phosphorus leaching.

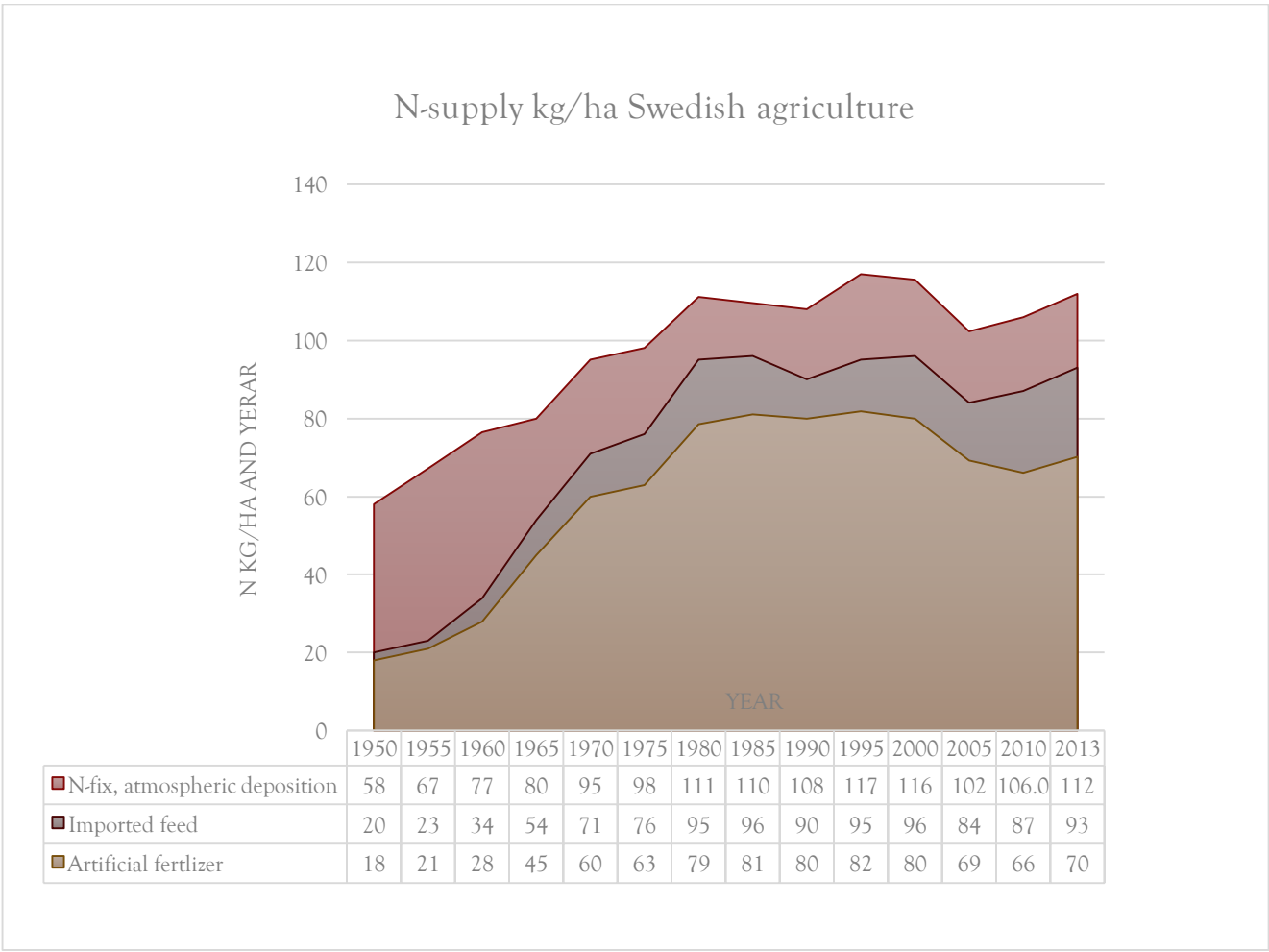
Currently in Sweden, as in all industrialized countries, specialized cereal farms that rely on external resources such as artificial fertilizers, herbicides and pesticides for production dominate the cultivated area. Animal production, on the other hand, is primarily concentrated to specific regions where animal density is too high, resulting in nutrient

accumulation and leaching. Globally, crop production is primarily used as fodder for animals to meet the increasing demand for meat.

While cereal farms are dependent on purchases of artificial fertilizers, an ever-greater excess of nutrients in the form of animal manure accumulates on the specialized livestock farms – leading to two unclosed loops with linear flows. Intensive livestock production farms tend to be localized in the same areas and it is from these regions losses of nutrients to streams, lakes and oceans are the greatest. But these farms are dependent on fodder from the specialized crop farms and from specialized crops farms in other countries. For this reason, we use the term of linear flows of nutrients: Artificial fertilizers → crop production → animal production → surplus of manure → emissions to the environment. Phosphorus and nitrogen compounds from manure flow to rivers, lakes and seas leading to eutrophication; excess nitrogen also affects the climate in the form of nitrous oxide emissions (N_2O, known as laughing gas). Emission of greenhouse gases (both nitrous oxide and carbon dioxide) takes place in the beginning of this chain through fertilizer production. Emissions of nitrogen, in the form of ammoniac (NH_4) oxidized to nitrate (N_2O), become acid rain.

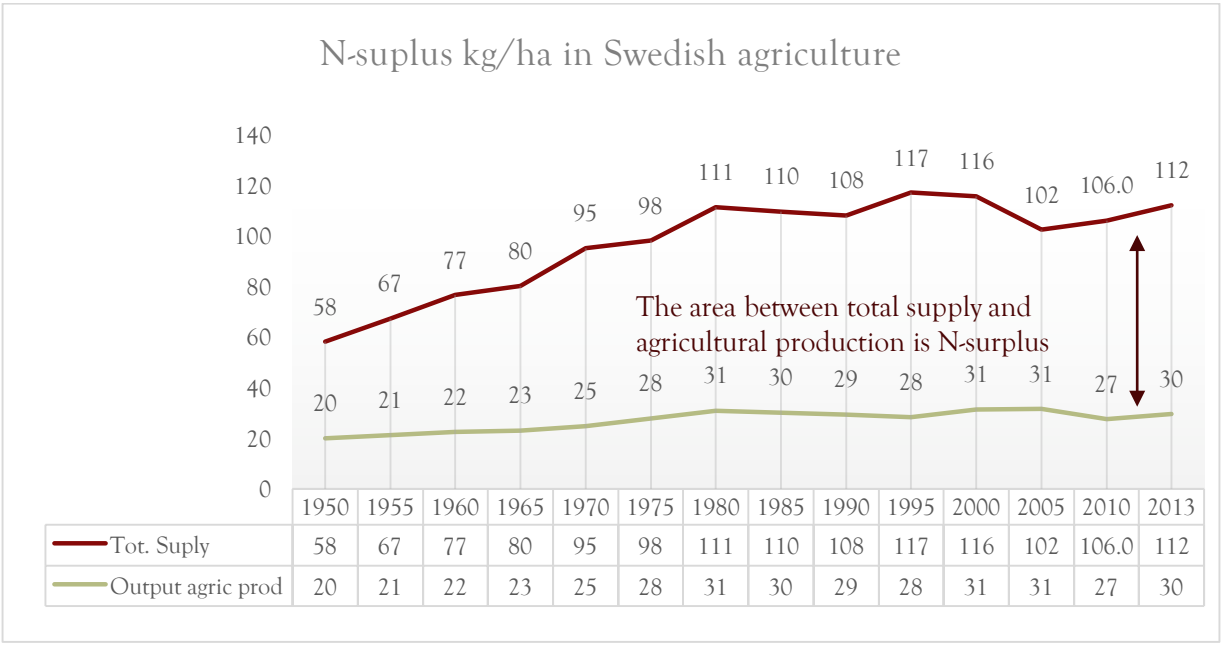
The separation of crop and animal farms, with an increased need of artificial fertilizers and increased emissions of nitrogen after 1950 is well illustrated in Figures 14 and 15 with Sweden as an example. In 1950 use of artificial nitrogen was lower than 20 kg per ha and year. At that time nutrients were recycled with an animal density comparable to ecological recycling farms today. Additionally, sufficient manure, a small addition of artificial fertilizer and nitrogen fixation with mostly clover leys was common on most farms. The situation was similar with phosphorus and potassium, with a culmination about 1980. Unlike with nitrogen, only a smaller part of the surplus phosphorus is lost to the environment but enough that together with nitrogen agricultural runoff is the most important source of eutrophication in the water systems.

After the Second World War, more farms became specialised without animals and thus became dependent on artificial fertilizers. At the same time, animal production increased on a smaller group of farms, with fodder bought from specialised crop farms on regional and global markets (Figure 16). This resulted in an increase in the difference between input of nitrogen and output of agricultural products and the total surplus and emissions of nitrogen increased (Figure 17).



	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2013
N-fix, atmospheric deposition	58	67	77	80	95	98	111	110	108	117	116	102	106.0	112
Imported feed	20	23	34	54	71	76	95	96	90	95	96	84	87	93
Artificial fertlizer	18	21	28	45	60	63	79	81	80	82	80	69	66	70

Figure 16 The difference between nitrogen input and output (surplus that burdens the environment) peaked in 1990. Increasing organically farmed acreage then led to a limited reduction. In conventional farming, the supply of nitrogen in the form of fertilizers and imported feed soya protein continues to increase, in relation to removal of nitrogen through the production of food products (Artur Granstedt, 2016).



	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2013
Tot. Suply	58	67	77	80	95	98	111	110	108	117	116	102	106.0	112
Output agric prod	20	21	22	23	25	28	31	30	29	28	31	31	27	30

Figure 17 Nitrogen surplus in Swedish agriculture. The gap between the total N-supply and output agricultural production is nitrogen surplus which finally lost through emissions to the environment.

The story is more or less the same for all countries with industrialized agriculture but the consequences are particularly clear for the Nordic countries due to our shared, very sensitive Baltic Sea. This industrialization of the agriculture was earlier in Denmark and later in Poland.

According to the figures from EU statistics (European Union, 2016), in Northern Europe and Sweden, the number of dairy farms is decreasing while the remaining farms are intensifying their production. Unfortunately, specialization and exclusion of more diversified, often smaller, farms lead to increased nutrient surplus and runoff (instead of a reduction), as well as an increased pesticide use. This is not least the case now in also the Baltic countries Estonia, Latvia, Lithuania and the parts of Russia bordering the Baltic Sea. There is still some small-scale farming in Poland that, at present, is undergoing a necessary structural rationalization. However, the direction of this development is critical. An understanding of current development is important and needs to be studied – how is Poland's agriculture changing at the moment and to what extent?

In addition to the overuse and consequent surplus of plant nutrients nitrogen and phosphorus, the emission of greenhouse gases and loss of biodiversity are ranked as the greatest challenges for the human existence (Rockström et al 2009).

Global warming generated by agriculture

An analysis of the global warming potential for Swedish agriculture and ERA farming was done by Granstedt and his colleagues in the BERAS project and presented in the book *Agriculture for the Future* (2012) and in a supplement (2016). A current calculation based on the same methods is presented in Figure 18, with the latest available data for Poland and compared with Ecological Recycling Agriculture (ERA). Emissions of greenhouse gasses generated by agriculture are almost 80 % higher in Polish agriculture compared to Ecological Recycling Agriculture and also higher than the Swedish agriculture. Conventional agriculture generates emissions of greenhouse gases through both deforestation and soil degradation. Together, industrial agriculture and the industrial food system are responsible for between 30 and 40 % of global warming and according calculation on global level to round 50 % (GRAIN, 2013).

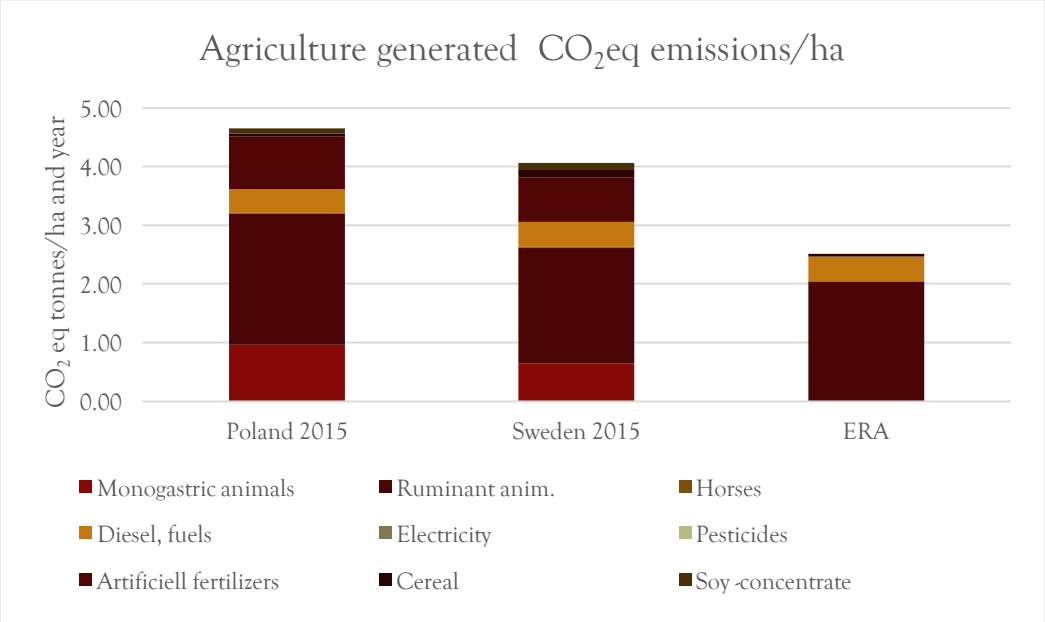


Figure 18 CO_2eq emissions kg /ha generated by agriculture in Poland, Sweden and converted to Ecological Recycling Agriculture scenario.

Unlike conventional agriculture, ERA-production reduces use of fossil resources by not using of artificial fertilizers and pesticides. Carbon sequestration, which compensates for methane gas emissions from animal husbandry, is achieved through larger areas of semi-perennial grassland including legume crops on all ERA farms. A complete conversion to Ecological Recycling Agriculture, combined with a diet with less meat, makes it possible to reach the goal of reducing emissions of greenhouse gasses from the food sector by 80 % and reach the goal for the Paris agreement (IPCC, 2014; Larsson, Granstedt, & Thomsson, 2012).

Use of pesticides and degradation of biological diversity

Specialization and industrialization of agriculture has led to Poland going from being one of lowest polluting countries to one of the highest polluting in the last twenty years. Poland used twice the amount of pesticides per ha compared to Sweden in 2014 (Figure 19)(Eurostat, 2017). This increases the health risk for both farmer and consumer and has negative consequences for the Baltic Sea environment.

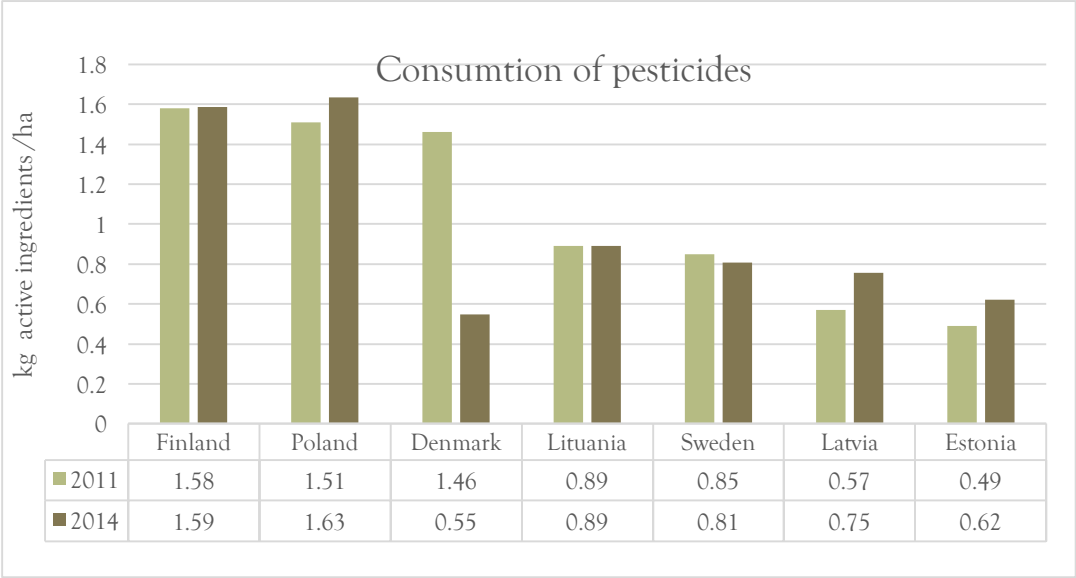


Figure 19 Sale of active ingredients in pesticides 2011 and 2014, Source: Agri-environmental indicators (Eurostat June 2017).

Biodiversity in the agricultural landscape is affected by many factors both inside and outside farming systems, especially in areas that are not cultivated such as wetlands, ditches and extensively grazed areas. But this is changing quickly as a consequence of agricultural restructuring and increased use of artificial fertilizers combined with increased use of pesticides. An analysis of the effects a transition to ERA on biological diversity was beyond the scope of this study. But a change to non-use of pesticides will have a direct positive effect on pest insects but also their predators. Higher diversity and abundance of weeds are also habitats for other organisms, their predators and bird life (Bengtsson, Ahnström, & Weibull, 2005). Diversity of plant and butterfly spices on a farm in increases as rapidly as one year after conversion to organic farming systems (Jonason et al., 2011).

Chapter 3. Study area – Overview of Polish Agriculture and its Historical Setting

Małgorzata Lekan

Poland occupies 312,679 square kilometres and is largely bordered by the Baltic Sea in the north and Carpathian Mountains in the south. The largest central area between north and south are central lowlands ('Polish plain') (91.3% of the total land in Poland is in lowlands) (Bochenek, Dąbrowska-Zielińska, Ciolkosz, Drupka, & Boken, 2005). It has been calculated that 99.7% of the Polish land is in the Baltic Sea drainage basin (Pastuszak, Stalenga, Kowalkowski, Kopiński, & Panasiuk, 2014). The country is divided into 16 Voivodships (provinces; in Polish: 'województwo'), which are the highest-level administrative division of Poland, which are further split into counties (in Polish: 'powiats') and municipalities (in Polish: 'gminas') (for the administrative and topographic setting of Poland see below Figure 20).

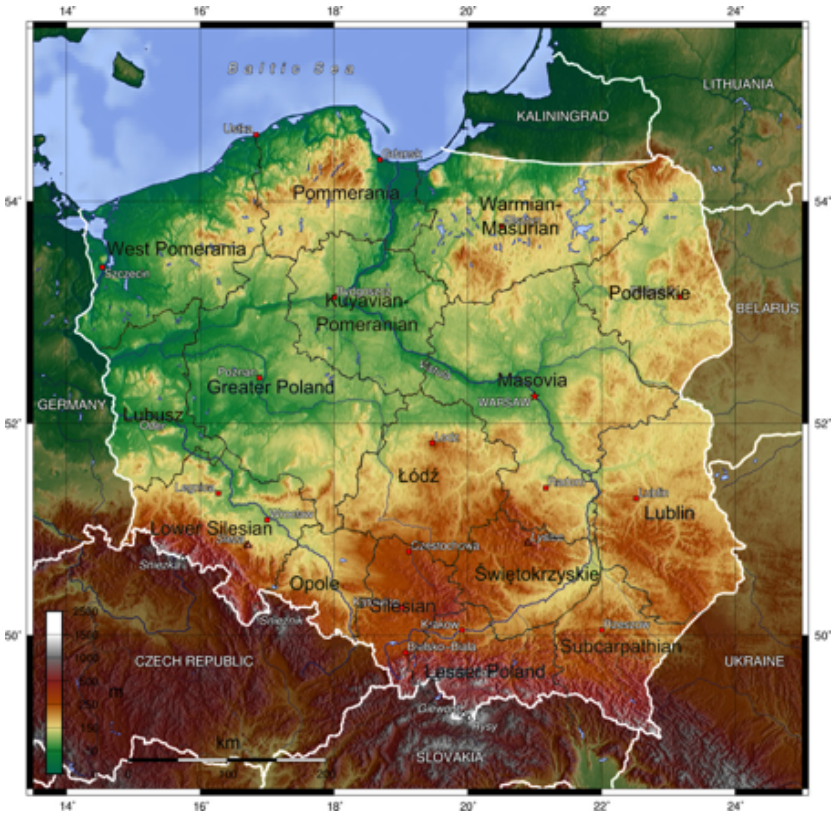


Figure 20 Topographic map of Poland in the wider administrative and European setting. Image source: Captain Blood 2005 and Odder 2016 (Wikimedia Commons)

Polish agriculture in statistics

Total area of agricultural land in Poland was 14,500 ha in 2015 (Central Statistical Office of Poland, 2016). Poland has also the largest agricultural area of the total land area (47.1% of the total land area in 2014) among the Baltic countries and the agricultural sector contributes to the national economy with GVA (Gross value added) that amounts up to 2.6% ("Trading Economics," 2015; FAO in: World Bank 2017). Conventional farming dominates the agricultural landscape and occupies nearly 96% of total agricultural land.

Remaining agricultural land is certified organic farms and certified integrated production, the former one currently occupying 4.3% of the total agricultural land, and the latter one occupying 0.1% of the total agricultural land (Central Statistical Office of Poland, 2016). Even though organic agriculture only makes up 4.3% of the total farm land, Poland is, due to total size, ranked as the 5th country in EU-28 in terms of the total organic agricultural land area. Organic agriculture is partly managed very extensively. Approximately 10% of the Polish population was employed in the agricultural sector in 2014, nearly twice as much compared to the EU-28 average that was 5.2% in 2013 (Central Statistical Office of Poland, 2016; European Union, 2016).

Climate

Poland is in the North Temperate Zone and its climate is shaped by dry continental air, which brings cold temperatures; and wet oceanic air, which brings warm weather. Varying weather patterns and daylight hours throughout the year are sub-divided into four seasons. Overall, the climate in Poland is currently characterized by increased variability and unpredictability. While winter periods are becoming prolonged and much colder, summer periods are becoming hotter and wetter. Such altered climatic conditions are also reflected in increased variability of wheat, rye, barely and potato yields. Moreover, the increasingly shorter vegetation seasons limit crop diversification and make it much more difficult to cultivate intercrops. Since livestock relies on cereal-based feed, the animal sector is also affected by the climate change due to limited availability of good quality fodder (Kozyra, 2012).

Soils

Poland has moderate quality soils and the predominant types of soils are brown soil, pseudogley and podzolic soils that can be greatly found in Masovia, Greater Poland and Lublin voivodships. The most fertile soils (black, alluvial and muck soils) constitute the minority and can be mainly found in the Lesser Poland, Lublin, Lower Silesian, West Pomerania (Szczecin lowland) and Pommerania (fenland of Żuławy Wiślane). In addition, more than 60% of soils are light sandy soils, approximately 80% of the soils are acidic and only 20% are characterized by neutral or alkaline pH (Igras et al., 2014; Staniszewska & Stalenga, 2013).

Farm structure

The farm structure in terms of type of production (incl. whether it is specialized in either crops or livestock, or mixed) or size of farm, is highly differentiated across the country due to the intersection of many factors such as geological formations, type of soils, terrain, climate as well as wider political and socio-economic circumstances.

Production type

Agricultural production in Poland is highly diversified and the main agricultural output is crops. The dominant crop types include cereals (particularly wheat, triticale, barley, oats and rye); sugar beets; potatoes; and rapeseed and turnip rapeseed (Central Statistical Office of Poland, 2016). Potatoes are mainly cultivated in the northern and eastern-central Poland

(Masovia, Lodz, Greater Poland and Sub-Carpathian); cereals and sugar beets are largely cultivated on more fertile soils. In terms of fruits, Poland is one of the world's biggest exporters of apples and it has been estimated that 3.168 million apples were harvested in 2015, mainly in Masovian voivodship (Central Statistical Office of Poland, 2016).

With regards to the type of production, whether it is specialized (in either crops or livestock) or mixed, the statistics reveal that there was a substantial increase in the number of crop-specialized farms at the expense of decrease in the number of mixed and livestock-specialized farms between 2005 and 2013 (see Figure 21 below).

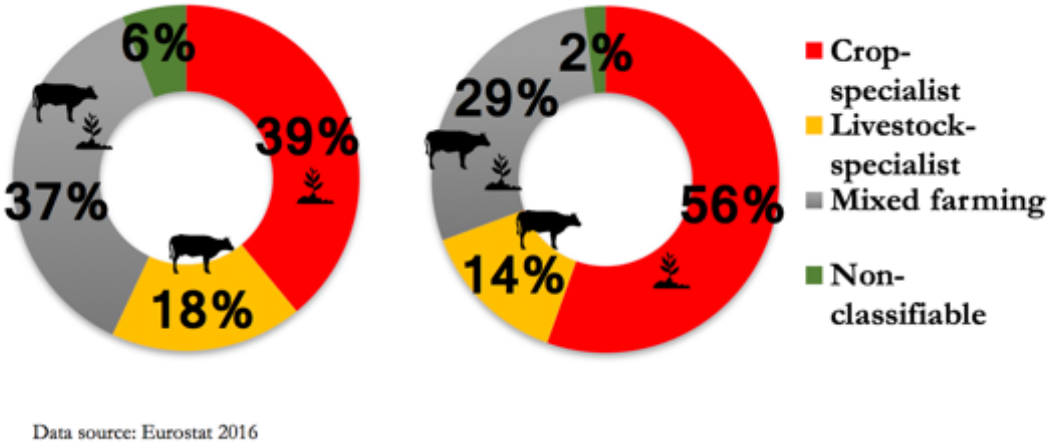


Figure 21 Types of farming among Polish agricultural holdings in 2005 (2,476,470 farms) and 2013 (1,429,010 farms).

In addition, Table 2 below demonstrates that the trends toward specialization in crops are especially discernible in the organic farming sector and the number of crop-specialist farms has significantly soared.

Table 2 Types of organic farming (number and %) in 2013 and 2014 in Poland

	2013		2014	
Organic farms	**Number**	**Rate (%)**	**Number**	**Rate (%)**
Crop-specialist	14 854	55.8%	20 003	**80.7%**
Mixed crop-livestock	11 744	44.2%	4 795	19.3%

Data source: Agricultural and Food Quality Agency 2015

Farm size

While the average size of 1,409,649 farms in Poland in 2015 was 10.49 ha, thus being relatively small compared to EU-28 average (16.1 ha in 2013); the number of farms in 2003 amounted to more than 2 million farms and the average farm size was 6.6 ha (Central Statistical Office of Poland 2016; Eurostat 2015 and 2017; PROW, n.d.). Figure 22 below demonstrates that the agricultural landscape is highly fragmented, as apart from the smaller farms, which constitute the majority (1-10 ha), there are also farms above 50 ha.

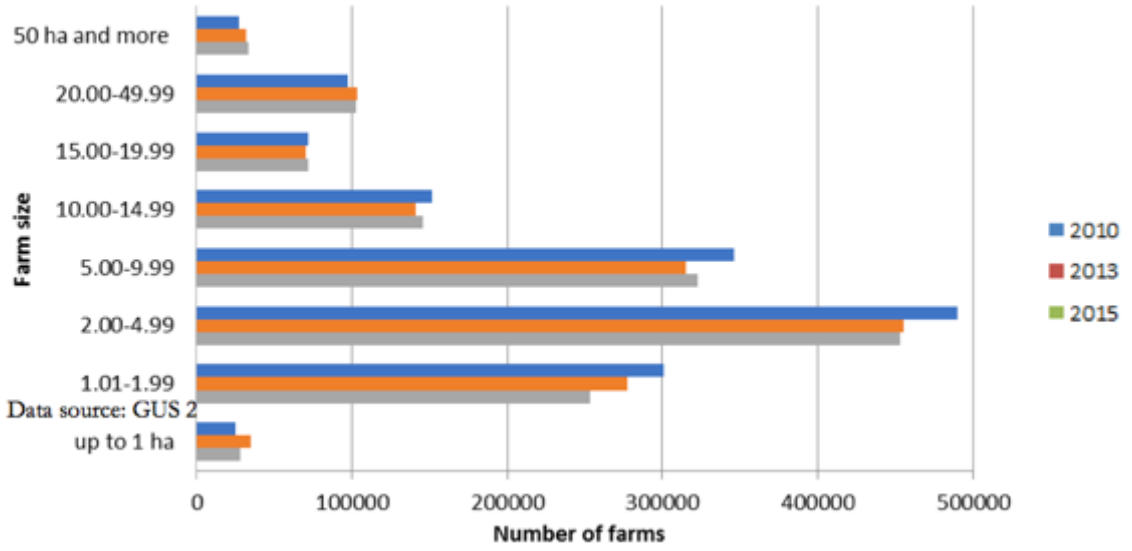


Figure 22. Farms grouped by area of agricultural land in absolute numbers in 2010, 2013 and 2015. Most Polish farms are less than 10 ha. Data source: Central Statistical Office of Poland.

In relation to farm size by voivodships, the farms between 1-5 ha are mainly located in Lesser Poland, Sub-Carpathian, Silesian, Lublin, Lower Silesian and Swietokrzyskie (thus in south, east and south-eastern of Poland); farms between 5 and 15 ha are mainly located in Masovia, Lodz, Podlaskie and Greater Poland; farms between 15 and 50 ha are mainly located in Kuyavian-Pomeranian, Podlaskie, Warmian-Masurian and West-Pomeranian (and thereby in the north and north-east of Poland); farms between 50 and 100 ha are largely situated in Warmian-Masurian and West Pomeranian; and the farms >100 ha are likewise mainly located in Warmian-Masurian and West Pomerania (north of Poland) (Central Statistical Office of Poland, 2016). For an overview please see the Figure 23 below.

Figure 23 Average size of farm.

Regarding the organic farming sector specifically, the largest certified organic land areas belong to West Pomerania, Warmian-Masurian and Podlaskie voivodships. However, the voivodships which have the highest number of certified organic farms, are Lodz, Sub-

Carpathian and Lublin (GUS 2016). This indicates that in the central, eastern and south-eastern parts of Poland there are many farmers with smaller area units who practice organic farming, while in the north there are fewer but larger farms that have certified organic production.

Use of fertilizers

Poland is a big producer of mineral and chemical fertilizers. As the Figure 24 below, which compares production of mineral fertilizers in Poland in 2010 and 2015, reveals, the production of phosphatic and especially nitrogenous fertilizers has risen. The same figure also shows that the production of multi-ingredient fertilizers was slightly lower in 2015 when compared to 2010.

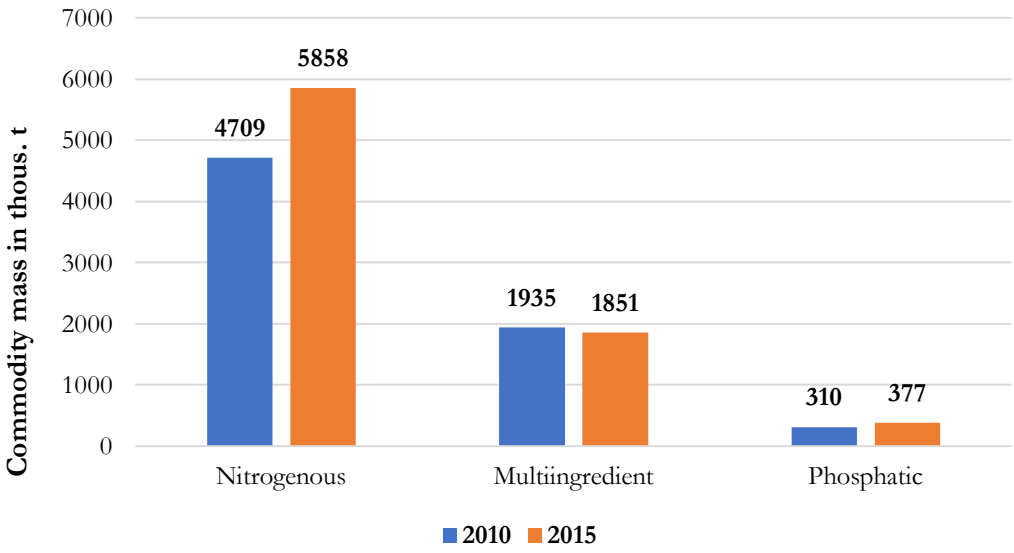


Figure 24 Production of mineral fertilizers in Poland 2010-2015. Data source: GUS 2016.

Use of pesticides

The most commonly used plant protection products are herbicides, fungicides and seed treatments. Insecticides and plant growth regulators are used to a lesser extent. Figure 25 below shows that the sales of plant protection products have increased significantly since 2005.

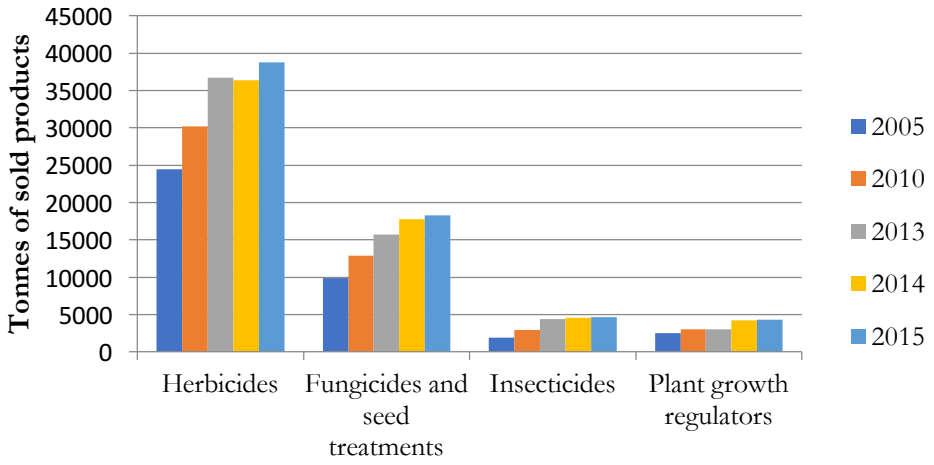
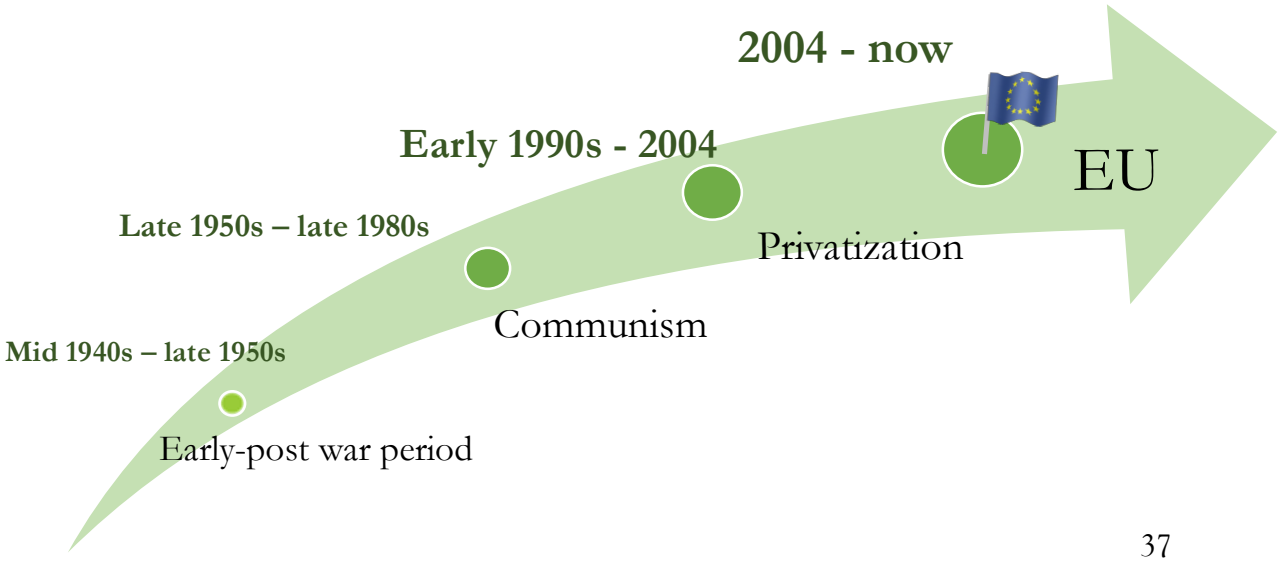


Figure 25 Sales of pesticides in Poland 2005-2015. Data source: GUS 2016

Setting the stage: historical background

Agriculture is deeply embedded within the society in any given country as it provides food to ensure a thriving society and constitutes an integral part of economy, be it at national, regional or local level. More importantly, milestone political decisions, which emerge in response to the heavy accumulation of various socio-economic factors, have the ability to spark a chain reaction across the entire country with consequences for the agricultural sector for many decades to come.

Therefore, this brief historical overview of the Polish agricultural sector focuses on the most recent time periods, each of which was commenced in response to a major political decision that has had large repercussions for the overall state of the agricultural sector, which are felt even today. Reviewed time periods are as follows: the early post-war period; communist period when the so-called State Agricultural Farms were allowed to dominate the Polish agricultural landscape under the state ownership (starting in 1950s and lasting until early 1990s); privatization period, which started in early 1990s and lasted until Poland entered the European Union, and the third and most recent time period that began with the EU accession in 2004.



Early post-war period

After WW2, which had a devastating impact on the state of the Polish agriculture and 7.5 million ha agricultural land was abandoned, one of the key agricultural reforms that was announced via the Polish Committee of National Liberation, was the creation of the State Agricultural Fund in 1944 (Stola and Szczesny 1982 in: Bański 2009). This fund helped implement the program according to which agricultural land exceeding 50 ha had to be parcelled out to serve local unemployed farmers, especially those who had big families. The reason behind such forced division of land, which often took place by means of oppressive measures, can be partly explained by the necessity to provide food for the army. As a result, nearly 980,000 farms were created or benefited from the state-ruled land allocation that encompassed in total approximately 6.1 million hectares agricultural land between 1945 and 1949. Farms in this period were characterized by mixed production system (Olszewski 1985 in: Bański 2009; Grzelak, C., Stańczyk, H., Zwoliński 2009).

Communist period (State Agricultural Farms)

Once the WW2 officially came to an end, the Polish government initiated the process of agricultural collectivization that lasted until 1956 and led to the emergence of the so-called **State Agricultural Farms**, which were a form of collective farming on numerous plots, which used to produce various types of crops (incl. quality seed) and livestock. More importantly, in the early 70s, state-owned farms began to undergo the process of creation of multi-plant enterprises to increase productivity through higher **specialization** in either crops or livestock and mechanization. To accelerate this process, several demonstration farms were created to show how to effectively manage farms and prevent collapse. Nonetheless, these attempts to pursue economies of scale failed and multi-plant enterprises proved to be **unsuccessful**. In result, smaller farm holdings were revaluated in the 80s, yet farms remained large as their size usually ranged between 4,000-10,000 hectares and were comprised of no more than 5 enterprises (Szpak, 2005). All in all, State Agricultural Farms, which were in fact large food cooperatives, helped to ensure independence from imports; largely prevented unfavourable fragmentation of agricultural land; and (intentionally) disempowered private farms whose owners did not have priority to purchase fertilizers or machines, which were under the control of state agencies, and thereby remained small and largely unproductive. According to statistics, approximately 10,000 state-owned farm cooperatives emerged, especially in the so-called 'Recovered Territories' in Northern and Western Poland (currently West Pomerania, Lubusz, Pomerania, Warmian-Masurian and Kuyavian-Pomeranian voivodships); and Southeastern Poland (currently Lublin voivodship) where the development of large state-owned farms followed the displacement of Ukrainian people that used to largely inhabit this region. Interestingly, individual farms, which were often pluriactive, occupied nearly 76% of the total agricultural land in the late 80s, thus constituting the predominant type of farm (Bański, 2009).

Organic agriculture began to evolve during the interwar period under the leadership of Stanislaw Karlowski who worked on a biodynamic farm in Silesia (southern part of

Poland). However, organic farming was largely suppressed during the communist regime. Even though the concept of organic farming re-appeared in 1960 when Julian Osetek practiced biodynamic farming on a 3-ha farm, mainly due to ideological motivations; it wasn't until Osetek's public lecture on his farming practices in 1981, during which he inspired wider academic circles to raise public awareness on biodynamic farming. One of the professors, who were greatly inspired by Osetek's findings, was Mieczysław Górny – a specialist in soil ecology, who helped to spread knowledge about biodynamic farming that quickly became recognized as an alternative farming method in Poland. Nonetheless, development of this type of agriculture accelerated only after the fall of the communist censorship in 1989 when the first organic farmers' association – 'Ekoland' was established and quickly became a full member of IFOAM (International Federation for the Organic Agriculture Movements) in 1990 (Szeremeta, 2005).

Privatization period

After the downfall of the communist regime, Poland entered a new era marked by the shift of the socio-economic system built upon centrally planned economy, which was influenced by the state ownership, to the system based on the free market economy that opened the door to foreign capital. This political and economic transition was meant to restore a market balance and counteract the economic crisis, which was preceded by the short-lived economic prosperity manifested in increased use of machines, higher productivity and introduction of pension insurance schemes. However, agreements made with foreign companies to export Polish products only exacerbated high inflation rates and led to heavy debt by State Agricultural Farms, which were no longer perceived as manageable, and eventually collapsed. Various people argue that some of the better-off state-owned farms could have adjusted to the new economic paradigm, and had they not been liquidated, many people would not have lost their jobs (Bański, 2009). Either way, according to Ślązak (2013), all 1,665 state-owned farms, on 3,742,380 ha agricultural land (22.6% of the total national land) were ultimately liquidated by 1994 and de-collectivized into small units for lease or sale to farmers or investors, often those who had ties to companies with foreign capital (Bański, 2009). The lease agreements were typically made for a 20-30-year period and granted the right of pre-emption, which increases the chances of selling leased agricultural land (usually upon the end of such lease contracts) (Ślązak, 2013).

During this time, many small farmers also received extra financial support to their pensions as long as they had at least 1ha land. Effects of such politics are reflected in the contemporary agricultural landscape in Poland, which remains greatly fragmented (Chaplin, H., Gorton, M., Davidova, 2007). Overall, during the privatization period Poland became dependent on imports and economic analysis of farms reveal that many (small individual) farms during this period (especially in the late 90s) were much less prosperous when compared to the communist period, unless the farms were under western influence. Even though animal production decreased, small family-run farms had to rely on traditional farming methods such as mixed crops-livestock systems to procure organic

fertilizers. It is estimated that approx. 28% of farms in 2002 suffered from increasing depreciation of fixed assets (Bański, 2009). Many agricultural areas were abandoned and production was largely extensive (Bański 2009). In the light of the above reforms, it is possible to discern a correlation between average farm size per agricultural land area and the regions, which were greatly dominated by the large State Agricultural Farms and then privatized or leased. For example, the Pomerania voivodship in the North-Western part of Poland, which used to be the major 'hot-spot' for state-owned farms, currently has the largest average farm size (30 ha in 2015) (Prow2014-2020 2015; Marshal Office of the West Pomerania voivodship 2015).

Most organic farms were private enterprises already prior to the collapse of communism in 1989, and privatization of agriculture did not significantly affect the organic sector (Bobik, 2010). Interestingly, during the privatization period the state provided farmers with financial support to reduce costs associated with inspections (1998) and management of organic agricultural land by introducing area payments (1999). The Polish government also set rules for organic agriculture, which was built around national standards on organic farming (2001) (Szeremeta, 2005).

EU membership

Following Poland's accession to the European Union (EU) in 2004, the Polish agricultural sector has been exposed to a set of new policies and regulations (Common Agricultural Policy), and has received reduced financial support from the state in favour of EU subsidies (which are co-funded by the EU member states). While one of the legacies of post-communist land privatization in Poland were small scale family and semi-subsistence farms, EU reforms combined with subsidies have propelled many farmers to enlarge, specialize and modernize their farms to compete with Western economies on the 'common market' (Bański, 2009). Some of the foreign investors that began to lease Polish agricultural land before the country entered EU have been eligible for EU subsidies, which are complemented with national budget (Ślązak, 2013). Overall, it is widely assumed that neither liquidation of State Agricultural Farms nor privatization of the previously state-owned farms and membership in the EU, triggered the increase in the agricultural production. Some of the main criticisms related to the EU membership indicate that the EU reform has led to substantial specialization in crops at the expense of livestock or mixed production, and consequently a dramatic decline in pork, which is currently one of the major imported commodities (Bański, 2009).

As far as the organic farming sector is concerned, EU membership led to the enforcement of a new law on organic farming, which was updated in 2009 to include new rules for the implementation of Council Regulations ((EC) No 889/2008 and (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control). The EU also offered organic farmers subsidies through the Rural Development Plan under the Common Agricultural Policy (CAP), which led to an increase

in the number of certified farms from 26 in 1990 to 2,464 in 2015; and the percentage of organic area in total agricultural area rose from 0.5% in 2004 to 4.3 in 2014 (Bobik, 2010; Central Statistical Office of Poland, 2016; Willer, H., Yussefi, 2006). Moreover, Ekoland introduced new standards for organic food production, and the new Association Demeter Poland, which issues certificates for biodynamic farming, was established in 2005 (Szeremeta, 2005). The Ministry of Agriculture also released The Action Plan for Organic Food and Farming for 2011-2014. The highest number of organic farms is in Warmian-Masurian (4,244 farms in 2014), West Pomerania (3,549 in 2014) and Podlaskie (3,453 farms in 2014). These numbers correspond with the highest total organic land surface per voivodship and thereby it can be concluded that the key 'organic regions' are in the north of the country where there were the biggest concentrations of state-owned farms during the communist period, and which were subject to privatization after the economic crisis that led to their collapse (Agricultural and Food Quality Agency, 2015). Nonetheless, the statistics reveal that development of the organic farming sector is currently stagnating, and both the total agricultural land area of certified organic farms and the number of certified organic farms were lower in 2015 than previous years (see Figure 26 below).

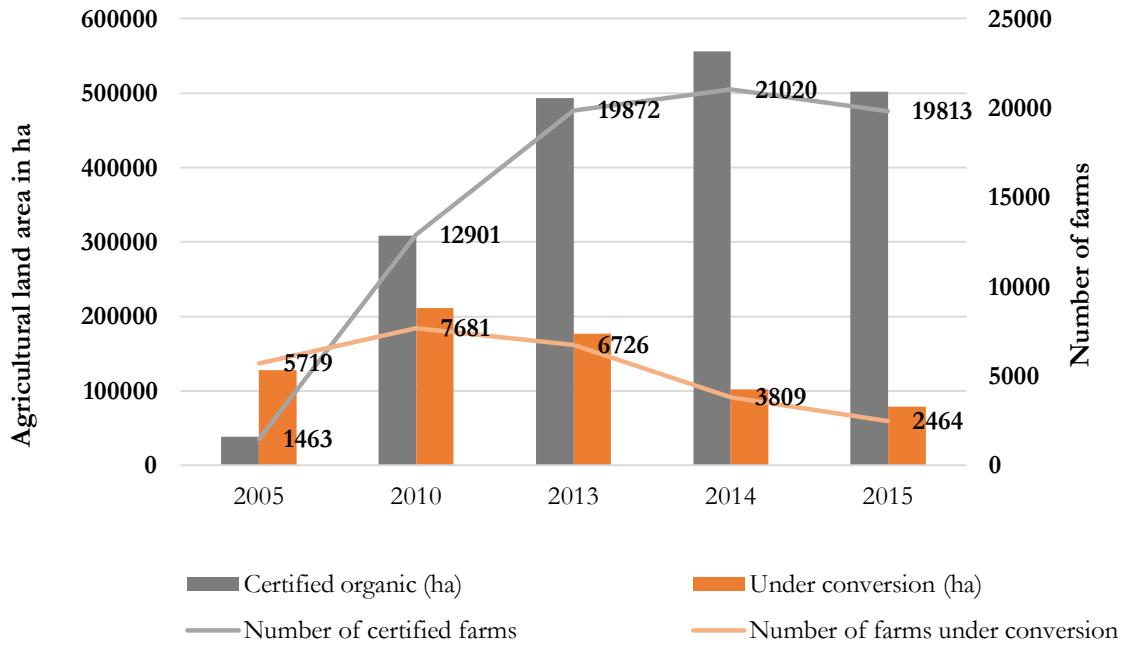


Figure 26 Farm types. Data source: Main Inspectorate of Agricultural and Food Quality in: Central Statistical Office of Poland.

Such decline in the organic farming sector might imply that there is limited institutional and economic support for this type of agriculture. For example, given that the certified organic farms (Council Regulation (EC) No 834/2007) are automatically eligible for the 'greening payment' (under the Pillar 1 of CAP), such concept of equivalence seems to have only impelled national policy-makers to decrease support for the organic farming sector under the Pillar 2, which is concerned with rural development schemes that can be oriented

at programs promoting the development of organic farming infrastructure (EC 2013). By referring to the promotion of organic mixed crops-livestock production systems specifically, organic farmers who had both animal density between 0.6 LU/ha and 2 LU/ha of total agricultural land on farm, were eligible for additional financial support amounted up to 20% of bonus only between 2004 and 2006 (Golinowska & Pytlarz-Kozicka, 2008).

Chapter 4. Farmers' Conditions and Perspectives

Sheshti Johansson

Introduction

Farmers manage their farms in many different ways, and have all made different choices regarding farm direction. Findings in e.g. Larsson & Granstedt (2010) and (S. Johansson, 2013) indicate that farming systems that include a mix of animals and crop production, humus-building crop rotations (including perennial leguminous leys), are self-sufficient in fodder production and rely on recycling of manure can cope with several environmental problems. If agriculture surrounding the Baltic Sea relied on such principles, it would significantly improve the state of this sea, which suffers from severe eutrophication and dead sea-bottoms (Artur Granstedt, 2012). Yet, as food is increasingly being traded on global markets this has created a trend towards specialization and increase in farm size throughout the European Union. In Sweden, this trend has been present for over half a century resulting in a highly mechanized, specialized agriculture in larger and larger units, dependent upon external inputs such as fertilizers and pesticides. However, in Poland this trend started relatively recently, and Poland is still a country where most farms rely more or less on the principles mentioned above (Watson et al., n.d.). Nevertheless, pressure is high also on Polish farmers to compete on the global food market. For example, a large amount of the organic production in Poland is now exported, mainly to Germany, but also to all of Europe. Farmers experience that their local markets are disappearing, but also that the "richer" countries can pay more for organic food than the average Polish citizen.

Our objectives with this book are to investigate obstacles and promises for a future in which agriculture relies on recycling principles and local resources. Farmers are the main actors in these matters, even though they feel that they don't have much say in the political discussion that sets the conditions for their livelihood. We visited farmers with a range of different farm sizes and directions, to gauge their opinions and visions for the future. First, we introduce the farmers, and then we present each farm interview. Our aim hasn't been strictly organized interviews with prepared questions. Rather, we were interested in the interpersonal meetings and what farmers want to show or share with us as we introduce our concerns and ourselves. These meetings have been both inspirational and educational, and we never stopped being impressed over the great hospitality and friendliness we met. And of course, the great lunches and pastries together with coffee or tea served with a slice of lemon.

In the County of Nowy Wiśnicz, not far from Krakow, we visited the farmer Jan Goryl who integrates cows and horses with crop production. He started up in the 1980's with 22 ha and managed the family farm with draught horse power. Nowadays he manages 140 ha, of which 65 ha are his own, and about 120 cows of which 60 are milking, 35-45 are heifers and 20 are out of lactation at any time. His thoughts about this were two-sided. He said: "when I managed the farm with horses my economy was good and my head was light", meaning

that now he is in debt with loans for large machinery, and concerned about his profitability since the milk prices are low. He is aware that he is in a vicious cycle of expansion, where more expansion gives larger incomes but also higher costs. His present goal is to have meat and milk processing at his farm, this would give him better returns for his products.

Farmer Witold Durak from Kurów who manages 14 ha and 14-15 milking cows was also aware that loans create a hold on the farmers by banks, therefore he bought his tractor with cash. Both these dairy farmers are self-sufficient in fodder, but Mr. Goryl does not apply any fertilizer or pesticide and is certified organic, while Mr. Durak is not certified and uses small amounts of these external inputs. Although Mr. and Mrs. Durak manage their farm in a traditional way, including all the important recycling principles, their reason for not certifying their farm as organic is that their neighbours had very disturbing experiences with the control agents.

We also visited the large Juchowo farm, with 2,000 ha and 300 milking cows, close to the border to Germany at the outskirts of Szezcinek in western Poland. They have certified biodynamic production and aim at keeping the principles of recycling even at this scale. The farm is owned by a German foundation and all products from the farm (currently mainly milk) are sold to Berlin. Demand for organic products is seems to be never ending in Germany, and prices received are much higher than could be achieved at local markets. The farm also has an educational role in biodynamic agriculture, and we noticed that the farm size of the farm makes all operations far-reaching. For example, to renovate buildings takes a lot of time and monetary resources, and *e.g.* research on field management that they want to connect to their farm has been set aside. On the other hand, they have prioritized the cows, and the barns are modern and top-notch. The size of the farm forces prioritizing certain areas at certain times and the farm still seems to be in a "build-up" stage.

Another farm direction we encountered was pig farming. We visited Wiesław Dekondy in Niedrzwica Duża, who has 40 pigs and 40 ha. The farm was run conventionally, but a large part of the fodder was produced at the farm. To get the right proportion of protein in the fodder they import 4 tonnes of feed concentrate as soya beans each year. The pigs where held indoors in a feedlot.

Another pig farmer we visited was Jacek Plotta. His farm was an example farm and an educational centre in the BERAS Implementation project (2010-2013), and his farm was a beautiful example of outdoor pigs preparing and fertilizing the fields as they grazed. Mr. Plotta's pig farm was certified organic; Jacek himself and the local advisory service had study visits and trainings for farmers. However, Mr. Plotta exported all his meat to Germany and Denmark, and was put in an economic crisis when the alarms about African Swine Fever stopped all imports of pork to these countries. We asked Mr. Dekondy at the conventional pig farm if they had any of those problems, but they were not at all at risk since their pigs are not held outdoors. Mr. Plotta was forced to get rid of all his pigs, and

doesn't want to go into pig production again. Instead, he will consider keeping cattle, as he needs animals to eat the legume/grass leys that are necessary in the crop rotation, and the manure for maintaining the fertility of the soil. Yet, due to the low milk and meat prices he sees the cattle as a part of his soil management, and is considering investing in poultry for cash.

Only one of the farms we visited had pigs, cattle, poultry production integrated with crop production. The farmer Piotr Zdziarski in Minikowo was also selected by BERAS Implementation as a role model farm, and Mr. Zdziarski prepared a special building where classes could come, and where the advisory service could also invite other farmers for discussion and training in ecological recycling agriculture. Mr. Zdziarski was confident in his farming methods and tries to inspire young farmers by showing that organic farming is just as high-tech as conventional farming. One of the drawbacks of his setup was that he had 1,000 chickens in a feed-lot, and because the regulations around organic production and antibiotics, he calculates that 40% of the chickens will die of disease.

Farm portraits

Good practice farm: Jan Goryl

Sheshti Johansson, notes from farm visit June 20, 2016

The farm of Jan Goryl is a nice example of what we think is the right direction: well managed crop rotations and balance between animals and cropland. In this interview, we had the pleasure to have Maria Staniszewska with us to translate and also to assist with her large bank of knowledge.

Figure 27 To the left Mr. Goryl in one of his wheat fields. Here we see wheat after clover, which gives a clean field with low weed density. Further back is a darker green field, which is wheat after wheat, with much higher content of weed. The beneficial effects of clover leys were evident. To the right the road up hill to the Goryl family farm. Photos: S. Johansson.

The area is hilly and farms are spread out on top of the hills or close to the village road, but not centred in a village. The structure resembles the Swedish situation where there has been a deliberate structural shift from villages with fields surrounding, to single farms surrounded by their own fields. However, this farm has fields spread out in the village and

up to 5 km away, so there are some costs attributed to transportation between fields and home.

The total farm area is 140 ha, of which 65 ha are owned land and 75 is leased. There are around 11 ha forest, 30 ha pasture and the rest is arable land. Mr. Goryl started up with 22 ha in 1985, and first after 1990 he expanded. Therefore, the fields are a mixture of leased land and land he bought at different times, which could be a reason why the fields are so spread out. In southern Poland, a 22-ha farm is considered large, as the average farm size is approximately 5 ha.

Figure 28 To the left Simmental cows for milk production in their pasture They go to the pasture after morning milking at 6 o'clock and back to the barn again for milking at 18 and night rest. It is about a 800 meter walk from the barn. To the right Approved room for meat processing located in a renovated old horse stable. Photos: S. Johansson.

There are 80 milking cows plus 35 heifers at the farm. In addition, there are 15 cows in another farm, 10 km away (at pasture). Through the year, there are approximately 60 milking cows. Each cow has an average lactation break of 2 months. The herd provides around 700-800 l per day, totalling 250,000 l milk per year. Milk yield could reach 6000 l per year per cow at maximum at this farm, but Jan Goryl points out that a good yield is closer to 5000 l per cow and year, but typically somewhat lower. He uses an alpine breed from Switzerland, the Simmental cow, for milk production, but for meat production he keeps another breed.

Mr. Goryl says that the biggest barrier for organic meat producers is slaughter. He is lucky as there is a slaughterhouse only 2 km from his farm, and his production is so large that he can book in his cows and slaughter his animals that day. However, for some reason with the slaughter and "mountains of bureaucracy", the meat will not be sold as organic although the production system is both organic and "organic plus" (ERA).

Every other day, milk is transported to a dairy. The milk is sold as organic to a higher price, but the farmer often receives the same price as conventional milk producers. However, it depends on the market, sometimes the price is higher, sometimes lower. These obstacles to getting price premiums for his organic products are two reasons why Mr. Goryl is

preparing to have his own processing at home. An old stable is being renovated and prepared for meat processing, and wood from European beech (*Fagus sylvatica*) for smoking the meat for sausage production was stored in the attic.

Figure 29 To the left Van with cooling room for transportation of meat from slaughterhouse. To the right Storage of wood especially prepared for smoking meat for sausage production. It is important that the wood is from deciduous trees. Mr. Goryl uses wood from European beech (Fagus sylvatica) called "Buk" in both Polish and Swedish. Photos: S. Johansson.

He has not yet found the right equipment for milk processing, but a room is prepared for that as well. He is also starting up a small farm shop where he could sell his own meat and vegetables Jan Goryl says that people in general don't know much of organic food production, and that it is easier to market the food as "Natural product from farmer" than as "organic". Perhaps this is related to the "locally produced"- concept, so popular in Sweden at the moment. Jan Goryl's meat also tastes better than meat from the grocery shop, because of better animal welfare, right fodder etc., and people who taste are then often willing to pay a higher price.

Artur shared that in Järna the production level per cow is 40 % lower than the average conventional cow, but that the price for the milk is about twice as much as conventional milk, which makes is economically viable even in competition with the farmers with lower production costs. Maria Staniszewska, (Polish Ecological Club) suggested that a local label instead of simply "organic" may be a good idea. Artur wonders whether he will co-operate with other farmers in his processing facilities, but Mr. Goryl think that co-operation with other farmers is difficult, and would rather buy their land and expand himself. Currently, there are 4 people working at the farm: Mr. and Mrs. Goryl and their two eldest sons.

The crop rotation is at least 4 years, but mainly 5 years. The first-year crop wheat or maize, followed by 2 years of clover, then oats in the spring followed by wheat, maize or rye for the animals in the autumn. As we went to look at the fields we could see a significant difference between the fields with wheat after wheat or wheat after clover regarding weeds.

Figure 30 Mr. Goryl points at the cow manure and explains that the horses don't care about it. As the horses come to the pasture last in the grazing cycle they eat down the grass tussocks left by the cows and spread out their manure at the same time. Photo: S. Johansson

Figure 31 Mr. Goryl shows us the clover field after rye. Prof. Granstedt is investigating the crop and noting the straw leftovers from previous harvest in the ground. Mrs. Staniszewska to the right in the picture. Photo: S. Johansson.

For the pastures Mr. Goryl has a special system; rotation of 4 weeks. The first week milking cows graze, the second week the young cows and the third week horses, then the pasture rests for 1 week. In the pasture, he lets small trees grow all around the fields, and then he cuts them so they work as fence posts. There are also trees kept in the pasture for shade and for the cows to satisfy their special needs of minerals or vitamins. Mainly young cows need the leaves, but also the older cows can at times have some needs the trees will fulfil. It keeps the herd very healthy. The horses graze the next level, the shorter grasses, and after week three in the system the pasture looks just as neat as after a lawn mower.

Mr. Goryl had horses all his life. Between 1985-1990 he worked his farm with draught horse power; 2 large working horses. However, at that time he had 22 ha to take care of, and as he has expanded up to 140 ha he could not manage everything with horses. Horses may be efficient in converting biomass to work, but a tractor is efficient if time is the measure of optimization. Yet, the feelings of Mr. Goryl is that when he had his smaller farm and worked with horses he had more income and felt "light headed" – both happy and without concerns for the debts he now pays after investing in large machinery. This is an effect of EU policy and the advisory services that encourage farmers to scale up and invest in larger machinery. Easy access to credit also facilitates this direction. Sometimes Mr. Goryl dreams of scaling down and working with the horses again. However, now he also occupies his sons in the farm, and that is also an advantage as he sees it – when the farm expanded more members of his family can make a living there. His dream now is to include processing which would create a better financial situation for his family.

'Figure 33 Mr. Goryl shows us the old harnesses from the years when he worked his fields with draught horse power. Photo: S. Johansson

Figure 32 Polish horse breed, Konik, kept by Mr. Goryl as a "hobby". He has had horses all his life and can't be without them.

Mr. Goryl keeps horses at the farm because he "can't be without them". He calls it a "hobby", but their contribution to the pasture system is beneficial for the whole farm. He keeps a national breed, Polish horse, Konik, and some Shetland ponies. I guess also the children are fond of these horses.

This was a wonderful meeting with a passionate and very hard-working farmer.

Dairy farmers: Mr. and Mrs. Durak

Sheshti's notes from study visit in Lubelski, October 20, 2016

Figure 34 Mr. and Mrs. Durak in the milking barn.

On this farm visit we had the pleasure to be accompanied by Jarosław Stalenga and Jerzy Kopiński from the Institute of Soil Science and Plant Cultivation in Puławy. These two researchers have worked as agricultural advisors in the area, and also gathered information from many farmers in the area for research. They chose this farm for us to show a "conventional" version of farming that is still very close to the objectives in ERA.

The size of the farm is 14 ha and there are 14-15 milking cows of the breed Polish Black and White Lowland. They yield on average 5,400 litres per year and cow. When we approached the farm, we saw the black and white cows tied up one and one to a pole in the fields, where they were grazing. As we walked around the farm we also saw that there were some cows in the barn. The barn was traditional, with straw beds and each cow tied up with the head towards the fodder board. The cows were clean, the floors and beds were clean, and the atmosphere in the stable was calm and safe. The cows have daily contact with the farmers. Each morning they manage to clean the barn and milk the cows in two hours. A portable milking machine is used with a bucket for the milk. The milk is then emptied in a milk tank.

Figure 35 The well treated black and white cows, the milking equipment and storage tank for milk.

Manure is stored on a cement slab with drainage so that urine is separated. Manure is also sold to neighbours.

Figure 36 To the left: The farmer shows the cement slab, Jarosław Stalenga in the foreground. To the right: A neighbour comes to get manure, he shovels it by hand.

We sat down to share a cup of coffee, tea and some biscuits in the comfortable kitchen with cosy warmth created by the traditional wood stove. Jaroslaw started by explaining the current status of the Baltic Sea, the work of BERAS and our reason for coming to visit them. Mr. Durak agrees with the fundaments of the concept, and acknowledges that it worked well in Poland 30 years ago.

Prof. Granstedt wondered what conditions Mr. Durak would need for choosing to convert to organic farming. Mr. Durak explains that his farm is already based on recycling, so a conversion would be easy. They even sell manure to neighbours without livestock. This farm is similar to the model of ERA. There are grasslands on the arable land as well as permanent grasslands. All the fodder is produced on the farm; they only purchase vitamins and minerals. Only a very small amount of fertilizer is applied.

“One reason why I would not do any effort right now for converting into organic is that I am soon going to retire. It is not difficult, as I said. We are almost organic already, perhaps even better than many organic farmers today. But to get certified you must write contracts for 5 years at the time, and before that we will retire. I think I might have certified my production if I was younger. But 7 years ago, we had a stressful situation at the farm. There was a big storm and thunder. Lightning struck our farm and our buildings and barns were damaged. The roofs and the tractors were destroyed (after this period my hair turned grey…). We had no extra insurance for disasters, so we really lost some years just to rebuild our capital” said Mr. Durak.

“What do you think about the future of the farm?” Prof. Granstedt asked.
“One of my children lives here, and maybe she is interested in taking over the farm in some way. We would not, however, recommend our child to work with animals. We are so tied up at our farm and we can never travel. I think it would be better for them to specialize in crops. I like the animals because they keep a nice landscape. But this is my perspective. I don’t know what my child wants to do. We should look for a rich guy with horses so we can receive salary but have the freedom to leave the farm when we want.” Mr. Durak says and laughs. “We will quit with the milking cows after we retire. My wife and I have never been able to go for vacation or travel, maybe we would like to come to Sweden!”

We wondered if the price of the milk was an important factor for choosing to turn away from milk production in the future. But Mr. and Mrs. Durak do not at all see this as a problem, they rather stress that it is hard work to keep animals, and that they want to rest. But he admits that it may be difficult to make a good livelihood from such a small farm without animals, and we agree that this may be a main reason why so many choose intensive berry production. Mr. Durak says that this production direction is more flexible for the farmers and also preferable for that reason. However, the perennial berry plantations are sensitive to price fluctuations. For example, last year they received approximately €3/kg for raspberries, this year the price was reduced to €1/kg. For black currants, the price was €1.5/kg in 2015, and this year €1/kg. And no matter the price, you still need to employ people for harvest. So, really, the milking cows are quite a good choice.

After we had been talking a while and gained trust in each other, Mr. Durak confessed that there were further reasons why he does not want to certify his production as organic.
“My neighbour is an organic farmer. Once, he bought non-certified vitamins for his cows, so the inspector said that the milk was not organic. This may be understandable, but the inspector also insisted that all the manure had to be taken away from the farm! So, he had to remove it all, this is done by hand so it was a huge task… And I have another example: I know a financially poor farmer who lives in an old-style wooden house, with no bathroom. He certified his production as organic, and the inspection agency forced him to renovate his barns and put in tiles. The cows had a much fancier home than he did. And there were so many inspections! The inspector found a spider in a corner, and came back after two weeks

to check if it was removed. They can have four inspections in two months! And they come without announcing – like a police officer during the war! EU decides the rules, and the inspection agencies follow those rules. inspection and bureaucracy – this is the real reason why I did not convert" he explains with emphasis.

Prof. Granstedt was surprised by the behaviour of this inspection agent, and said that he should be removed.
"I am also an inspector" said Jaroslaw. "It is really important that we are friendly. I don't like the philosophy with penalties – I think it is a bad system. There are many farmers that hesitate to convert just because of this. I think we must change the inspection system. I am acquainted with the inspection body that was involved with his neighbour: they actually tell the inspectors that they should act like a police officer".

"I think it was better before we entered the EU" said Mr. Durak. Even if the EU-subsidies are included in my economic accounting, I still think it was better before. Now prices for food are the same, while the price for inputs such as fertilizers, pesticides and oil have increased, and the subsidies only compensate a small part of that loss. About 10-15 years ago I grew tobacco. Then the price was € 2/kg, and the price for 1 l of oil were € 0.2. Now, the price for tobacco is the same, but the oil costs €1/l. Another example is that, previously we could buy 300 kg N for the same price as 100 kg wheat, now it is the opposite: 300 kg of wheat corresponds to 100 kg of N. Also, the milk price is the same as for 20 years ago, € 0.2/l, while the costs for production are increasing".

This is also the situation in Sweden. Prof. Granstedt says that when it comes to food production it is only if borders are more closed (or rather national markets are more protected) that increased production costs lead to an increase in food prices. And is it not a good thing – could not rising prices on the mentioned inputs encourage using less? Mr. Durak says that he already uses minimum amounts and always looks for opportunities to reduce production costs. But it has come to a point where further reduction would affect yields, and therefore the way it affects them is that profits are lower.

"Is there any way of changing this system?" Prof. Granstedt asked.
"It depends on the loans and banking system that creates money and keeps the economy growing without connection to real values" said Mr. Durak. "We should not feed the banks with our money… I am against taking loans from the bank. Many farmers take loans to buy cattle and machinery, but when the cattle die and the machines are broken they still have their loans. Therefore, my philosophy has always been not to take loans. I would also like a better price for our food, or lower price for the inputs."
"I don't believe the prices for inputs could become lower, but I understand that we need a protected market for food." Prof. Granstedt said.

“We are worried about the agreements of free trade between the US and Canada. It would go in a totally wrong direction with even cheaper food. We hope it will not be signed.” said Mr. and Mrs. Durak.

Large-scale biodynamic farm: Juchowo

Sheshti Johansson’s notes from study visit at Juchowo farm September 26, 2016

Figure 37 Professor Józef Tyburski to the left, Professor Artur Granstedt and wife Carol to the right in front of the main administrative building of the Juchowo farm.

In this study visit we had the pleasure to meet the board of the Juchowo farm: Krzysztof Ostrowicki – responsible for crop production, Monika Liberacka – responsible for the cows, Renata Żelazna – administration, Hr. Sheiwe – responsible for farm finances. We also had the opportunity to travel together with Professor Józef Tyburski from the Warmia-Mazury University in Olsztyn, Poland

We came out from the taxi in front of a blue and red building where there were two women sweeping the floors and stairs, a younger woman shaking a mat and then resting in the sun, chatting with other people passing by. At another table, we saw a few men drinking coffee, and a man dressed in working clothes walked over the yard. A woman came and asked us to have a seat while we were waiting for her to announce our arrival. After a few minutes, a young woman with a cup of tea in her hand and a smile on her face showed up. She went straight up to Professor Tyburski and they greeted each other as if they had met before. This was Monika Liberacka, formerly Professor Tyburski’s student. She offered us coffee and tea and we introduced ourselves and chatted for a while in the sunshine, it was a beautiful day. After a while, Krzysztof Ostrowicki and Renate Zelazna joined in as well as Rolf Novy-Huy, a visitor at the farm, and interested in sustainability issues and working with urban land matters in Germany. Mr. Sheiwe would join us later for lunch.

Monica and Krzysztof were our guides. They told us that they have not yet started up any on-farm processing, and that all milk, 10,000 litres every other day, was transported to

Berlin. But there has been so much to do, including looking after all buildings. Currently, they were renovating a few buildings and removing dangerous old materials. Krzysztof also told us that the person running the long-term field experiments had left with all the data. He had agreed to give Krzysztof the data but not yet done that. Therefore, the field experiments were currently not managed more than necessary. The former contact person for BERAS, Sebastiaan Huisman had also quit a few months ago and the whole administration is undergoing changes.

Figure 38 The focus of the farm was building renovation at the time of our visit.

Krzysztof was responsible for all crop production, which mainly was for fodder. He showed us the hay machine and told us that they dry the hay in two steps: it is left on the field to dry to 14 % water content and then further dried in the "barn" where a modern hay dryer was installed. If the weather is good the hay may dry even to lower water content in the fields, but they never leave it out for more than three days. The dryer uses hot air from the ceiling as a first step and if that's not sufficient, heat is produced by burning wood. Part of the wood comes from the Juchowo forest, but they also need to buy wood. The capacity of the hay dryer is 200 tonnes per day, corresponding to 800 bales. The milking cows are only fed dry hay, but heifers are also give hay silage. Monica brags a little that they have the best tasting premium milk. Józef says that he thinks his neighbour has the best – when you feel that the sour milk tastes sweet you know the quality is good. Monica tells us that they also feed some fodder beets and a bit of grains, mainly maize in the winter. Krzysztof says that they use (and produce) approximately 100 tonnes of fodder beets. Monica says that fodder beets are fed twice a day in the winter, and it is cut, washed and then mixed with hay cut in small pieces and grain. Józef shares that beets work as appetizer, which stimulates fermentation in the gut of the cow. It is also used in biogas production – the very same mixture, beets and maize grains stimulate the methanogenic bacteria. Monica agrees and adds that fodder beets are not like feed concentrate but more like forage.

Figure 39 Fodder beets in front of the bales of hay, and a few hay-silage bales to the left.

The only feed they buy is maize grains and lupine, the rest they grow on their own. Józef asks why they don't grow these on their own, but Krzysztof explains that they tried but failed for several years. Józef says that they must visit the farmer Jacek Plotta, he manages good yields of both maize and soya beans on sandy soils. Krzysztof wonders how he manages the weeds, but Józef says that it is easy and no special methods more than regular field operations (ploughing, harrowing, cultivation…). 25 tonnes of manure per ha is enough according to Józef who has worked closely with Jacek Plotta, conducting field experiments and given him agronomic advice. For the last seven years Jacek Plotta grew maize with great success, it is a fantastic crop!

Soya beans, on the other hand, have turned out to be quite difficult. Józef has never experienced any crop that is more sensitive to the local micro-environment. It is crucial what variety is chosen in order not to succumb to root disease. Therefore, you must start with only a small area to test which variety is the most suitable. But almost every year there is a new disease and Józef is experimenting with seed treatment to avoid this. Monica is curious about soya bean because it's a drought resistant crop. Rolf wonders whether it would help to change the area they grow it. Józef says that it does to some extent, but fungus, primarily fusarium but others as well, are present in most soils and could be problematic. For example, in Austria there is a long tradition of growing maize, it came a long time ago from China to Vienna, but now suddenly problems with root diseases are appearing. Artur wonders if applying compost would help. Józef says that it would be a good experiment for the Juchowo farm to try.

Artur notices that there is a new pond since he visited the last time. Monica explains that they put ponds at places where rainwater naturally accumulates. They have about 20 ponds at the farm. Unfortunately, the cows got sick when drinking from them, thus they realized that the water in the ponds got too warm, so that parasites could grow in them and the cows were infected. Now these ponds must be fenced so that the cows can't drink form them. In

the future, Monica wants the cows to be kept in a more natural environment where they could eat and drink freely.

Figure 40 A new water pond since the last visit of the BERAS project.

Krzysztof tells us that they harvested 1,300 tonnes of grains this year. It is dried in boxes with hot air from the ceiling. This year was a bad year for winter crops, but spring crops gave a better yield. They also have equipment for de-husking spelt since they get a much better price for spelt. They get €1,200 per tonne for cleaned spelt, compared to €650 if not cleaned. Józef is surprised as farmers in his region only receive approximately €300 per tonne for organic spelt, while apparently, Demeter pays more than twice the price. Monica says that the market in Poland is limited so they sell everything to Germany. Józef says that it is a big mistake in the policies for organic farmers that there has been no focus on creating a good market. Artur agrees that this is an important aspect, as most of the organic production in Poland is exported to other countries. Józef says that in the south were there are a lot of small-scale farmers with intensive production (and a lot of hard work) almost 100% of the production is for export. Artur says that Aleksandra and Mieczysław Babalscy, who buy local organic grains and processes it to pasta for the local market, has taken a very important initiative. Józef says that it is easier with dry grains as they can be stored longer than, for example, fresh vegetables.

Figure 41 Grains being dried in boxes.

Figure 42 Dressed up to visit the barn. From the left: Józef Tyburski, Monika Liberacka, Rolf Novy-Huy, Artur Granstedt and Carol Granstedt.

We were also shown around the barns, but before we went in we dressed up in white overalls and plastic "socks" to protect our clothes from smell and manure. As we enter the barn we see many flies in the hay, but not so much around the cows. Monica says that the problem was worse before they used an effective product from Germany for removing flies. First, we entered a section for calves. They had a straw bed that was removed once every month. For the larger cows, they may need to remove the bedding more often. The cow breeds are Brown Swiss and Black and White. The Brown Swiss is born almost white, and after a few months they become grey, and finally as adults they are brown. The Brown Swiss has a better somatic system than the Black and White and is both easier kept and has higher milk quality. Now they will also start trials with the Polish Red cow breed. They will start by buying 10-15 heifers so that they could adapt to the herd and environment and then continue breeding them. Monica points out that breeding cows is a long-term activity since it takes time between each generation.

Calves stay in the barn until they are 5-6 months old. They have a kind of "igloo" they can enter if they are cold. The barn is built so that a lot of air can circulate, with large open areas. If it is very windy and rainy they have curtains for protecting the calves from bad weather. Previously the calves stayed in another building, which was more like a house with "closed" (regular) walls. The indoor air was much worse and a lot of the calves developed lung disease. Lung disease still occurs when the weather is cold and wet, but not at all to the same extent.

Figure 43 Black and White calves and two Brown Swiss to the right. An "igloo" in the back of the box for shelter

Monica showed us the milking machine, a Happel-system (from the German company Happel). She told us that this is the only one in Poland, so it is difficult to service, but it mostly functions very well. The milking system is developed to resemble hand-milking and the cows are content with the treatment. The milking machine has place for 32 cows at the time, and the milking hall is large and bright with large windows, which is important because cows feel safer in a large, light area than a small, dark one. Józef's opinion was that the hall was not large and bright enough.

The milk is very good quality. In an average conventional milk farm the number of somatic cells is 300-400,000 according to Monica, while in the Juchowo herd it is 150,000, meaning that there is a low concentration of pathogens. The somatic cells are the number of white blood cells. Above 200,000 there is an infection of mastitis (udder infection), and cows with a significant amount of pathogens have above 300,000 somatic cells.

Figure 44 Happel milk machine

We went to the barn where the adult cows reside in the winter. At the moment, there were a few cows with hoof injuries in the barn, while the others were still at pasture. Cows are outside from April to mid-October, but in the beginning and end of the season they only go out during the day so that they slowly get used to the new fodder situation. They are out day and night from around May until September.

Monica says that in conventional farming it is common to have less space per cow, since all cows do not rest at the same time. However, at the Juchowo farm they have enough space for each cow. Since the cows have horns it is even more important that they can get away from each other. There is room for 100 cows per barn but only 80 are kept in the area. They stand on a layer of compost mixed with straw pressed together to a hardwearing "floor" that is easy to clean. Now and then a large stave is pulled over the floor and brings down manure to a slurry basin. Then there is "playing boxes" for the smallest calves, which are cleaned every morning. Artur adds that in Sweden some farms have a mixture of peat and straw, and this also functions very well.

Figure 45 Active brushes for the cows in the barn. Floor made of a composite of compost and straw.

Hay is spread out along the barns so that the cows can come and eat as much as they want. In the barn, where the cows are loose, they also have active brushes, which they like very much. On very hot days in the summertime there is a misting system in the barn, which is also appreciated by the cows that are indoors. It is always comfortably cool in the barns since there are no closed walls, ensuring good ventilation (just the curtain-like protection against wind and rain). The dry cows are kept on deep straw, it is their "holiday". Two months before the next calf they need a pause in lactation so that they can give all their energy to the new calf. Monica points out that in conventional farms it is common not to give the cow this pause. Józef adds that typically cows die after two lactations in such intensive milk factories. Monica tells us that they have around four lactations in their barns, but the oldest cow in the barn is 13 years old, and many are around 10-11 years. It takes some time also to see the outcome from breeding. The first selection of individuals is based on how well they manage with feed consisting mainly of forage.

Artur asks how they transport the hay to the barn. Monica explains that it is carried by a truck every day. In the winter, they have two employees for this chore, one in the morning and one in the evening. But in the summer the same person who manages the fields does this once a day.

There are three bull boxes for each herd. They breed their own bulls, and then pick those from good cows that are well adapted to the circumstances at this farm. To bring in new blood a few bulls are even purchased from Germany. Taking care of the bulls requires extra caution. The boxes are designed so that it is easy for caretakers to get out quickly if needed, and there are always two persons when dealing with the bulls. Monica tells us that they select bulls based also on their temperament. Aggressive bulls are removed.

We were then shown the manure heaps and a slurry from the more liquid manure from the barns. The liquid manure storage looked dry and unused. Józef asked why it is not used, and Monica explained that they mix it when it is time to apply to the fields, and in October Krzysztof will put it on the fields.

Figure 46 Dry slurry to the left, heaps of manure to the right.

When we went out from the barn we saw a black and white cow in a cage carried by a truck. Monica gestured towards them and said that she does not like this system. This cow is being sent to slaughter. Monica wishes that they had their own slaughter house at the farm so that the cows didn't need to be transported.

Figure 47 Cow on its way to slaughter.

To see the field trials, we had to cosy up in the back of a small van. We saw the straw after a harvest on buckwheat, yielding 1.1 tonnes per ha cleaned. The soils are sandy and Artur points out that decomposition of organic matter and mineralization is very fast; hence the stabilization of the humus content is much slower than in clay soils. If one has sandy soils with low organic content it is important to strive to improve soil quality.

Crop rotation in the field trials is at the moment 2 years of lucerne, followed by spelt and then buckwheat. Józef remarked that buckwheat does not take up any water after it is ripe,

thus it would be a good pre-crop. Krzysztof explains that they had problems with lucerne, that it was too dry. Józef says that dryness is never a problem for lucerne since the roots are up to 10 m deep, but the calcium content on the other hand is crucial. Krzysztof says that the soil has pH ±6, and add agricultural lime. Sheshti asked if it is possible to use bone meal from the farm. Artur explains that bone meal is very expensive but good considering recycling. However, calcium from rock is the best when building up calcium content in the soil. Rolf asks how organic farms manage the phosphorus balance. Artur says that phosphorus is limited and that maximum recycling is important. Mineral soils normally have a large storage of phosphorus, so crops with deep roots will stimulate weathering and make minerals available for other crops in the rotation. We also discussed some other methods, for example recycling of human faeces, or mussels – since the nutrients end up in water bodies. Also, seaweed is used in some cases, but can seaweed can contain heavy metals, especially cadmium and is thus problematic.

Figure 48 Professor Józef Tyburski showing his agony over the field experiments. Krzysztof Ostrowicki to his right.

Józef has some concerns about crop sequence in the field experiments. First lucerne builds up a lot of nitrogen in the soil. Then spelt is sowed in the autumn, from August to December. After this there was nothing. Winter comes with an empty field and rains deplete the soil of nitrogen that has accumulated by the lucerne ley. Buckwheat is not sown until April-May. Hence, nitrogen was not utilized in this trial. Józef judged it as very poorly planned. Artur asked again to confirm if they didn't have a catch crop after spelt, and Józef says that they do in the ordinary fields, but not in the trials. Krzysztof explains that before buckwheat in the crop rotation they have a special mix of winter crops in the fields. However, regarding the trials he is sorry to say that nobody is responsible for the field trial any longer. Józef wonders if they have a plan, and suggests that it would be good to compare different crop rotations on the different trial fields. Krzysztof explains that they have the same crop rotation, and what they are comparing is various kinds of field management. The aim was to minimize field management to reduce their energy use. Józef suggests that the trials should be revised so that the main emphasis is on how to improve

soil quality, and this is mainly about working with crop rotations. The mechanical treatment should, according to Józef, be secondary, and Artur agrees with this.

Figure 49 Soil analysis in the field

Józef takes a spade and digs a hole in the soil. He explains that in a good crop rotation we should see remains of lucerne roots since they are very deep. However, since there was no catch crop after spelt, the lucerne decomposed very quickly. Thus, no residual lucerne is present in the soil. The carbon is of course in there, but a crop is needed to catch the nitrogen. Rolf asks what Józef suggests as a catch crop. Józef answers that a cover crop is a good choice, for example mustard or phacelia. Artur explains that phacelia is only effective as a catch crop, it grows fast and stores biomass and nitrogen from previous crops, and in spring it will be ploughed under.

Artur and Józef suggest that Krzysztof should wait for the data and during winter work out a plan for how to revise the trials. Józef points out that there were many failures that are worth learning from in this trial. Perhaps the data from the person formerly responsible for the field trials could be used to create a baseline. Józef points out that here the focus was on ploughing or non-ploughing, but he thinks it should be the crops doing the work – the soil likes crops, not machines…

After visiting the field trials, it was time for lunch, and Mr. Sheiwe joined us. Sheshti took the opportunity to ask about the energy system at the farm. Currently, the tractors use conventional diesel and electricity is the grid. The tractors use a lot of fuel, and Sheiwe's idea is to install photovoltaics and wind power so that excess is produced and exported into the grid, and in this way "compensate" for the diesel they were buying. Sheshti asked what they would do if there were a shortage of diesel, and Sheiwe supposed that draught horses probably would then be a part of their plans.

Conventional pig farm: Mr. and Mrs. Dekondy

Sheshti's notes from farm visit in Niedrzica Duza, October 20, 2016

Figure 50 From the left: Artur Granstedt, Wiesław Dekondy, Jerzy Kopińsk and Jarosław Stalenga

This study visit as well was done together with Jerzy Kopiński and Dr. Jarosław Stalenga.

The farm is 40 ha and has 40 pigs. Pigs are slaughtered after 6 months. Currently there are 8 sows, but this number varies somewhat from time to time. After 6 months, there is a new batch of pigs and therefore the previous batch is slaughtered at this age, so there is room for the new ones.

Figure 51 To the left: The pig pen, to the right: Artur and Jaroslaw by a field of winter rapeseed.

Previously Mr. and Mrs. Dekondy raised cattle for meat, but prices went down. Poland is in many ways a "pork- country"; a lot of the food culture contains sausages and pork in different forms. Therefore, this family found it more profitable to change to pig production.

The pig manure is only used on 6 ha of sugar beet. They are almost self-sufficient in fodder, but buy 4 tonnes of feed concentrate per year. The self-produced fodder is a mixture of barley, wheat and field pea, and the purchased fodder is soya bean. Soya bean is mainly used to get the right balance of protein in the fodder, so it is difficult to replace. Mr. and Mrs. Dekondy would like to grow soya beans, but the varieties are not yet well adapted for their circumstances with, for example, cold climate.

He also purchases some fertilizer: 5.8 tonnes of nitrogen, 2 tonnes of phosphorus and 3 tonnes of potassium. Even though he applies pig manure on to the sugar beet crop he also applies some chemical fertilizers. After the sugar beet crop he grows barley. Sugar beet leaves are left in the field, but he still needs to apply 50 kg N/ha on barley. The crop rotation is 4 years: sugar beet – spring barley – winter rapeseed – winter wheat. There are also peas and potato. Field pea is used as intercrop. According to the Polish soil classification system, the soils are medium (silty, not sandy), around class III-IV.

Winter rapeseed is hard to grow in Sweden, so we were curious about the yields. Mr. Dekondy harvests 4 tonnes per ha.

We also asked if they have any problems with ASF, as we had previously visited Mr. Jacek Plotta who put down his pig production due to the risk of this disease. Mr. Dekondy tells us that all wild boars are hunted down because of ASF, but it does not affect his pigs.

After a small farm tour, we were invited for coffee, and Mrs. Dekondy had baked special Polish pancakes for us, as well as delicious cakes. In addition to this culinary experience we also had a nice discussion. Mr. Dekondy started by asking about our interests and why we had come. Artur told that our main interest is to protect the Baltic Sea by converting all agriculture in the Baltic Sea region to Ecological Recycling Agriculture. We asked Mr. and Mrs. Dekondy if they would ever consider converting to organic farming.
“No. There isn’t such a large demand for organic food in Poland, and the best option would be black currants. However, our soils are not suitable for that” said Mr. Dekondy.

“Would anything give you a reason to convert? For example, if there were high taxes on fertilizers, would you convert to organic farming?” Artur asked.
“It would be very difficult to put high taxes on fertilizers” was Mr. Dekondy’s response.
“I had a proposal that the income from taxes should go back to the farmer for converting to organic agriculture. Farmers in general are against high taxes, because tax pressure is high as it is. But I imagine that taxes could go back to the farmers with priority to those that convert” Artur suggests.
“We are afraid that we will never see that money again” said Mr. Dekondy.
“The problem is that fertilizers cause a lot of environmental damage, so in reality we are not paying the right price. Fertilizers are too cheap” said Artur.

"No, the problem is the global market. If we put taxes here, we would only import cheaper fertilizers from Ukraine, or Canada" said Mrs. Dekondy.

"So, we need a protected local market in order to have sustainable agriculture in the future?" Artur concluded.
"We are against globalization. For us, it was better before we entered EU. The intensification and polarization of agriculture has come the last 10-15 years" said Mr. Dekondy.
"Yes, the fictive global prices don't show the real price for food. We really need to change the policy around these issues" said Artur.
"So, in a perfect world – what would you want?" Sheshti asked.
"The goal should be that others could buy our food locally. I think bureaucracy is the most important factor. Controls and agencies – they treat a small company the same way as a large company. We must fulfil all bureaucracy the same way as a large company" Mrs. Dekondy complained, and Jerzy adds:
"Even if you are a small company you must find customers. Currently, consumers prefer the cheap food in the supermarket."
"I think that milk, grain and products from horticulture should be bought in the area where it is produced" said Artur, and together Mr. and Mrs. Dekondy explain that this was the exact situation 30 years ago. They emphasized that it created trust between baker and consumer, and since both knew each other personally quality was maintained. "Now we are anonymous" they said.

"Add that we in the future won't have fossil fuels to support fertilizer production and long-distance transports. We have two restrictions: environment and resources. We have to go back to renewable resources" said Artur.
"Yes, but we were speaking about prices… electric cars cost twice as much!" said Mrs. Dekondy.
"The infrastructure for electricity, and electricity in itself, is often non-renewable. We need to work with nature, for example with horses and so forth" said Sheshti, and Mr. and Mrs. Dekondy shared that they used to work with horses 30 years ago. At that time, they also had a cow for self-sufficiency.
"What was your reason for converting to tractor?" asked Sheshti.
"It was cheaper with tractor at the time, and we had more land to cultivate" answered Mr. Dekondy.
"According to a study by one of my colleagues, the horse has become more profitable than a tractor, but not if accounting for "man-hours"" shared Jerzy.
"In the future, the "man-hours" will not be limited, only the resources" Artur speculated.
"Perhaps globally, but regionally in Poland there are fewer and fewer living in the rural areas" responded Mr. Dekondy.
"But in the whole of Europe there is an increase in population due to emigration" said Jaroslaw.

“We have to accept that people come from other countries since we have better conditions for meeting climate change here in northern Europe” said Artur, but Mr. and Mrs. Dekondy and Jerzy agreed that there appear to be social problems connected to immigration. “Many that come are not interested in work, only in taking government subsidies.” they said, but Artur responded that in the future this would not be possible, that everybody must work. Mr. and Mrs. Dekondy think that Artur is too optimistic in this matter, and don’t believe that all immigrants want to work according to the “European model”. Artur maintains that we must change our attitudes, be more open and accept differences, but to this Mrs. Dekondy does not really agree.
“I know, it could be difficult…” said Artur.
“USA is an example where all nationalities have mixed…” said Mr. Dekondy.
“I think that immigrants must accept the law” said Mrs. Dekondy.
“Yes, but we also partly protect our lifestyle. It is not easy for poor people to enter our standards, we don’t really allow them” said Artur.
“It will happen in heaven after our death…” said Mrs. Dekondy.

“Okay, the conclusion from this discussion is that we need a more protected local market” said Artur.
“Artur told us about the non-GMO soybean that is used in Sweden, since the farmers’ union (LRF) has decided to ban GMOs.” Jaroslaw informed.
“I did not know there is non-GMO available… I will think about that. But there is a difference – the Swedish consumers want local production” Said Mrs. Dekondy.

“Here people only buy the cheapest” said Mr. Dekondy.
“In Sweden only 12 % of the income is used on food” said Artur.
“In Poland, it is 50%” said Jerzy.
“Another problem for locally produced food are the strict regulations against slaughter, especially for pigs. It is similar to the occupation! We will go to prison if we slaughter at home! And we can’t do anything about it…” said Mr. Dekondy.
“You are producing the foundation for human existence – the society should really give you the best support!” was Artur’s final remark to this friendly discussion.

Former organic pig farmer: Jacek Plotta

Sheshti Johansson's notes from meeting September 27, 2016

Figure 52 Mr. Jacek Plotta

Advisors Aleksander Banasik and Katarzyna Jasińska from the advisory service of Luban picked us up at the train station in Starogard Gdański. In the car, we had a general discussion about Poland. The energy system in the country relies on domestic coal from southern Poland, and gas from Russia. The Russian gas is expensive; they charge more for exporting to Eastern Europe than Western Europe. There is an entirely different price for gas in e.g. Germany and Poland, according to Aleksander. Regarding "renewable energy" there is wind power on the coast near Gdańsk, and photovoltaics are encouraged by subsidies for private house owners. Producers get paid for exporting their surplus production to the grid. As it comes to the economy, Aleksander's opinion is that it is becoming worse every year. This is also reflected in policy, as less funding is made available for agriculture. There is an increasing complexity in regulations regarding funds as well.

As we arrived at the farm of Jacek Plotta, we spotted a sign with the logos of BERAS, Baltic Deal and Sustainable Agriculture at the entrance to the house. Mr. Plotta was selected as a model farm through these projects, and the advisory service has been arranging "trainings" or inspiration days for other farmers at this farm. Mr. Plotta also received an award as second place winner of the WWF 2015 National Baltic Sea Farmer of the Year.

Figure 53 Artur notices the sign at the entrance to the Plotta family's house.

Artur suggested that we make a round table presentation of all attendants. Jacek Plotta starts by telling us that he is a farmer, practicing organic farming with his family. The farm is 130 ha. He tells us that some problems the past years forced a change in the farm system, but that we can talk more about that later. Artur speaks about this project and why we are here. He says that we are starting a follow-up project – what happened after BERAS? Jacek wonders if it is an evaluation of BERAS as such, or if we do this for preparing a next project. Artur answers that the purpose is both those reasons. The evaluation would be a base for next project. Katarzyna says that she is an advisor in economics of agriculture, from Pomeranian Agricultural Advisory Centre in Luban. They moved their headquarters in July this year; previously they were situated in Gdańsk. Sheshti presents herself as an engineer and researcher focusing on food systems and fuels. Katarzyna says that they want to build up a system in Luban with "renewable" energy – photovoltaics, biogas, geothermal and windmills, as a demonstration centre for farmers. Aleksander tells us that he is at Pomeranian Agricultural Advisory Centre of Gdańsk. He gives advice for both organic and conventional agriculture, but they have certain specialists on the organic farming in Lubany if he needs help.

Artur started the interview by presenting some more background about the BERAS projects.
"BERAS involved two separate projects. The first one was in the years 2002-2006, and then there was the BERAS Implementation in 2010-2014. Now we wonder whether these projects had any results? One goal of the BERAS project is to reduce nitrogen leakage to the Baltic Sea. A second goal is to reduce the greenhouse gas emissions from agriculture. A third goal is to protect biodiversity. In the first period, we assessed how to reduce these environmental impacts and in the second period the focus was on how to realize this. Good examples were important for learning and information sharing, as we have seen here as well. Another target was to develop the advisory service to help other farmers, and thirdly we also aimed at stimulating the demand from the market. Have we initiated a change?

How is it going? In this current project we interview farmers, advisors and politicians and we also collect data on greenhouse gas and nutrient balances etc. The project is carried out during one year, and would generate the basis for a new project. We have a special focus on Poland."
"Why Poland?" asked Aleksander.
"It is the largest agricultural land around the Baltic Sea. There are 9 countries around the Baltic Sea, and Poland has 40 % of the area" Artur replied.
"I now understand the focus of this meeting and why you are here. I will give you my point of view. I did not conduct any research; I have just been farming day by day and can only tell you about this." said Jacek.
"We know how the farm was doing during the BERAS project, but now we know you have made some changes. We met Józef Tyburski yesterday and he gave us some information. We will try to be efficient in our study visit because we don't want to take too much of your time…" said Artur.
"Please, this is no problem, you are my guests and you have travelled far to come here" said Jacek.
"Thank you. The size of the farm is the same as before, 130 ha. Do you have animals and crops? Is the crop rotation the same?" asked Artur.
"No. Previously the entire plant production went to feeding animals. I had a mix of cereals for pigs, plus clover for seed. For now, I predict a change in livestock production. I am thinking about cows and very high-producing hens. Now I have a few cows to feed the house. I look at this as a transition period, and for that I made some changes. At the moment, I don't have any mixed cereals, only pure for sale. I have spring wheat and blue and yellow lupines. Wheat goes after clover, which is very late. Hence I must sow spring wheat." Jacek explained.

"So, you plough down very late?" asked Artur.
"The clover is one reason, but the second reason is the summer draughts – the ground is so dry and hard that I must wait until the winter comes and give enough moisture to plough and sow the spring wheat" said Jacek.
"There is a problem with the summer droughts throughout this region – ditches are empty and there is no ground water" said Aleksander.
"Every year it becomes drier and drier, and the water level is one meter lower than it used to be in my pond. So, nutrient leakage is actually limited by nature. No water – no leaking. The leakage is much less than for 10 years ago, about one third" said Jacek.
"So, it is good for the environment with no leakage, but the drought is not good for farming… What time of the year are you ploughing?" asked Artur.
"Now I have a shallow cultivation, and I plough in the end of November. When the field is clean, I plough and to save some moisture I sow the same day as I plough. The spring ploughing is only for very light soils; heavy soils are ploughed in the autumn" Jacek explained.
"We use the same strategy in Sweden" responded Artur, and Jacek continues:

“The spring ploughing gives cleaner fields and faster growing, so it is cheaper due to lower fuel use.”

“Before spring wheat, how many years of clover do you have?” Artur asked.
“One year. The clover is sown two years earlier together with cereal sometimes if the fields are clean. If we have a lot of wheat it is only one year before. I do it this way for the sake of economy – to be able to sell for cash. I will only have this system until we have animals again. We Polish farmers like to grow legumes because we have support for this. The government pays €100 /ha” said Jacek, and Aleksander adds that the support was €200 /ha before, but now it is cut by half. A lot of farmers are disappointed, but continue to grow legumes.
“At the moment, I felt forced to farm in this way to avoid bankruptcy. In a longer perspective, I must have animal production, and the present system is only for a short period of time. I am convinced about the system principles with animals and crops for both due to environment and economy” Jacek said.

“How large are your lupine yields?” Artur asked.
“In average 1.5 tonnes per ha. It could be more, or less, depending on weather and rate of disease. Fungal disease targets especially yellow lupine, which is more sensitive” said Jacek.
“How large is your average yields of spring wheat?” Artur asked.
“This year I only got 2 tonnes of spring wheat per ha, but my soil is poor so I am satisfied. I sold it to a company that exports it to Germany and therefore they give a good price of €/270 /tonne. It was sold as ecological; therefore, I received this high price. The rest of the farmers got €100/ tonne, so I am pleased with my price. The absolute maximum for conventional wheat is €450/tonne. I am 100 % sure that my yields would double as soon as I have animals at the farm again. The yields are still better in those fields where the pigs have been.” Jacek explained.
“Yes, we really need the animals for fertility.” Artur adds.

“How long ago did you get rid of the pigs?” Sheshti asked.
“Two years ago, all were gone. I reduced the population little by little since year 2013, when I took the decision to put down the pig production. It was for economic reasons, I lost 50 € per pig. I also figured out that there is no gain from cow production as both milk and meat are so cheap. The only gain is from the manure, which is the only “profit” left form this kind of production nowadays.” Jacek said.
“I would like to learn more about your present crop rotation. What comes after lupines?” Artur asked.
“Wheat. This crop rotation is not good for nature… it is wheat – lupines – clover. I know it is wrong, but it is a transition period and I need to decide what to do with my farm. If I decide to raise livestock, crop production will change and include hay and legumes. I will have a change by next year. Then I will grow hay for four years, shift around the fields of course, but four years. I also grow maize in the last ten years. It is good feed for the cows

and yields have been high. I grow some maize for seed, and some for green fodder. In the future, it would depend about the animal production. If I have mainly chickens I need the maize for seeds, and if I have mainly cows I need it as forage. The maize is good for both purposes." Jacek said.

"Where in the crop rotation do you grow the maize?" Artur asked, and Jacek explained that he has two head categories of soil:
1) Good soil of class 4
2) Poor soil of class 5 or 6.
"On the good soils the crop rotation is: red clover – wheat – lupine – wheat + clover – clover for seed (1 year or two years. Then I grow wheat again, I know it is too often, but I do so in this transition period. In the poorer soils, I have ley with clover (grass and clover, could be up to four years) – maize – yellow lupine – perhaps wheat + clover or legume ley. This crop rotation is planned for having animals, and if I had manure it should give 10 tonnes of maize per ha. As for now, three years of clover gives enough richness in the soil to provide a maize yield of 4 tonnes per ha. I discussed this system with professor Tyburski, and he said that the maize could give good yields because it is so efficient in absorbing nutrients from the humus. Many other farmers have difficulties understanding this crop rotation with so large part of clover ley. I use manure in the autumn, and if no nutrient demanding crop such as beetroot or potato is planted then, all the nutrients would end up in the Baltic Sea. I use maize for making use of the manure. Directly after applying manure I plough to activate the manure in the soil, and then sow immediately. We mostly have rain in July and that is when we want to stimulate the soil (give it oxygen), and the amount of nutrients in the manure is largest before the rains. The pre-crop was lupine, which left approximately 30-40 kg nitrogen in the soil. I applied 20 tonnes of weak manure per ha. I did it this way for five years and had similar yields every year. I do not want to go back to pigs" said Jacek.
"Our government wants our farmers to produce legumes. It gives more locally produced fodder so we can reduce imports of soy" Katarzyna added.
"This is a good policy! It stimulates own local fodder production and limits imports" said Artur.
"The reason why I had to end pig production was the ASF (African Swine Fever). The German buyer stopped all import. We have a large problem with ASF in Poland, and it is a big risk for infections when keeping animals outdoors. So, I will never have pigs again. I have decided to have both poultry and cows – cattle for manure and poultry for cash" said Jacek.

Figure 54 Jacek Plotta shows us his soya bean field.

After this discussion Jacek shows us his fields. We start at a soybean field and Jacek explains that there is a new problem every year. It takes a lot of work to grow this crop here. It is important to find a suitable variety for this specific region, and here we see "Malaga". Jacek hopes that he will solve this problem soon. We see a lot of weeds in the field and one of the challenges is to find the right number of plants per square meter. We ask why he chose to cultivate maize and soya bean. One reason is that they are sown late in the spring, which allows time for good soil preparation before seeding. Also, after harvest of maize, the soil is very clean.
The next field we see is clean, and there are no signs after the weed *Agropyron* even three years after the pigs were there since they ate it.

Figure 55 Field of clover

Figure 56 Clean field three years after the pigs were there.

Next, we were shown a clover field. It is a poor, sandy soil, but thanks to the pigs, yields are better on this field. Last year there was no harvest of clover in this field, but clover was sown into wheat. This year first cut of the clover was after flowering, and in the summer, they

harvested the seeds. This clover will remain one more year, depending on how well it survives the winter.

Further down in the clover field we see more weeds, and Jacek says that he needs to plough, or else the *Agropyron* will grow high and compete with the clover for nutrients. In the spring, he cuts the clover for hay, and now in September he harvested the seeds. Artur asks about the total biomass of clover, and Jacek estimates it to approximately 10 tonnes of dry matter from both cuts. Artur notices that it is a very high yield, and Jacek says that this year the clover grew very high in the part of the field were the pigs had been a few years ago. In another part of the field about 4 tonnes of dry matter per ha is a more accurate estimate.

Figure 57 Jacek introduced Phacelia for the bees.

Jacek also tells us that he observed a significant increase in pollinators since he started farming ecologically. Not so many bees, but an increase in the number of bumblebees. His way of farming has developed biodiversity in the area. This is one of the goals of BERAS, so it was satisfying news. Another goal is to mitigate climate change. Jacek tells us that most farmers must think primarily in economic terms – if you earn money you are a good farmer, which means you have a good system.

"What about next generation?" Artur asks. Jacek understands, but explains that if another farmer asks him about his system, the first question is how much money he earns. But Jacek have one long-term project that is only aimed for the next generation, and this is a forest he planted for 20 years ago. He won't profit from it, but perhaps his children will. In front of the forest we see a field of clover yielding approximately 4 tonnes per ha. Closer to the forest however, yields are down to 2 tonnes. The bales of forage harvested on this field consist of a mixture of wheat straw and clover that grew to the same height. He says it is good forage, but gives some difficulties in the combine harvester. But it was seen as a minor problem since he was happy to have clover in the mixture.

Jacek also tells us how he used to keep bees and wants to establish honey production again. At the moment, he has 25 beehives. For this reason, he introduced a new crop: phacelia, which is good feed for the bees and gives a lot of honey. Lupine is also good for honey production. The maximum yield of phacelia he gets is about 1 tonne per ha, and he also uses it as fodder. Artur gives his opinion that Persian clover (*Trifolium resupinatum*) could also be a good alternative to phacelia, but phacelia may be better on these sandy soils.

We were also shown the maize cultivation. Maize requires a lot of water due to large mass.

Figure 58 Maize field

It took 20 tonnes of nitrogen for this maize to grow, and in two weeks it is time for harvest. Jacek tells us that it is time for harvest when the corn tassels turn black. The pre-crop was lupine, and after harvest the soil is clean which is good for next crop. This is one of the main goals of growing maize. He wants it for green manure, clean soil and fodder for the cows. Artur says that we discussed with Józef that it would be a good idea to write a special report on this maize cultivation. Jacek says that yields are definitively comparable to conventional methods, but without the inputs. Józef Tyburski has all the data.

“I sell all my wheat, every month I export to Germany where there are no limits to demand. German companies buy all organic production in Poland. The Polish market is very bad” said Jacek.
“What about Aleksandra and Mieczysław Babalscy? They manage to sell on the local Polish market” asked Artur.
“He has a very small production and his processing capacity is limited. He can’t take in more wheat than he’s already got” said Jacek.
“You would need a “Babalscy” here too, in all regions, to take care of the Polish market” Artur said.
“Yes, that would definitively develop the Polish market” concluded Jacek.
“It seems that more local processing is needed in Poland in order to increase the amount of local products and own markets” said Artur.
“Yes, I agree. The goal is clear enough, and similar to what we discussed regarding the subsidies on legumes – stopping import is a good direction” said Jacek.

“Perhaps this is an assignment for a third BERAS project – development of a local market” Artur suggested.
“It requires that everyone thinks in this direction and there must be investors, or processors that initiate these kinds of investments. There must be political decisions and also production that enables it. It can’t be done in one or three years, it must be a process” Aleksander said.

Figure 59 Our visit ends with the handing over of a hand-made bag from “Klockargården”.

“My son will go to the University of Agricultural Studies and I hope he will bring our farm in that direction. I will take care of the bees, it is my hobby, and he can take care of the rest. I will retire 10 years from now, so I need a hobby for my retirement…” said Jacek.

“How many cattle do you have? Is it enough to utilize all the good fodder you have?” Artur asked.
“Now I only have one cow and 8 heifers, but fodder production is dimensioned for 50 mother cows. I bought the heifers because they must be certified. Currently I prepared fodder for at least 20 cows to prepare for increasing my herd. I have decided to have 100% cattle first, and after that I will think about poultry. With cattle, I can utilize this fodder. I want to use it within my farm so that I can have the benefits of returning the manure to the soil” said Jacek.

Mixed farm: Piotr Zdziarski, Minikowo

Sheshti's notes from meeting in Minikowo October 18, 2016

In this meeting, we were accompanied by Justyna Lesiewicz, Bożena Błaszyńska and Agnieszka Dobosz-Idzik form the advisory service in the Minikowo-region.

Figure 60 From the left: Artur, Justyna, Bożena, Agnieszka and Piotr with his youngest son.

Figure 61 The sign of the BERAS project is placed on a door in the training centre.

Justyna works with international contacts and projects at the advisory service in Bydgoszcz. She picked us up at the train station in Bydgoszcz and took us by car to Mr. Piotr Zdziarski's farm in Minikowo. In the car Justyna tells the tragic story about how Piotr's wife got cancer and, after a very fast progression of the disease, she died within a month, leaving two children and Piotr. Piotr has now remarried and had a small son of one year. When we arrive at Piotr's farm we met Joanna, his wife, and also two advisors form the advisory service: Bożena and Agnieszka. Agnieszka is certified from the Ministry of Agriculture as an advisor for organic farming, and is the direct link between the farmer and the ministry.

We started with a tour around the farm. In the previous BERAS project, Piotr was used as a model farmer, and received some financial help to prepare teaching facilities. It has been several years since the last BERAS project, but visitors continue to come and the spaces prepared for education are well used. Piotr gives trainings for other farmers organized by the advisory service, but also school classes from primary school up to university level visit the farm. In the past three months, there were 9 groups of visitors. A sign from the BERAS project is on the door to the learning centre. Piotr says that he really doesn't have time for all this teaching, but he is passionate about ecological farming and feels a call to share his knowledge. He doesn't receive any compensation for giving trainings at his farm – he does it because he's an idealist.


Figure 62 The small farm shop and pigs in feedlots out-doors and pigs in feedlots out-doors

We spoke about meat processing on the farm. The facility is large enough to process meat from 24 farms in the vicinity. However, he only buys pork. About 20% of the pork they process is from their own pigs, and the rest is bought from other farmers. However, beef and chicken they process is only from their own production. They have a small farm shop where they sell sausages and charcuterie, but this farm shop only represents 1 % of their off-sale. They deliver to stores in Bydgoszcz, Toruń and Warsaw, but most of their sales are to customers they meet in person with their portable food trucks. Four trailers are equipped as small, portable shops, with three cars to pull them. Customers appreciate this direct contact with the farmer – it creates trust that there are no intermediaries. There are 25 employees involved in processing and retail.


Figure 63 Mr. Zdziarski watching his cattle and chicken production

We also got to see the pigs, cattle and chickens. The pigs were held on small feedlots. We asked Piotr if they are out in the fields sometimes, but he answered that he tried but that the

pigs ran away. There are wolves in the area, but Piotr says that they are not interested in pigs. However, they do attack chickens. The chickens are held in a portable house in the summer season, but now when it is colder they moved to a warmer chicken house. They have 1,000 chickens. They grow 81-100 days before slaughter. Piotr points out that it is a long lifetime compared to conventional chicken production. Piotr loses 30-40% of the chickens every season due to disease. He takes that loss because he doesn't give them antibiotics. Piotr explains that a conventional farmer never would accept such large losses. On the other hand, the price for an organic chicken is about four times the price for a conventional chicken, so he can afford the loss. Piotr says that they are still learning; they try to have them more outdoors and test new breeds to reduce losses.

All in all, we see that Piotr has continued in the same manner as when BERAS met him a few years ago.

After the farm tour, we moved into the house to have coffee and sweets. Artur started by presenting our reason for coming – that we are following up what has happened in Poland after the BERAS *Implementation* project, and to investigate promises and obstacles for agriculture, as a whole, to change towards the concepts of ERA.
"It was nice to see that you have continued with the same concepts and developed them further" said Artur, and continued: "Our ambitions are high – all agriculture must be converted to protect the Baltic Sea and the environment and the climate."
"What do the conventional farmers need to convert to ecological agriculture?" asked Sheshti.
"This summer, the groups that have been here were quite engaged in the issues around the Baltic Sea. I told them that the Baltic Sea is dying and that they must think about what they are doing wrong" said Piotr.
"It is also important that we are willing to pay the right price for food. In the first BERAS project we could see the potential, and in the second BERAS project we made suggestions for practical changes to farming" said Artur.
"So now we also need your opinion" said Sheshti.
"One issue is the one you mentioned – the profits are too low for farmers" said Bożena.
"There are no subsidies for maintaining ecological farming. There are ecological organic farms, but no production" said Agnieszka, meaning that "ecological" farming is equivalent to recycling agriculture.
"Organic farms just receive a lot of subsidies, but do not produce food" adds Bożena.
"When Piotr's father makes inventories of to which shops he can sell our products, it irritates him that there are so much "pseudo-organic" products, there is only the label but not the right content" said Joanna.

"When I meet the younger students they often have the idea that organic farming is old-fashioned, and associate it with draught horses. My opinion is that we need more teaching, showing and training for the next generation of farmers. I tell them that organic farming

has modern machinery. The students' only talk about the newest equipment, investments, it is all about money…They also think that organic farming takes much more work than conventional, but I try to explain that it is not true" said Piotr.
"Even in organic farming, farmers want to specialize on crop production" said Bożena.
"We see this also in Sweden. Specialization is a main problem with all agriculture; crops and animals are separated" said Artur.

"Another problem is that farmers don't even know they are polluting" said Piotr.
"How do they react when you tell them this?" asked Sheshti.
"They don't understand, they say that they are not farming close to the sea" Piotr answered, and Agnieszka and Bożena together explains that in Poland there is a kind of idealized picture of "farming", as something close to nature and healthy, even if it is intensive. Many farmers keep a few animals for the family, which they feed differently. But there is also a problem that people in general pay only for quantity.
"So, what do we need to do? The closed-loop connection is lost in agriculture today. How can we re-establish the recycling principles? What do you propose? Piotr speaks about teaching, but mustn't we also change policies?" Artur asked.
"Piotr told us that the young farmers often understand and want to change, but that in practice the father's still have some control over the farm" Bożena explained.
"Is the older generation a large obstacle?" Artur asked.
"I think that it also depends on the fact that agriculture, as a whole, is more oriented towards conventional farming: there are more subsidies and various programmes for conventional farming. The Ministry is much more oriented towards conventional farming than organic" said Agnieszka.
"There are a lot of organic farmers out there. Maybe we should measure how the soil improves on these farms over a period of time and use that as an argument? This could be a measure for promoting organic farming" Bożena suggests.

"In our long-term studies, we have seen that it takes approximately 10 years after conversion from conventional farming to organic, before the organic farm gives similar yields as the conventional" said Artur.
"I see another problem with farmers in general, and that is that they don't know how to use leguminous leys in their crop rotation to increasing fertility. Many farmers grow maize and use a lot of fertilizers. And to get protein feed they import soya beans. We have subsidies for lupines, but they are so small that many don't bother with it. Farmers' don't always know what they are doing; they farm for money" Piotr complained. Artur agreed that it is very important to have a good crop rotation. He picked up his book, *Farming for the Future: with a focus on the Baltic Sea Region* and showed a picture on how the humus content pulsates annually, but shows a long-term trend of increase.
"It captures a lot of carbon from the atmosphere, which is important for coping with climate change. With this kind of farming we could accumulate approximately 400 kg

carbon per ha and year, which is equivalent of 1,500 tonnes of CO_2 per ha and year. Organic farming is an important instrument for mitigating climate change!" Artur explained.
"In Poland, we have subsidies for decreasing the use of fertilizers, but since the yields become lower the farmer loses income, so they don't care much about these subsidies" Agnieszka informed.
"All the time we are following the West – monocultures, conventional farming, and maize production… We must stop using maize and teach the farmers how to use legumes. Maize is chosen because it gives higher income than wheat, but this is such short-term thinking" said Piotr.

"When we are discussing a change for Poland we are really discussing a change for European agriculture. We need Poland as an example since industrialization came late here" said Artur.
"When I speak to farmers they say that they would go bankrupt if they change to organic" said Piotr.
"Is it true?" Artur asked.
"I try to explain that it is not, but they are thinking in a short term" said Piotr.
"What do you want to say to politicians?" Artur asked, but to this question Agnieszka and Bożena sighed and said that they don't have any influence on policies.
"We think that good examples are important, so we can demonstrate to politicians that it works. But we also think that the subsidy system for organic farming is bad, there is a lot of 'non-true organic'" said Artur.
"It depends on the restrictions: if the regulations are too complicated, few will want to convert. For organic farming, there are many more restrictions, inspection systems and certification. Farmers think it is too much trouble" said Agnieszka.
"Is your opinion as advisors the same?" Artur asked.
"Yes" said Agnieszka and Bożena.

"So how do you think it should be?" Artur asked.
"We think that the rule that you must produce and sell at minimum 30% of your production is good. A lot of farmers were certified organic before, and received subsidies, but did not contribute with any production. But unfortunately, the number of organic farmers decreased because of this rule" said Agnieszka and Bożena, and we ended this informative discussion.

Organic farmers meeting

Mieczysław Babalscy is one of the pioneers of organic farming in Poland. He also manages co-operations between many farmers for processing organic food. In March 2017, he invited 60 organic farmers to his town, Pokrzydowo, for a gathering, and we were fortunate to receive one hour of their time during this meeting. To our aid with language we had Dr. Jarosław Stalenga, who helped us lead the discussion. Also, Maria Staniszewska joined us and helped us prepare for this meeting.

One of the main problems directly linked to eutrophication of the Baltic Sea is the fact that farms specialize in animal or crop production, leading to higher animal densities at a few farms, and no animals at most farms. The number of mixed farms is steadily decreasing, thus diminishing the opportunity for recycling manure. Maria Staniszewska told us that the number of cow farmers decreased by 36% between 2004-2016, and 70% of farms with pigs disappeared in the same period. Both Jaroslaw and Maria identified one of the largest problems for organic farming in Poland is that 80% of the organic farms are managed without animals. Among the remaining 20% that have animals it is common that animal production is not certified organic, only approximately 10% of the organic farms keep organic animals. Some farmers of course keep animals for the household, and while farming crops for cash.

The focus of our meeting with the farmers in Pokrzydowo was to get their opinions on what challenges there are mixed organic farms in Poland.

The farmers came from neighbouring voivodships such as Kujawsko-Pomorskie, Warmińsko-Mazurskie, Wielkopolska and Mazowieckie. We started by asking how many of them had animals at their farm, and approximately 15 out of 40 farmers raised their hands. However, Mr. Babalscy explained that there is a large disparity between them*:*
"I can tell you about our village (Pokrzydowo): here we have 80 agricultural land taxpayers, but those who work in agriculture make up to 11 taxpayers – the rest take EU subsidies. Our voivodship, Kujawsko-Pomorskie used to be a big producer of pigs and now we don't have pigs at all."

Another voice shared the situation in his voivodship, Warmińsko-Mazurskie:

'There used to be 33,000 cattle. Currently, we have 47,000 cattle. This is the biggest voivodship when it comes to cattle production. Not many sheep, goats. Around 115,000 pigs. In 2003 there were around 180,000 pigs. Now we have less.'

Three other farmer voices:

- 'It is important to differentiate animal production from animal breeding'
- 'There are 4 main regions in Poland with ecological produce, there are maybe 20 truly organic farmers, incl. Mieczysław, the rest of organic farmers just want higher subsidies'

Then we asked why they chose to have animals, and they answered that it was because of the manure and to prevent nutrient surplus, to improve biodiversity in the agricultural landscape with grasslands, and that some animals can consume organic waste such as food waste or waste from processing. When we asked what obstacles they are facing by keeping animals we received a range of answers:

- *Difficulties to manage animals (chains; fodder etc.)*
- *Bird flu (extra requirements to comply with and extra risks)*
- *There is a risk associated with change of production type (extra training is necessary and there is no guarantee it will all pay off) – external factor*
- *Fragmentation of agricultural lands and small land area*
- *Young people don't want to work in agriculture (and <u>especially not with animals</u>) as it is very time consuming (24h work incl. weekends) – <u>generational issue</u> (young people don't want to work the way 'we' used to work in the past, e.g. there used to be 300 units of cattle and now 15 in a village); many old people pass farm land to children but they often decide to sell it and migrate to cities/ pursue non-agricultural careers*
- *Prices are not enough for animals (when they want more cows they cannot e.g. buy more land/rent more land as some other people keep land to receive EU subsidies)*
- *Extra expenses for infrastructure (fences, buildings)*
- *There is problem when a cow makes a mess' (so they are in chains now)* (Mieczysław Babalscy)
- *Globalization: animal farms are becoming bigger (competition)*
- *No collection centres (limited market infrastructure) 'Here there is one guy who is mobilizing other regions in Poland (esp. lubelszczyzna) to collect food as there is not enough ecological produce here (Toruń) when it comes to vegetables. In the past, such collection/purchase centres used to work in every village- it used to be regular on weekly basis'* (Mieczysław Babalscy)
- *'We would like to produce more but economy doesn't allow; nothing incentivizes to work like money'*

'Many of you here have animals, but in Poland 80% of ecological farmers don't have animals (are stockless) and among the remaining 20% of farmers who have animals only 10% have ecological animals – the remaining 10% of animals in the organic farming sector are conventionally grown as they have less requirements in relation to their management. The situation is getting worse and worse each year.' Said Dr. Jarosław Stalenga.

One of the findings from our previous farm-visit interviews was that co-operation among farmers could be difficult. So, we asked these farmers if they are willing to co-operate with

other farmers. One farmer said that co-operation is good, for example if one farmer has animals and another has a surplus of fodder products, however manure is very precious and rarely traded according to this farmer, or for example if one farmer is processing and another could deliver products. Mieczysław Babalski believes that co-operation is worse in conventional agriculture. Only five of the farmers present declared that they process their food, so it seems to be relatively rare that farmers do their own processing. In January this year, a law was passed to enable direct processing and sale of agricultural products. We asked what they think about this law, but it is difficult to say anything now since the law is very new. Current regulations seem to remain unclear, but are promising, not least because they remove many tiresome regulations.

At the end of this question-oriented seminar we asked more generally what they experience as becoming better or worse during the past 30 years, and received many answers about what has become worse (but none of what has become better):

- *We get older*
- *More modernization, which is not good for environment*
- *No hands to work*
- *Farming is becoming more and more simplified*
- *Lots of bureaucracy and inspections (overly normalized/overly bureaucratized) – yet it is not based on 'natural laws' ('people who set requirements do not work in field'), in the past regulations were relatively flexible*
- *No harmony with nature/too many chemical pesticides ('too much focus on chemical processes and too little focus on biological processes')*
- *Agriculture is controlled/manipulated by chemical companies*
- *Waste companies are facing the problem of maintaining/proliferating beneficial bacteria (e.g. too many antibiotics are being used)*
- *Control should be at source (where chemical products are being produced/from where they are being released)*
- *'There used to be extra payments for balanced animal-crop production under EU subsidy scheme' (but it was eliminated = no more extra payments)*
- *EU payments encouraged farmers to convert to organic farming BUT: subsidies are higher for cereals (*** 500zł/1ha vs. 900zł/1ha for maize/wheat production, thus no financial incentive to raise animals)*
- *EU payments do not recompense production costs*
- *Veganism/vegetarianism – lower demand for meat (global trends)*
- *Regarding conventional farmers lobby is very strong for chemical substances and farmers don't know what they should use in the future (everything is changing quickly); toxicity is becoming more visible (there is some recognition by EU in terms of toxicity but it's not enough)*
- *Strict sanctions during inspections* (Józef Tyburski)
- *Only 1.5% of the organic arable land is associated with "production", and only 4% of the total arable land is organic…* (Maria Staniszewska)

- *'It would be good if at least one organic farm could enter each Agricultural Market Agency (AMR) under EU to receive more financial support and cover the price difference of ecological products vs. conventional products'* (proposal of Mieczysław Babalscy)
- *'Polish government is fighting off Polish ecology totally'; '5% of funds should be for organic agriculture but AMR currently supports conventional farmers'* (Józef Tyburski)

Summary of farmers' perspectives

Several farmers witnessed that the current economic paradigm that involves a free global market even for food is creating pressure on farmers to produce larger and larger quantities, which is probably a main reason for the trend of specialization seen in both organic and conventional farming. One farmer explicitly said that he was against globalization.

They had a common experience that agriculture in Poland worked well 30 years ago. At that time, a couple of our interviewees were working their farms with horses and selling at local markets. Now they have been "voluntarily forced" to increase in size, thus they have loans for large machinery and are frustrated over low food prices, especially since production costs are increasing (price of diesel and fertilizer). One farmer decided to be as independent as possible and only bought equipment he could pay in cash, and resisted vividly the idea of certifying as organic because of regulations at EU-level and the idea of having inspection organizations visiting every now and then. Another farmer caught himself from time to time with dreaming back to the time when his farm was smaller and he worked with horses. This farmer was planning to start processing and retailing his products at home to solve the problem of low prices. Only one of the farmers we visited had on-farm meat processing, and was not at all worried about food prices since he also got premium prices for his organically labelled products.

There seems to be a cultural idea that farmers represent wholesomeness and health, no matter how they manage their farms, so customers in general do not care very much of e.g. organic labelling. It is also a matter of living standards, as the average Polish citizen spends about 50% of his income on food, while we in Sweden spend 12% of our income. Thus, the power of the consumer is small in comparison, and agriculture in Poland is at the moment quite subjugated to what is decided at EU-level.

The very large biodynamic Juchowo farm is a special case, which is not at all representative for farming in general in Poland. Here, we saw that administration and the large scale of things made them it difficult to maintain their overview. We found them rather specialized in milk production instead of the exemplary, multi-functional farm they dream of being and teaching others about. We conclude that scale may be an important factor when it comes to realizing Ecological Recycling Agriculture.

Conclusions from these meetings were that there is a lack of local markets, food prices are too low, farmers don't want to be too driven and controlled, and that they experience that policy decision making is going on over their head. At the same time, we saw that these farmers give their best to their farms, and it struck us that we should be so very grateful for their existence. We really hope that society will come to value food and the farmers much higher in the future.

Chapter 5. Trends in Polish Agriculture

Maria Micha, Małgorzata Lekan & Sheshti Johansson

We interviewed different actors in the agricultural sector. Our aim has been to gather opinions and knowledge from scientists, policymakers, agricultural advisors and organic inspection agencies, and most importantly – the grass root level; how do the farmers experience the terms of their livelihood? What do these actors see as obstacles or opportunities for realizing Ecological Recycling Agriculture at a larger, national level?

Increase in farm size, specialization and intensification

According to statistics and information gathered in previous BERAS projects there is a trend towards land concentration and increasing farm size (Granstedt 2012). The overall trend in all agriculture, organic as well as conventional, is towards specialization and intensification. Our interviews confirm these findings. For example, a farmer currently specialized only in three types of cash crops on a 130-ha farm shared his farm history: '*In the past, this farm had 5ha. There were 4 horses doing shift work (some of them working in the afternoon and some of them during the day); there were 5-6 cows and 20 pigs on fragmented yet increasingly larger farm acreage. Now, having more land, I don't raise animals. Buildings were prepared and I could have had animal production but it is not cost-effective. The animals were gradually sold around 20 years ago. If I had 3 cows I would be stuck with no profits. You either have a lot or none. Now I use modern machines.* […] *Yes, I rely on fertilizers'* (Lekan, 2017).

The specialization trend also causes difficulties for farmers with poor soils. One crop farmer from the voivodship of Greater Poland (characterized by shallow soils) stated that: '*the soils are here so shallow and root crops require a lot of nutrients so that I need to apply fertilizers. Manure is a precious resource and farmers don't want to sell it as they keep it for themselves'* (Lekan, 2017).

Fewer but more indebted farmers

Farmers who increased their land and invested in equipment and infrastructure to manage it such as machinery, buildings, etc. testify to the pressure they experience because of debts. Being in debt increases their vulnerability to all sorts of events, such as price fluctuations, changes in policy and subsidies, disease, crop failure etc. In particular, Jan Goryl and Jacek Plotta, who went through a similar increase in farm size during 1990-2010 (from ca 20 ha to ca 130/140 ha) told us about this state of precariousness and of their differing strategies in trying to cope.

In Jan Goryl's village there were 300 smaller farms there are now only two larger farms left. This is, of course, also a huge change in societal terms, the consequences of which would merit a deeper analysis. Jan Goryl is at present investing and preparing to process and market his products himself to get the premium price for organic products. Even though

his production meets ERA and organic standards, he is currently forced to sell his meat as conventional. Similarly, his milk is sold as organic, at a higher price to the consumer, while he still gets the same price per litre as a conventional dairy farmer. To counter this, and for better compensation, he is investing in processing facilities for milk, meat and a farm shop.

Jacek Plotta's trajectory has involved moving from what they term a "multidirectional" farm with a diversity of farm animals and crop production into a sole focus on outdoor organic pig production for export. In a previous visit and interview (2013) he spoke of the pressure of continually increasing his pig herd as the German import company demand larger volumes while putting pressure on the price per head. His reflection then was that he did not want to have more pigs than he could feed through his own crop production, one important reason being that buying feed would be expensive. Soon after that interview he was affected by ASF and has since dismantled the whole pig production, since the disease made export impossible. He is now considering intensive chicken production for cash and cattle for manure to increase both soil fertility and harvest yields. He says he won't make any money from milk or meat production, manure is the only gain from keeping cows.

Consequences of intensification in animal production

Researcher and farm advisor Jarosław Stalenga tells us that the total number of farm animals in Poland has been steady but a large-scale change resulting in a regional specialization has been observed during the last 10 years. Animal populations are decreasing in some regions and increasing in others. This structural change relates to increasing farm size and the process of intensification. One result of increased regional animal density is that cows no longer are let out to pasture, but instead kept in barns all year round. As a part of this increasing animal density and the production intensification cows are mainly fed maize-silage, and the farmers convert their permanent grasslands to maize fields. Two of our interviewees, Maria Staniszewska and organic farmer and instructor Piotr Zdziarski, testify to how maize production is increasing to the detriment of the soil since it requires a lot of herbicides and fertilizers and drains the soils of nutrients as it is grown year after year. Less diversified crop rotations and an increase in cereal production at the expense of legumes are also part of the intensification process, consequently degrading soil fertility. However, Professor Józef Tyburski helped the farmer Jacek Plotta to grow maize in his organic crop rotation with very good results.

In milk production, intensification is achieved by feeding cows imported soya beans and only keeping the cows in production until the age of three. In combination with the practice of keeping them indoors all year, animal welfare is compromised. When milk production is intensified and production increases, it leads to price dumping. Low milk prices push farmers even further to intensify and increase farm size. Maria Staniszewska and Jarosław Stalenga have followed agricultural sector development for many years, and are increasingly concerned about the observed direction. They describe this as detrimental to the life of

people and animals alike, and as inflicting severe environmental damage, not the least to the Baltic Sea.

Organic agriculture is also affected by specialization and intensification and the number of farms is decreasing

Even for organic farms, there is a tendency to specialize, and both mixed farms and animal farms are disappearing in favour of crop production. Jaroslaw tells us that in western part of Poland there are no mixed farms left at all, and organic farmers specialize in intensive berry production. Now only 20% of organic farms in Poland have animals integrated in crop production.

The number of organic farms is also decreasing because of changes in the rules of payment to organic farmers. Until 2013, the number of organic farms increased, and the main condition to qualify as organic was to have a "no-input"-farming. This encouraged extensive agriculture, Michał Rzytki at the Ministry of Agriculture tells us. A rule that 30% of the production must be marketed was recently introduced for organic farmers, and along with some additional rules such as a regulation on the number of trees in an orchard, some farmers have left the sector, Michał continues. Jaroslaw expressed concern about the development in the agricultural sector: "We are making the same mistakes as the rest of Europe."

The increase in factory farming has slowed down

The previous trend in Poland of large-scale factory farming, owned by foreign interests, seems to have weakened substantially. Jarosław Stalenga and Maria Staniszewska tell us that laws regarding foreign ownership of land have changed which has stopped land grabbing. Foreigners are now forbidden to buy land. Only Polish farmers can buy land, and you need to prove that you are a farmer and already have land in production or come from a farming family. Nevertheless, there seems to be ways to by-pass the laws. One of the interviewees in Lekan (2017) stated that: '*The foreign influence here is big and many foreigners want our land. There was once here one guy who substituted a German investor with someone from Poland so that the German guy could buy it. They were looking for farmers who have 2-3ha and kept substituting so that they could enlarge their farms. And what the agency did? It was leasing all this land, which was automatically appropriated by German investors. So, everything was 'legal' and all necessary papers were in place. You basically bypass the law. And someone else is using the land. And this German guy is sharing subsidies with the guys who helped him to get the land*' (Lekan, 2017).

Jaroslaw also told us that the number of factory farms is not increasing much. A small increase of the number of farms can be seen, but the large change is within farms. Big farms are getting bigger, but protests against factory farming make it difficult to establish new ones.

In western Poland, the Juchowo farm presents a large-scale example of biodynamic farming. The farm is, however, owned by German investors and milk and meat is exported to Germany, so in this sense it resembles the foreign-owned factory farms, even though they apply entirely different farming practices. We visited the Juchowo farm to try to find out if there necessarily is a conflict between large-scale and ecological recycling agriculture. It did not show clear results – there are several challenges with managing a diverse production, so they tended to focus on their milk production.

Reasons for structural rationalization in Polish agriculture

Against the background of development described above, we now turn our attention to which factors drive "structural rationalization", i.e. the processes of increased land concentration, specialization and intensification. Some aspects were already discernible in the description above and below we take a closer look at how market conditions and globalization affect agriculture in Poland, as well as national law and EU-policy. Several farmers testified about the former diversity at farms compared to the simplifications of modern days. For example, the Lublin voivodship is now dominated by crop production, but one of the interviewees in Lekan (2017) referred to the past and said: '*It was a zoo. There used to be cows, ducks, etc. and everyone had to have them all and now you have more crops than animals. Now you have more crops'* (Lekan, 2017).

However, it is important to mention that agricultural land in Poland remains greatly fragmented and that there are over 1 million farms between 1-10 ha accounting for approx. 28% of total agricultural land in 2015 (Central Statistical Office of Poland, 2016). This is mainly due to geographic conditions as well as political decision to parcel out large farms after the fall of communist regime. However, Dr. Gradziuk from the National Institute of Rural and Agricultural development in Poland, and Dr. Wrzaszcz from the Institute of Agricultural and Food Economics in Poland, also mentioned that the smallest farms are characterized by unsustainable agricultural practices as they tend to apply large volumes of fertilizers to maximize their profits on a small pieces of land in the wake of falling commodity prices (Lekan, 2017). This was also confirmed during interviews by smaller farmers who admitted to applying a lot of fertilizers (Lekan, 2017). When asked about the future, most respondents mentioned that the trend toward increasing farm size is likely to continue to exist (Lekan, 2017).

Market-driven change and globalization

The owner of a big commercial farm specialized in pig production (producing nearly 15,000 pigs per year) previously said: 'I don't work, I hire people to work for me'; 'there is no way any smaller farm can compete with me in this region' (Lekan, 2017).

When we ask why there is a concentration of animal factory farmers while others are losing their animals – is it policy or economy? – the answer is that both play a large role and seem to enforce each other. Danish companies alone already own 9 big farming facilities in

Poland (Jørgensen et al., 2013). One farmer said: '*Germans and Dutch people bought 'our' meat plants so that they could sell their commodities here. In this way meat is being transferred from the West to the East - to Poland, and from the East to the West. However, with all those investments our meat industry is also developing rapidly and the bigger animal industry is, the worse quality of meat it offers, just like in the West'* (Lekan, 2017).

Another farmer, working a farm of 20 ha, said: 'Such a small farm like ours does not have any chances to prosper. We even built a modern pig house with air-conditioning and central heating but it's empty. We are unable to compete with all those big industrial animal farms. Mainly bigger landholders remained as they have those contracts with butcheries that buy everything at wholesale prices. They have thousands of pigs' (Lekan, 2017). Yet another farmer said: 'farm profits are becoming lower and lower; my soils are depleted' (Lekan, 2017).

The global market greatly influences prices and the price of milk has become this low because we have a free market with no milk quotas. As described above, Jaroslaw finds a vicious cycle in milk production where the milk price is going down as a result of intensification, which in turn means that only those farmers with many cows will survive. Prices are continuously dumped and the main survival strategy is to become bigger and benefit from economy of scale. In fact, the farmer Jan Goryl told us that he has to sell some of what he produces at prices below production cost.

Also, conventional pig farmer, Wiesław Dekondy, felt strongly that the problem lies with the global market. Both Mr. and Mrs. Dekondy related how they think the situation was better before Poland became a member of the EU. Intensification and polarization of agriculture have come the past 10-15 years. Further back in time, about 30 years ago, they could sell their farm products locally and it created trust between producer and consumer, and since both knew each other personally quality was maintained. A result of the globalised market is also anonymity. They really wish that the food they produce would be bought locally. They claim bureaucracy is the largest obstacle to this, as inspections and agencies, they argue, treat a small company the same way as a large company, demanding they fulfil all bureaucratic procedures the same way as a large company.

Several of the organic farmers testify to the difficulty of finding a local market for their products, and organic and conventional farmers alike complain that consumers are only looking to buy as inexpensively as possible. For us, coming from Sweden where only approximately 12% of total income is spent on food, it is interesting to learn that Polish consumers on average spend half of their income on food. The general statement that we should change the food system and our attitudes as consumers so that we pay what food actually costs is thus easier to make in Sweden than in Poland given the difference in food expenditures for consumers. Agricultural advisors Katarzyna and Aleksander also speak of this difference when they say that the Polish market and demand for organic products is

not as developed as in Sweden, and because the income of farmers is very poor it makes them less interested in organic production despite benefits following of it. Katarzyna and Aleksander believe that the consciousness of Polish society is high but generally consumers are not willing to buy the very expensive organic products because their purchasing power is still limited. They add that developing a green market is just a matter of time and time is needed to improve the financial situation in Poland.

We have also witnessed how some farmers have been more successful in finding local and niche markets through taking control of more steps in the food chain and value creation in later stages of the chain. When primary production doesn't pay enough, engaging in food processing and marketing may bring better value to the farmer and can be a strategy to capture a local market for the farm's products. In chapter 4 we look closer at how farmers use these strategies.

The concept of paying the real price of food can include external costs, for example having high taxes on fertilisers. This suggestion is met with opposition when we talk with senator Jerzy Chróścikowski who thinks this would put too much pressure on farmers since 90% of them use fertilizers and have a difficult economic situation already. Mrs. Dekondy thinks that such a tax would only result in import of cheaper fertilisers from e.g. Ukraine or Canada, regarding it as another problem of the global market.

In Lekan (2017), one farmer mentioned that he feels threatened by the Comprehensive Economic and Trade Agreement with Canada (CETA), which removes trade restrictions with Canada and was ratified on the 15th of February 2017 (Linder, 2017). The Deep and Comprehensive Free Trade Area (DCFTA), a temporary free trade agreement, established between the EU and Ukraine and enforced on the 1st of January 2016 (MR 2016), was frequently mentioned as a 'threat' to the agricultural sector in Poland and for scaling of recycling principles. For example, one of the farmers from Lublin voivodship (bordering Ukraine) stated: '*If the export of wheat from Ukraine continues, I am not sure if we will have the market for our products. All the eastern mills or facilities manufacturing fodder purchase cereals at lower price, and now possibly lower quality, and they distribute it to various entities across the country*' (Lekan, 2017).

A conclusion we draw from all this is that globalisation may be good for other activities, but for agriculture and food local markets make better sense for several reasons to which we return in "Means to realise Ecological Recycling Agriculture in Poland".

Societal and personal values

'Villages are ageing and there are only 2 young farmers per 60 farms. They don't see opportunities; staying here is not very profitable' (Lekan, 2017).

Societal and personal values, which can have an impact on the decision of an individual on whether to adopt recycling principles, can be deeply rooted in the traditional values, which are shaped over the course of history. Mixed crops-livestock farming systems were largely practiced in Poland until the 1960's. Our interviews reveal that there are still family farms, which managed to preserve the traditional farming model as they value autonomy and renewable resources (Lekan, 2017). However, these mixed farms are becoming marginalized, as such farming practices often serve as '*a constant reminder of the unfulfilled promises of modernity*' (Brown 2015), rather than '*backwards modernization*' (Gilarek *et al.* in: Bowen and De Master 2011).

Similarly, Pine (2007) pointed out that socialism promoted the image of a science-oriented, rational and profit-driven farmer, as it was typical in Russia where farms were massive and clearly oriented at pursuing economies of scale. Small-scale rural family farms, on the other hand, were undervalued and sometimes even perceived as committed to pursuing 'illegal' practices within 'the black market' rather than working for the 'welfare of the country'. The core of the prevailing ideology was to match modernity with social equality. And suddenly, one political decision to make a transition toward market economy led to the collapse of large state-owned farms and 'everything' fell apart. For example, one organic farmer observed that: *'there is still this communist spirit; when it was widely regarded that a tractor is something beautiful and horses are obsolete; that ecology is backwardness, but it's opposite'* (Lekan, 2017). Many farmers, at present, tend to value heavy modern machinery by viewing it as 'progress' as typical of Western countries in a globalized world, not to mention the fact that reliance on heavy machinery doesn't require as much knowledge and workforce as agroecological farming methods. Either way, the key aspect here is also monetary value as according to economic studies at the farm level, production costs can be higher in case of adopting recycling principles, which internalize socio-environmental costs. For example, a widely-recognized assumption among conventional farmers from increasingly bigger animal industries is that '*if a pig does not grow to 100-120 kg within 3 months, it's deemed no longer cost-effective*' (Lekan, 2017).

One farmer also mentioned that: '*In the past there used to be agricultural clubs and farmers could share machines between each other. Now everything is gone*' (Lekan, 2017). Such 'agricultural clubs' were common during the communist period when the so-called State Agricultural Farms (established via the Fund for Agricultural Development in 1959) were allowed to dominate the Polish agricultural landscape. Members of such clubs had access to machines that could be used on sharing basis (Bański, 2009). Had such collective sharing of technology via agricultural clubs been maintained, efficiency of integrated mixed crops-livestock systems based on recycling principles could have increased (Moraine, Duru, Nicholas, Leterme, & Therond, 2014).

EU-policy and subsidies

We now return to the question why there is a trend of increasing livestock concentration in fewer and bigger farms to explore which role policy is playing.

Maria Staniszewska tells us EU-policies are directed toward land concentration. With land concentration follows specialization. Animal farms are to a large extent disappearing in regions dominated by small farms. The small farms traditionally kept a few animals integrated in the farm. Now enlarged farms generally opt for crop production whilst animal production is concentrated in fewer and larger units. In this case policy makes life impossible for small-scale farmers.

Smaller farms are also negatively affected in the sense that they often have difficulties in meeting regulations, it becomes too costly for them, Jaroslaw continues. Some organic farmers who keep their animal production solve this dilemma by declaring that the animal production is "conventional". It is accepted to use "conventional" manure for "organic" crops, so this solution is strongly recommended by the advisory services.

Opinions on how the system of EU-subsidies for organic agriculture is working differ among the interviewees. Advisors Katarzyna and Aleksander spoke of how one of their main tasks is to inform about and help farmers receive this support as part of environmental protection measures. Marta Kalinowska from WWF, on the other hand, told us that among advisors, interest and knowledge of agro-environmental schemes in CAP is very low, and said WWF shares this experience with the Ministry of Agriculture. They also see how the big subsidies go to large companies, just as Maria Staniszewska said above. Our contacts at WWF Poland also say that less than 1 % of the farms that receive subsidies are inspected, and that this means that subsidies may be misdirected.

When Michał Rzytki at the Ministry of Agriculture talks about the subsidies, a sense of powerlessness transpires from his declaration that since the subsidies come from EU, the rules are also set at that level and at a national level only responsibility for inspections remain. This remark is part of his statement of the possibility of changing regulations to promote Ecological Recycling Agriculture.

Senator Jerzy Chróścikowski echoes this position that changes have to be made at EU-level and the task of inspection resides with national authorities. He speaks of stricter inspections being implemented now, and advocates for the possible need of even stricter inspections. To achieve change, he is convinced that incentives such as subsidies are far better instruments to influence farmers in the desired directions than imposing a burden on conventional farmers through significantly higher taxes on fertilisers, as was referred in the previous section.

These perspectives were countered by the conventional dairy farmer, Witold Durak, when asked if he would consider converting to organic production. As it turns out he is essentially implementing the principles of ERA and converting to organic agriculture would not entail large changes to the way he already manages his farm. However, he has a list of reasons for not converting and the last one, which he says is also the most important, is the number and degree of inspections he would have to submit to. He tells horror stories of neighbours subjected to very harsh inspections which have deterred him from considering becoming an organic farmer. Other farmers from Lekan (2017) also testify about the inspecting bodies being both illogical and restricting to the farmers' own ideas of common sense. For example, one farmer stated: '*Now they* [the controlling bodies] *are crazy with avian flu – you have 15 chickens and you cannot even set them free outside for a while in the backyard*' (Lekan, 2017), and another farmer said: '*The regulations are often illogical. For example, a friend bought a protein supplement for a calf from a company he shouldn't buy from and he even didn't know about it. And then the controlling body forced him to destroy the manure of that calf*' (Lekan, 2017).

In fact, finding a farmer who appreciates the subsidy system will be difficult. In all conversations and interviews with farmers, a recurring theme is a strong will to get away from dependence on subsidies and an equally strong wish that the work they do to provide one of our most basic needs, the need of sustenance, be compensated through food prices. Farmers also want fairly priced food to be produced under conditions that don't deplete food production capacity and our ability to continue living on the planet. Farmers don't support food production at high environmental costs, with bad working conditions or with poor animal welfare.

Some voices from Lekan (2017) on the subject of EU and the system of subsidies:

- 'Subsidies do not compensate production costs. Last year I got subsidies for 30 cattle and this year you can get subsidies for 20 cattle so already received less. Before the subsidies for cattle there were subsidies mainly for fodder, and for me it was more profitable as I have many animals to feed and a closed loop. Now, people who have only cattle and not pasture.'
- 'Before EU I had more money than now because now the prices are different. EU support does not compensate prices. All our outputs became nearly 4 times cheaper. Even if someone buys machines it is still very expensive. I would rather go back to times prior to EU accession, but I want my commodity prices back'
- 'In 2007-2013 the direct payments better covered the price difference as there were no environmental requirements. Now we have greening measures and the production costs are not fully compensated'
- 'EU spoiled a Polish farmer. If subsidies were for production instead of acreage, farmers would be forced to work on the field rather than just chill. Then, those who work hard would get subsidies but the government will never do that as they seem to benefit from such system'
- 'Subsidies sickened the system. I want to evolve and I need land but many elderly farmers keep it as they want subsidies and torment soils'
- 'There used to be cow on every farm. People used to exchange manure, fodder and agricultural outputs among each other other, one could even sell animals to another farmer. All those things were not subject to strict registration. Now EU is pressurizing us with additional regulations'.

Prior to entering EU there was also almost no land leasing - a phenomenon, which adds an extra bureaucratic layer and partially stimulates the trend toward increasing farm size and possibly even land ownership, whereby the latter can occur in case the land after leasing contract can be sold.

Another conflicting aspect of the current system of subsidies, which concerns specific types of production, was emphasized by an organic farmer from Lublin voivodship who had integrated production (crops and chicken), and highlighted that reliance on the current system of subsidies, which in many cases seems to be a necessity for farmers to make ends meet, makes farmers vulnerable to policy changes. According to this farmer: '*For me it's a system of slavery of the 21st century. I am not a manager of my land in its entire sense as the agency tells me what I should do and what I cannot do. The problem starts when you have 5-year crop rotation system, yet you cultivate perennial fruits such as raspberries or blackcurrants whose rotation ends up in the mid of the 5-year crop rotation. Keeping such rotation with soft fruits does not make any sense as it only creates a ground for the development of diseases and weeds. Crops are becoming lower, yet you have to keep this no-longer-working crop rotation. So, let's assume we have 7-year crop rotation system: 5-year crops and 2.5-year crops such as soft fruits. If you want to cancel some crops you need to*

return any subsidies that you took in the second half of the 5-year crop rotation system, especially if you have at least 1ha of cultivated plants. For this reason, the agency punished me. I lost quite a large sum of money due to the lack of competency of agro-environmental advisory services. They come and just ask me about the details of my production – what kind of advisory service is it? I want to produce but subsidies are for land acreage' (Lekan, 2017).

Similarly, an organic farmer from West Pomerania voivodship who likewise had mixed crops-livestock production (sheep, milk cows combined with wheat and pumpkins) stated that he feels manipulated by the current system of subsidies: '*Yes, it's a system of slavery of the 21st century. It's about the 5-year system of crop rotations. You have pre-planned crop rotations and 'they' can suddenly interrupt them*' (Lekan, 2017). Another farmer said: '*You need to record and write down everything, especially since membership in EU: reporting, ear tags, medicine, fodder etc.*' (Lekan, 2017). And another added: '*People get lost in Poland but animals never get lost*' (Lekan, 2017).

The political environment is also found unstable. One farmer said: 'Here in our agricultural sector everything is going crazy and depending on the political party, everyone is ruling the way he/she wants. But you cannot convert entire farm in one direction and then change again. Every policy-maker says something different. They make up many wrong regulations and then farmers suffer' (Lekan, 2017).

The interviews clearly revealed that upon Poland's accession to the EU, which maintains strong ties with global markets, many of the Polish farmers invested money in off-farm inputs (e.g. modern fossil-fuel dependent machinery, fodder, fertilizers and pesticides), which helps them achieve higher yields (even if only in the short run) to remain competitive on the 'common' and global market, and reduce the need for workforce. As one farmer mentioned: '*EU has taught us modernity*' (Lekan, 2017).

To conclude, all of the above points to a food system which is detached from external costs and where efficiency is only considered in short-term gains. Greening payments under CAP seem to have generated a false image of a conventional farmer who is recognized as 'green', yet 'green' only by definition (Stolze, Sanders, Kasperczyk, & Madsen, 2016). Since subsidies are generally based on acreage rather than on what is actually being produced on the farm, it is worth highlighting that they foster polarization between small farmers and big land owners who increasingly take a lead of farms and might have vested interests. (Lekan, 2017)

Chapter 6. Challenges and Opportunities for Ecological Recycling Agriculture in Poland

Maria Micha, Małgorzata Lekan & Sheshti Johansson

Drivers of current trends toward increased land concentration, specialisation and intensification explored above are at the same time, in their current form, the main obstacles to a larger adoption of truly sustainable agricultural practices, such as Ecological Recycling Agriculture (ERA). We now turn to look specifically at what, in the current policies and market system, is working against the realisation of ERA and what could be changed to better promote ERA.

Appropriate incentives and policies

Jarosław Stalenga describes what is currently taking place in Poland as the very opposite to the principles of ERA. The Ministry of Agriculture has a system package called "Sustainable Agriculture" which is conventional farming, with limits on use of chemical fertilizers and required crop rotation.

Which incentives would encourage farmers to better utilize their own local resources?

Reduction in number of mixed farms which combine animal husbandry with crop production, related to above, is a large obstacle to realising ERA. According to Jaroslaw, who has written a report on this topic (Stalenga 2010 in Granstedt and Seuri (ed.) 2010), it is difficult for farmers without livestock to reconvert into a farm with animal husbandry. One possibility to overcome this obstacle on a regional level, again according to Jaroslaw, is to connect stockless farms with those that have livestock. There are incentives to grow legumes with government support. Now the compensation is €100/ha but it used to be €200/ha. This has disappointed a lot of farmers, but they still continue to grow legumes. It gives more locally produced fodder so imports of soybeans can be reduced.

A reasonably well-functioning market

Senator Jerzy Chróścikowski believes globalisation is a serious hindrance for local organic farming. As more free trade agreements are entered and the market is opened to products from all over the world it becomes difficult to protect standards he would like to promote which provide environmentally friendly products for consumers. Instead, there is a risk that mass-produced, low quality food products will take over. He also thinks that a coherent, global solution is needed. If stricter regulations are implemented only in e.g. Sweden or Poland, farmers will not be able to compete with other European farmers.

Some organic farmers, like Jacek Plotta, are almost completely export oriented. He exports all his wheat to Germany where demand is unlimited. He says German companies are buying all of the organic production in Poland and the Polish market is not working well at all. When primary production fails to pay farmers enough, some farmers turn to

processing and direct marketing as strategies to keep more of the added value of their products. Piotr Zdziarski, for example, has his own processing plant, and even buys and processes other local farmers' meat. Jan Goryl has come to the same conclusion and is beginning to enter direct marketing through his farm shop and eventually on farm processing of both dairy and meat. He hopes to receive better compensation.

Advisors and director Ryszard Kamiński at the Kuyavian-Pomeranian Agricultural Advisory Centre in Minikowo (KPODR) also believe that processing is a key opportunity for the organic farming sector. A simultaneous increase of consumer and producer awareness through knowledge to promote cooperation on a local level is also needed. In fact, they believe initiatives on the local level are the most important and feasible, e.g. cooperation with local restaurants, schools and school canteens to provide them with healthy organic food would be a big and important step.

This is a viable way to get better value and capture local markets. However, not every farmer can be expected to be willing or have the capacity to broaden the scope of their business activities to include running a processing company, marketing, distribution, employees etc. On the other hand, this is an area where cooperation among farmers and other actors in the food chain may foster viable solutions to the dilemma of a local market. Agricultural advisor Aleksander Banasik cautions that this is not done quickly and also requires that everyone thinks in this direction and that there are investors, or processors that initiate these kinds of investments. Political decisions and production that enable and support investments are also necessary.

Included in what might aid the development of a more favourable market situation is raising consumer awareness and fostering change in consumer behaviour. Senator Jerzy Chróścikowski thinks that one way might be convincing people to adopt a healthier lifestyle and connect it with food consumption. Currently only the richest or those who grow food themselves have access to good food. A change in perspective might help steer attention away from a single-minded focus on the price of food. Connected to this challenge Senator Jerzy Chróścikowski finds that focus would also need to change in the areas of GMO and biogenetics, which he means are currently pushing in the wrong direction – to develop food with extended shelf-life as the key criteria. Pharmaceutical marketing is also associated with these trends, implying that you can eat whatever you want and take medicines and supplements according to Senator Jerzy Chróścikowski.

Another hindrance to the development of local markets brought up by Wiesław Dekondy, conventional pig farmer, are the tough slaughter regulations, especially for pigs. "*It is similar to the occupation! We will go to prison if we slaughter at home! And we can't do anything about it…*"

Lock-ins

Wigboldus et al (2016) identify various types of 'lock-ins':

- **Formative/technological lock-in**: dominant technology paves the way for unsustainable practices; limited technical knowledge
- **Juridical lock-in**: e.g. some policy regulations limit available options
- **Economic lock-in**: e.g. subsidies for unsustainable agricultural practices
- **Physical/ biotic lock-in**: e.g. climate change can significantly affect the rate of adoption of certain agricultural innovations; poor quality of soils.

From this terminology, Lekan (2017) identifies which factors limit a wide-spread implementation of ERA. First, there is an **economic lock-in**: globalization, which leads to large specialized farms. This induces **juridical lock-ins** (flawed policies, over-bureaucratization and non-compliance) as an adaptation to on-going globalization. There are also **physical and spatial lock-ins**, in which climate change and poor soils cause spatially diverse farm types. This is partially an adaptation to the juridical lock-in, and promotes a response in the form of environmental programmes and policies at EU-level. The juridical lock-in indirectly stimulates a **value-based opposition** that lacks green mentality and cooperative spirit, which in turn stimulates a **technological lock-in**, where everyone wants "their own tractor" and reliance on large non-renewable infrastructures to provide fertilizers and machinery. Unfortunately, the value-based lock-in together with the technological lock-in stimulates an **analytical lock-in,** in which we see an erosion of traditional knowledge. A **demographic lock-in** (ageing, the urban-rural exodus) is also co-evolving with the mentioned value-based opposition.

Opportunities for realizing ERA in Poland at a large scale depend on how well the lock-ins are addressed. There is national flexibility to design policies, which may have the ability to unlock the juridical lock-in. On-going environmental work within EU policies arose in response to environmental problems we face with eutrophication, climate change and soil depletion, and once it falls in place it there may be an opportunity to properly address these challenges, and indirectly also can stimulate the un-locking of the analytical lock-in. EU programmes and policies already enable infrastructure for animal husbandry and manure storage. The volatile economic climate as well as rising prices on external inputs (also caused by globalization) are also an opportunity to turn to more local renewable resources within agriculture. In Poland specifically, small mixed farms are not yet uncommon, which is a good starting point, compared to e.g. Sweden. Some of the old practices are also compatible with modern technology, and modern availability of information and knowledge can also help a transition towards implementation of the recycling principles in a larger context. Many of the initiatives comes from grass-root level, and since large institutions are subjected to several lock-ins, the bottom-up approach is promising in that it may by-pass lock-ins.

Chapter 7. Agricultural Trends in the Baltic Sea Region

Artur Granstedt & Maria Micha

This report is mainly focused on Poland, however, a general overview of the situation in the entire Baltic Sea regions is also important to consider. Therefore, we asked our contact persons and national coordinators in the previous BERAS projects a series of questions. Their perspectives are important both for our understanding of the current status in the different countries and as a background to the policy recommendations we present in the next chapter.

Generational shift and changed farm structure

A generational shift is underway. The average age is rather high among farmers generally, and as aging farmers retire there is uncertainty of what will happen to their farms. As we have seen from interviews with farmers their children don't necessarily take over the farm, and if they plan to do so they may opt for a different kind of agricultural production. This is the case also in Denmark and our expert from the Danish Ecological Council, Leif Bach Jørgensen, tells us of three possibilities for farms that are sold as farmers retire. Some will continue as small farms with a high value production for a local market, some will be sold to neighbour farmers substantially increasing the size of their farm, and some will be sold to investors with the purpose of making profit. The situation is similar in Germany, Karin Stein-Bachinger at Leibniz Centre for Agricultural Landscape Research, tells us that particularly in former East Germany there is a lot of land grabbing by industrial investors that leads to a dramatic increase in land rents. Together with subsidies this also leads to more biogas farms. These farms have crop rotations mainly based on maize silage with a subsequent increase of nutrient surpluses and nitrogen leaching.

In Denmark, Leif Bach Jørgensen also says they hope for more redistribution of land, which can create a better demarcation of farms. This can also help to make natural areas more continuous than if they are divided into several land units. They also wish for vulnerable areas to be taken out of production and for increasing areas with organic farming.

Organic agriculture on the increase while specialization within organic agriculture also increases

Also in Estonia, Latvia and Finland there is an increase in farm size and all country experts testify that organically farmed area is both increasing and becoming more specialized. In Finland, 300,000 ha is cultivated organically of a total of 2 million ha agricultural land. This is 15% of the area under cultivation and the goal of Finnish government is to reach 20% organic by the year 2020. In Germany, there has been an increase during the past decade from 2.1% of the area in to 6.5% in 2015. Because of the very low price for conventional milk last year, many farmers wanted to convert to organic agriculture. However, the organic milk market needs to develop in step with production capacity which means that a conversion can only be realized step by step.

In Estonia, government strategy is to reach 20 % organic farming in the near future. Airi Vetemaa (Estonian Organic Farming Foundation) believes there is a good chance to increase organic production, and Estonia has already reached 18% organic of the total agricultural area. Also in Latvia, there is an increase of organic agriculture. In Poland, as described in chapter 3, certified organic production occupies 4.3% of the total agricultural land (GUS 2016).

As was reported in the first chapter, our country experts also observe a continuing trend of increasing specialization in conventional agriculture in their respective countries.

How can ERA be promoted?

Since there is general agreement about on-going specialization within agriculture – conventional and organic alike – and because we observe negative environmental consequences of this development, we now turn to what may be done. Which measures may counter these developments and support farmers to keep mixed, largely self-sufficient farms/or establish cooperation with neighbouring farms?

Airi Vetemaa argues, and Dzidra Kreišmane and Pentti Seuri agree, that there should be specific support measures in the CAP Rural Development Program, and more money should be transferred from 1st pillar to 2nd pillar focusing on environmental aspects. To promote ERA principles, Airi believes in good examples and high-level knowledge transfer and advisory. Pentti has been propagating for several years for a manure regulation reform.

Leif Bach Jørgensen's opinion is that we need to enforce measures within the Rural Development Programme in CAP. A new CAP reform is needed, which hopefully will phase out direct payments and strengthen the principle of 'Public money for public goods'. This means paying farmers to produce 'public goods', doing more good the environment, climate and rural development, and finding another kind of income-support if needed. ERA-farms fit very well with this aim depending on the national implementation of the reform and the construction and measures within the Rural Development Programme (RDP). Area-based income-support, which is now in place, favours the biggest farms and promotes intensification. There should also be support for new cooperative movements like the Danish cooperative movement '*Andelsbevægelsen*' which is a producer or consumer controlled organisation where each member owns a share.

Karin Stein-Bachinger agrees with Leif Bach Jørgensen's statements about CAP reform and the RDP and adds that ecosystem services and biodiversity achievements of organic farmers need to be rewarded in a more effective way and more individually. The polluter pays principle need to be implemented to save money (1st pillar of CAP).

Bottom up or top down?

We also asked our experts which scenario, bottom up or top down, they believe is more realistic for realizing ERA:

(1) Bottom up from farmer and consumer, from very local and regional government level, which eventually includes the whole country and Baltic Sea Region, or

(2) Top down from the EU-level through restrictions such as limiting animal density to fodder production (local and regional) and requiring use of recycling principles, restrictions and/or introducing taxes on pesticide and agrochemical use to force farmers to change.

For the most part, they agreed that both bottom up and top down approaches are needed. Leif Bach Jørgensen repeats his main message that the new reform of CAP should phase out direct payments and strengthen the principle of 'Public money for public goods' – and member states should create good measures in the RDP. At the same time, farmers and local societies should strive for a different development in rural areas by prioritizing local markets and cohesion between farmers and consumers.

Karin Stein-Bachinger agrees and continues this line of thought, adding that consumers nowadays want to have this kind of changes for more regional and GMO-free production. However, although consumers' power is big, there is no doubt that policy has the main influence on the kind of farming practiced as tremendous amounts of money are spent within the 1st pillar of CAP with very low or even negative environmental effects. Therefore, point (2) has more weight to change things. She says that introducing taxes for pesticides and nitrogen fertilizer would be very effective.

Dzidra Kreišmane believes in the power of local initiatives and mentions several initiatives for local processing for the local market, bee keeping, bakeries and dairy production. Taxes for nitrogen fertilizers would be good but it is not realistic to expect the government to introduce such taxes, according to her.

Pentti Seuri relates how governments have the principle that subsidizes from the EU should only be for extra costs and not for environmental goods. The agriculture ministerial office also discusses that up to 170 kg N/ha in manure should be accepted for organic farms. This is the exact opposite of Pentti Seuri's arguments for a stricter regulation for organic farming, not allowing more manure than from the own farm (although cooperation contracts with other farms is accepted).

Chapter 8. Policy Recommendations

Artur Granstedt

Treating symptoms, ignoring causes

Anthropogenic nitrogen and phosphorous inputs to ecosystems must be substantially reduced and nitrogen reductions seem to be the most urgent (Rockström et al., 2011). Estimates of the necessary reductions vary from around 30 % to 75 %. The lower estimates correspond to the direct costs of nitrogen pollution in Europe, while higher estimates are based on taking all consequences for the function of the ecosystems in consideration. Excess reactive nitrogen threatens the quality of air, soil and water. It affects ecosystems and biodiversity, and alters the balance of greenhouse gases (Sutton et al. 2011). Agriculture is responsible for the majority of anthropogenic nitrogen inputs (Billen, Garnier, & Lassaletta, 2013). The long-term cost of the nitrogen cascade is not fully understood (Galloway et al., 2003) and there is a lack of understanding of the systemic nature of nutrient-related problems. The term nitrogen cascade was introduced to describe the total anthropogenic emission of different nitrogen compounds to the ecosystems.

Most measures and actions target symptoms, not causes – probably because causal relationships are not clear to policymakers (Einarsson, 2012). A typical example in agriculture is the focus on manure, rather than on inputs of "new" nitrogen to the system. The Nitrate directive (EU, 2008, 2009) is only focused on limiting nitrogen in manure. In addition, up to 170 kg nitrogen per ha may be applied, which is too high to protect water systems. The link between manure and eutrophication is well-known, yet the structural relation between using artificial fertilizer in one region specialized in crop production, which in turn is transported to another region as fodder to specialized animal farms is not fully understood.

An inventory of the nutrient loading of the Baltic Sea by surrounding countries shows only modest improvements as described in chapter 2. For several countries, and for Poland in particular, with the largest agricultural area in the region, there is a continued increase of nitrogen and phosphorus loads to the sea. Hence, total load to the sea has increased as was described in the introduction chapter (Figure 11) which was based on official EU-statistics (European Union, 2016). The increasing surplus of nitrogen also means that pressure on the climate in the form of nitrous oxide emissions (N_2O) has increased. At the same time, use of chemical pesticides also increased. The reason for these increases is, as has been shown here and earlier in the BERAS projects (Artur Granstedt et al., 2008; Artur Granstedt & Seuri, 2013), the continued specialization in plant and animal farms. The process of specialization has been allowed to continue despite recommendations developed in BERAS Implementation and extensive information campaigns carried out targeting farmers, consumers and decision makers. Instead of developing a recycling-based ecological agriculture according to the scenario shown in Figure 8 (Artur Granstedt, 2012), specialization has continued in all countries around the sea. The limited decrease in

nitrogen surplus is a direct result of an increasing share of organic agriculture in for example Sweden and demonstrates how a more massive conversion to organic farming has the potential to reduce nitrogen and phosphorus load to surrounding ecosystems.

Previous actions aimed at relieving symptoms have led to partial reductions in some countries but are ineffective in the long-term and camouflage underlying causes that must be addressed to achieve real and lasting improvements. Only real awareness of a threatening catastrophe may undo this and this insight is still absent.

Conversion to ecological recycling agriculture

To reverse the pollution of increasing amounts of reactive nitrogen, phosphorus and pesticides, strong EU-level policy measures are needed for the entire Baltic Sea region. This is to be reinforced by actions adjusted to national circumstances and followed up by each country, as well as by the regional and local authorities that are responsible.

The goal is an ecological recycling agriculture with minimum losses of nitrogen and phosphorus based on local, renewable resources, protecting local and regional biological diversity while simultaneously producing food of sufficient quantity and high nutritional quality for the inhabitants within the Baltic Sea region. This needs to be realised in a way that guarantees a sustainable income for the farmer.

1. Economizing with nitrogen and other plant nutrients through recycling within the agro-ecological system to the greatest possible extent:
Losses of nutrients must be reduced to a minimum through effective recycling. This requires that the number of animals on the farm, or farms in close cooperation, is limited by farm area, and that manure and urine is managed in a way that minimizes nutrient losses.

Conventionally managed farms will need to take the following measures to attain (conversion) to ecological balance:

- Farms without animals will have to acquire the number of animals that they can support with home-grown fodder – or collaborate with a nearby farm that keeps animals.
- Farms that have more animals than they can feed with home-grown fodder will have to reduce the size of their flock or herd to match farm production capacity.

These measures achieve a balance between animal and crop production, and also bring about a better regional balance in the numbers of animals. All in all, overall density of animals per hectare in the countries will be roughly the same as the average today, but with one principal difference: a greater share of the animals will graze, and their diets will include more coarse fodder than today. From the animals' point of view, the change will mean a better environment.

2. A solar-based supply of nitrogen through use of semi-perennial ley legumes to fix atmospheric nitrogen, instead of fossil energy. Stores of nutrients in the soil should be fed through growing perennial crops (two – three years) with deep, well-developed root systems, and by stimulating microbial life and soil fauna. Nitrogen and carbon are keys to building humus, which in turn is beneficial to microbes, earthworms and other soil fauna, while it improves capacity of the soil to retain moisture, favours root development and, ultimately, plants' growth and ability to absorb nutrients, their hardiness and nutritional value.

Conventionally managed farms will need to take the following steps:

- Cultivation of ley with mixed grass and legumes will have to be introduced on at least 30-40% of the farm's acreage. This includes farms that currently grow mainly cereals and have no animals that eat coarse fodder. In the longer term, it also means that all farms should have some animals that eat coarse fodder or cooperate with neighbour farms for a mutual exchange of both fodder and manure.
- Ley needs to include legumes. Many conventional farms that cultivate ley grow mostly grass and import their nitrogen in the form of synthetic fertilizer to the grassland – at great cost for both farmer and the ecosystem, Legume-rich ley on 30 % of fields area make a farm self-sufficient in nitrogen, provided that management of manure and other farming methods all minimize nitrogen losses.

Next, we explore two possible, and not mutually exclusive, scenarios for achieving a change to ecological recycling agriculture:

(1) Top-down from the EU-level through restrictions such as limiting animal density to own fodder production (local and regional) and requiring use of recycling principles, restrictions leading to low use of pesticides and agrochemicals and/or introducing taxes on these high enough to force farmers to change.

(2) Bottom-up from farmer and consumer and also from local and regional government levels, which may include the whole country, based on individual insights to change lifestyle and if necessary to also pay extra for food.

Top-down from EU and country level

Tax system and by law regulations

Costs for environmental destruction are not included in production costs and thus the price of agricultural products is not representative of their real cost. The most generally effective method, and sometimes politically most unpopular one, is an environmental tax on fertilizer high enough to start a massive conversion process and re-establishing a recycling based integration of crop and animal production. Whether the tax targets fertilizer only, or other nutrient inputs as well, it should be combined with reimbursement. A tax of the reimbursing model also helps by generating the funds necessary to pay for technical or

financial assistance, either by increasing the income of the individual farmer, or the tax money available for agro-environment programmes, or a combination of both.

A fertilizer tax could also be combined with regulation of animal density to match the farms own fodder production by law with a maximum external purchase of fodder of 20% (the limitation for the BERAS-farms).

A tax on artificial nitrogen fertilizer that is high enough may motivate farmers to use renewable energy (collected through photosynthesis) to fix the necessary nitrogen. For a sustainable agriculture without fossil energy it is necessary to grow symbiotic nitrogen fixating crops, and it is important that this is economically motivated so that farmers take their decisions on knowledge based agriculture.

Economic compensation will be necessary for the farms, which have depended on erroneous recommendations and have made heavy investments in large facilities for keeping more animals than can be covered through local fodder production. Sooner or later consumers will have to pay the price for protecting the environment.

The above tax-oriented system for a stepwise conversion is oriented so that the consumer and market will pay the real cost for food in relation to what is sustainable.

Subsidized agriculture

The common agricultural policy (CAP) and agriculture in Europe

The share of the EU budget **allocated to agriculture has decreased substantially over the past 25 years**, from 73% of the total budget in 1985 to 39% in 2015. The total amount is about 50 billion EUR per year or 100 EUR per inhabitant at present, yet it covers only about 10 % of real food cost. CAP allows European farmers to meet the needs of 500 million Europeans. Its main objectives are to ensure a decent standard of living for farmers and to provide a stable and safe food supply at affordable prices for consumers.

The CAP has changed a great deal since it was established in 1962, and continues to change today. A decision was taken to protect water systems (EU Water Framework Directive 2000, HELCOM Baltic Sea Action Plan, BSAP 2007), and to protect biological diversity and the landscape (EU Biodiversity Strategy, 2010). EU has also signed new international commitments, especially those concerning climate change (through the 21st Conference of Parties COP 21, 2015). The June 2013 reform that was implemented in 2015 focused on three **priorities:**

- viable food production
- sustainable management of natural resources
- balanced development of rural areas throughout the EU.

The CAP budget is spent in 3 different ways:
Income support for farmers and assistance for complying with sustainable agricultural practices: farmers receive direct payments, provided they live up to strict standards relating to food safety, environmental protection and animal health and welfare. 30% of direct payments will be linked to European farmers' compliance with sustainable agricultural practices which are beneficial to soil quality, biodiversity and the environment generally, such as crop diversification, the maintenance of permanent grassland or the preservation of ecological areas on farms.
Market-support measures: these come into play, for example, when adverse weather conditions destabilise markets.
Rural development measures: these are intended to help farmers modernise their farms and become more competitive, while protecting the environment, contributing to the diversification of farming and non-farming activities and the vitality of rural communities. These payments are part-financed by the member countries.

Despite these initiatives, we note on-going specialization trend. For example, crop diversification with two or three alternative crops is not a required part of the crop rotation and none of the crops needs to be ley. The consequences are further degradation of the largest part of the agricultural soils. Nothing is included about recycling in the CAP greening measures.

A new further developed CAP-reform must include also the following conditions

1. **Coupling crop production and animal production for recycling of organic biomass and nutrients:** This will be realised through obligation for all animal farms to not have more animals than can be fed from own produced fodder (or from farm in close cooperation with exchange of fodder and manure). We propose that the maximum amount of fodder that is imported to a farm is 20% of the total requirements, according to Granstedt et al. (2008).
2. **Crop rotation for rebuilding the soil organic matter and biological support of nitrogen:** There should be an obligation for all farms to have diversification in crop rotation with, at minimum, a third of the area with grassland including sufficient amounts of nitrogen fixating legumes (so the farm can be independent of artificial nitrogen fertilizer)
3. **Protection of the living organism and biological diversity in soil and landscape.** This will be realised through adding an obligation to quit use of chemical pesticides, according the EU-standards for organic farming.

Criterion 2 and 3 above are already included in the EU-standards for organic farming, but it is necessary to also include the recycling principle mentioned in criterion number 1 above.
The EU law for organic farming; EC Regulation for organic farming (Council Regulation (EC) No. 834/2007) sets out the principles and aims for overarching rules of organic production and defining how organic products should be labelled: ***In organic farming,***

closed cycles using internal resources and inputs are preferred to open cycles based on external resources. A consequence of the word ***preferred*** is that there are certified organic farms with excessive use of external resources, leading to surplus and leaching of nitrogen and phosphorus to water systems, as well as excessive emissions of greenhouse gases. However, all countries are free to implement a stricter realization of the principles for Ecological Recycling Agriculture in the certification of organic farms and this way establish organic farming as prototypes for the future agriculture which need to be based only on renewable and local resources. A reformed EU law for organic production needs to comply also the with following conditions for certification.

Coupling crop production and animal production for organic certified farms recycling of organic biomass and nutrients: This will be realised through obligation for all organic animal farms to not have more animals than can be fed from fodder produced on-farm (or from farm in close cooperation with exchange of fodder and manure). A maximum of 20% of the total fodder is to be sourced from outside the farm (Granstedt et al 2008).

Bottom up from farmers and consumers

The role of the consumer

With the market-driven economic system we pursue today, a larger responsibility has been laid upon the consumer. In former, more localized food systems, people ate what was available at certain times of the year, and only higher classes having the possibility to choose from the whole world, as most of us in the industrialized world can do today. Therefore, the individual choices of food may be important for forming what kind of agricultural systems we will have in the future. Information to consumers can thus be an important tool for consumers to understand the consequences for the Sea, the climate and the environment depending on which kind of agricultural system they choose to support. This includes not only the choice of farming system for the products, but also for the climate, water and long-term food supply, as well as the necessary limitation of the amount and the kind of meat consumption. Nevertheless, in reality, there are many steps in the production chain where decision makers can have more power than each consumer, and ultimately the pressure of the entire economic system to produce food in the industrialized and mechanized manner of modernity. So, even if consumers were to "choose the right thing" they will still operate within the system that created the present agricultural paradigm. Since everyone, from individual to large institutions, companies, countries and international unions are, so to say, "swimming in the same water", it seems unlikely that any large changes can be done without a multi-level perspective.

In the BERAS implementation project we focused on the important roles of public consumers and responsible officials, and on increasing ecological food in schools based on political decisions, and the large effects this can have on increasing the supply of ecological food.

The role of processors and distributors are also very important. Grocery stores and bigger food distributors can have a strong influence on which kind of food will be available with influence of the primary production. In Sweden, the consumer cooperation coop and other food companies was very important to do it possible for big groups of consumer to buy organic foods and it was possible for farmers to become the higher price they need to convert to organic farming. Beside the governmental subsides this can be an important reason to the increase of organic farming special in Sweden compare to other countries. Similar can be observed in other countries were organic production has increased more frequent and this shod be a theme to recognise in a scientific work.

The role of the farmer

Even the producer has a key position – the farmer holds the soil, the landscape and the environment in trust.

Before the introduction of subsides and governmental regulations for organic agriculture, the organic conversion process was driven by farmers and consumers as there is a shared responsibility for the soil, the environment and food quality. Early organic farmers developed methods that realized agriculture without pesticides and artificial fertilizers. They were passionate and founds ways to make their farms sustainable despite many difficulties. The system of subsidies for increased organic farming has partly resulted in less surplus and leaching of nutrients, but only partial in relation what should be required in order to improve the conditions in the Baltic Sea. In some countries, such as Poland, there are only marginal results in reduction of the increased surplus and pollution of the environment of nutrients and pesticides. The individual initiatives and responsibility leading the way into the future.

Despite governmental laws, taxes and subsidies, each individual, local or regional initiative is important for the future. This insight may perhaps result in an enhanced conversion process. Such initiatives we can see in all the countries around the sea, including Poland. For example, local initiatives with food served in schools and kindergartens seem to be promising.

There is a possibility that interaction between the food demands of for example a school kitchen may stimulate farmers as we have seen in the BERAS-project in Sodertalje municipality. This also gives possibility to engage school children and integration of knowledge about food –even the quality of food- and the education program in schools.

Examples of pedagogic understanding how humans need to survive in long term is “My 2000 square meters” were we get to experience the size of arable land available for each human if all of the world’s arable land was equally divided among all humans. Here agriculture based on local and renewable resources with crop rotation can be demonstrated, including recycling adopted to human consumption with its dietary consequences of more

vegetables and less meat, and meat consumption limited to mainly ruminant animals fed by the necessary clover grass ley in the crop rotation.

The BERAS initiatives with organic food in schools is now under implementation in several schools in Sweden and could serve as a good model for other schools in Sweden and around the Baltic Sea. We have observed a successful example of this also in a preschool in Poland, which was previously part of an URBACT project disseminating the knowledge acquired in Södertälje on Baltic Sea friendly food – Diet for a clean Baltic. This local action for change was made possible through local and individual initiatives and serve as an example for important next steps. However, this should also be combined with a reformation of organic farming according to the principles for ecological recycling agriculture.

Chapter 9. Summary of Findings

Sheshti Johansson

Presentation at meeting in the *Institute of Soil Science and Plant Cultivation* (IUNG) in Puławy, Poland, April 19, 2017

Objectives

The main objective of this third BERAS follow-up project with special focus on Poland was to identify obstacles and promises for a future where agriculture relies on recycling principles and local resources. As we proceeded with our work we also recognized the need of policies enabling sustainable food systems. Therefore, we gathered opinions regarding policy recommendations from the various actors we interviewed as well as our own conclusions in that matter.

Interviewees

We interviewed farmers, agricultural advisors, policymakers, researchers and representatives from NGO's. They are listed below.

Policymakers
Senator Jerzy Chróścikowski, Senate of Poland
Minister Michal Rzytki, Ministry of Agriculture

Agricultural advisors
Aleksander Banasik & Katarzyna Jasińska, Pomeranian Agricultural Advisory Centre in Luban
Agnieszka Dobosz-Idzik, Bożena Blaszyńska, Justyna Lesiewicz and director Ryszard Kamiński at the Kuyavian-Pomeranian Agricultural Advisory Centre in Minikowo (KPODR) Minikowo

Farmers
Following farmers were interviewed at home in their farm:

Wiesław Dekondy, Niedrzwica Duża, 40 ha, 40 pigs
Witold Durak, Lubelski, 14 ha, 14-15 milking cows
Jan Goryl, Nowy Wiśnicz, 140 ha, 80 milking cows
Juchowo Farm, Szezcinek, biodynamic farm - 2,000 ha and 300 milking cows
Jacek Plotta, Trzciński, 136 ha
Piotr Zdziarski, Łabiszyn, over 100 ha, pigs, cattle, poultry production integrated with crop production

We also had the opportunity to attend at a gathering for organic farmers in Pokrzydowo, led by Mietek Babalscy, one of the pioneers of the organic movement in Poland. On this occasion, we had a group discussion with approximately 40 farmers.

Researchers
Professor Jerzy Kopinski, Institute of Soil Science and Plant Cultivation in Puławy
Professor Marianna Pastuszak, Sea Fisheries Institute, Department of Fisheries Oceanography and Marine Ecology
Dr. Jarosław Stalenga, Institute of Soil Science and Plant Cultivation, Puławy, Poland
Professor Józef Tyburski, Faculty of Environmental Management and Agriculture, University of Warmia and Mazury in Olsztyn, Poland

NGOs
Maria Staniszewska, Polish Ecological Club
Anna Sosnowska and Marta Kalinowska, WWF Poland

Experts from other countries in the Baltic Sea region
Leif Bach Jørgensen, Danish Ecological Council
Dzidra Kreišmane, Latvia University of Agriculture
Pentti Seuri, National Resources Institute in Finland
Karin Stein-Bachinger, Leibniz Centre for Agricultural Landscape Research (ZALF)
Airi Vetemaa, Estonian Organic Farming Foundation

Farmers perspectives

The farm interviews including a more detailed summary of the farmers' perspectives are given in chapter 4.

Economic pressure for specialization and scaling up production

Loans
Low food prices, animal products in particular
Subsidies promote crop production and lack incentives for mixed farms

Miscellaneous

- Limited market for organic products
- "It was better in the past"
- "We have no influence on policy"
- Inspections and control agencies for organic labelling scare away farmers
- Regulations discourage organic animal husbandry
- Generation shift – reduced occupation in agriculture/specialization in crops
- Own processing and retailing solution for both creating local markets for organic products and to receive better price for farmers

Researchers perspectives

A regional specialization has been observed for the last 10 years, but the number of animals has been fairly constant in Poland as a whole. It is connected to increasing farm size and economy of scale, which has the effect that the large animal farms continue to increase their number of animals, while the small farms put down production or specializes in crops. The

animal concentration thus increases in certain areas and decrease in others. Larger animal farms encourage increased maize production, since the animals should grow fast and give large yields, which craves more feed concentrate. The animals are also kept indoors to a larger extent, and silage from maize is used instead of grazing. The increase in demand for one single crop such as maize has lead to less diversified crop rotations, which in turn leads to increased use of pesticides and chemical fertilizers as well as degradation of soils. However, it is possible to cultivate maize without those mentioned side effects, which was showed at the farm of Jacek Plotta who worked out his crop rotations together with prof. Josef Tyburski. In short, intensive milk production is more or less bad for all included parts. Firstly, it is questionable from the perspective of animal welfare as the cows are kept indoors eating soya and maize instead of grass that their digestive system is suited for, with a short lifespan of approximately three years. Secondly, from the environmental perspective, soya is often imported from Brazil (containing GMO), causing long transports and undermines the possibility for local recycling of resources within the own farm. And thirdly, considering the economic pressure on the farmer – this self-enforcing trend of increased specialization and scaling up production contributes to dumping milk prices.

The trend of specialization is also observed in organic farming where mixed farms disappear in favour of crop production. Particularly in western Poland organic farmers specialize in intensive berry production, and most of the organic production in Poland is exported. Only approximately 20% of organic farmers have animals integrated in crop production. Professor Josef Tyburski concluded: "*We are making the same mistakes as the rest of Europe*". It has also been observed that it is difficult for farmers to reconvert from stockless farms back to having animals. In Dr. Jarosław Stalenga's research he finds that solutions must be on regional level – to link stockless farms and those with animals. Professor Józef Tyburski's opinion was that co-operation is good, but not if distance between farmers is too large. In fact, he suggests as a policy recommendation that there should be animals at farms with sandy soils to increase soil fertility (of course with a regulation of animal density added). There should be more support for farms implementing the rules of nutrient recycling agriculture, especially for organic ones.

We were also told that a law was introduced to prevent land-grabbing, therefore it is likely that there would be no large increase in the amount of factory farms, however, large farms are increasing their production – *"big is getting bigger"*. Unfortunately, this law also made it more difficult for many Polish citizens to buy land since you must prove that you are an active farmer to be able to gain land. There is also an observation that this law has not been that difficult to by-pass for foreign investors.

Policymakers perspectives

Recently, a new law was introduced with a regulation for organic farms: 30% of the production must be marketed. This law lead to a decrease in the amount of organic farmers since those with extensive production and for self-sufficiency disappear. Michal Rzytki at

the ministry of agriculture told us that production rules decided on EU-level, but that in theory each member country can decide on their own conditions, provided that they can be paid for with subsidies. He agrees on the principles of ERA, but do not believe that it is possible in reality to strengthen regulations in favour for recycling principles in agriculture, even though it would be possible in theory. Senator Jerzy Chroscnikowski believes that the only way to change the trends of specialization is by law, but should ERA be mandatory in e.g. organic agriculture it must be decided on EU-level. Otherwise farmers cannot compete with the other European farmers. In fact, what is probably needed is a coherent and global solution. In Poland, he says, the control system for organic farming has been improved, but he thinks it can be even stricter. But, as we are going towards mass-produced foods at low standards, globalization makes it difficult for local eco-farming. Perhaps the only solution is to by-pass EU-legislation by consumer power – for example if the polish citizens would choose a more healthy lifestyle and care more about their food. It would be difficult to put more economic pressure of farmers with e.g. increased taxes on fertilizers and pesticides, but it is also difficult for polish citizens to pay more for food since they already put 50% of their income in food.

Perspectives of agricultural advisors

The advisory service of Gdansk and Luban welcomes environmental projects such as BERAS and Baltic Deal. In the autumn and winter, when the farmers have more time, they organize a lot of trainings:

"When we give them knowledge and propose possible changes to their farm system we find them very interested! They really recognize the problems with pollution of the Baltic Sea; agree that it is wrong and what to help improving the situation"

For example, the farmer Jacek Plotta, whom we also visited, has been a good inspiration for many farmers in the region, and the advisors Aleksander Banasik and Katarzyna Jasińska, stressed the importance of good examples for promoting change of farm direction.

The advisors of Minikowo pointed out that the Ministry of Agriculture is much more oriented towards conventional farming. Many of the advices are common for both conventional and organic farming so that organic farmers also tend to specialize in crop production. They share that there is an idealized picture of "the Farmer" as someone "close to the nature" even if production is intensive, so there is not much worry among the average polish citizen regarding methods of agriculture. Therefore, quality is not paid for, only quantity. Profitability of agricultural production systematically decreases, especially in small and medium farms, and this forces farmers to increase the area of their farms. The advisors of Minikowo experience that the younger generation of farmers want a change but that the older generation may stand in the way as they still control the farms.

On the one hand the advisors of Minikowo recognize that many farmers think that it is too much trouble with restrictions, controlling systems and certification to convert to organic farming. But on the other hand, they stressed that the new law that forces organic farmers to market a certain percentage of their production is very good, since farmers before could receive subsidies without delivering food any food from their farm. They told us that there are subsidies for decreasing the use of fertilizers, but since the yields get lower the farmer loose income, so they don't care much about these subsidies.

When we asked what kind of agricultural policies they would like to see in the future they simply answered: "*We don't have influence on policies*".

But Bozena … did suggest that a possible measure for promoting organic farming should be improved soil fertility. However, this can be difficult to implement in policies since long-term increase in soil fertility is only seen over a period of at least 10 years.

Perspectives of NGO's

We interviewed WWF Poland and Polish Ecological Club. We met Maria Staniszewska together with Dr. Jarosław Stalenga at several occasions and her opinions were similar to those presented under the researchers perspective. The Polish agricultural club has observed that the issue of recycling is showing up in a kind of migration of younger farmers to areas where they can co-operate with animal farms: *"Young people are migrating in search for manure"*.

WWF Poland, represented by Anna Sosnowska and Marta Kalinowska says that agricultural advisors in general lack knowledge in water protection (referring to the Baltic Sea) and mainly focus on helping the farmers with the applications for subsidies. Therefore, they had on their agenda to organize a workshop for agricultural advisors and ask them to promote nutrient recycling among farmers. They also point out that the largest payments in form of subsidies goes to the large companies. Anna and Marta point out that most farmers receive subsidies, but very few in relation are controlled regarding how those subsidies are used. Furthermore, crop rotations are becoming more and more simplified compared to e.g. 20-25 years ago.

WWF Poland thinks that consumers should take larger responsibility. Not least in the matter of animal welfare: *"There is no extra payment for having healthy pigs"*.

Summary

Farmers are against globalization; politician acknowledges problems but see no way out of this trend.

Advisors, farmers and researchers think that more controls are not positive, politician and NGO (WWF) thinks that more controls are necessary for meeting environmental goals within agriculture.

Advisors and Farmers experience that they have no influence on policy.

All actors agree that specialization is increasing, that the number of mixed farms are decreasing and on the principles ERA as environmental solution.

There is a lack of local markets, food prices are too low, farmers do not want to be too much steered and controlled and experience that policy is going on over their head.

Discussion

- What are the obstacles of reintroducing animal husbandry in organic farms that have specialized in crop production?
- Which opportunities and obstacles are there for increasing collaboration between farmers with and without animal production?
- What does it take to become a food processor and retailer in addition to being a farmer? In terms of workload, competencies and employees, investments and debts, quality of products, markets, etc.
- Why is cooperation not more popular?
- What can/must be changed at the national level?
    - EU-level?
    - Local level?

Chapter 10. Concluding Remarks

Artur Granstedt & Sheshti Johansson

Artur's reflection

Humanity faces significant challenges to reverse current development so that ecosystems can continue support human life on earth. With an increasing human population, sufficient areas of cultivable and fertile soil; clean water and air; and diversity of living creatures, which through their interactions maintain the functioning of ecosystems, are needed. The climate must be maintained within temperature intervals that make cultivation of the soil possible and provide sustenance for more and more people. Our contribution to meeting this challenge is agricultural research.

The importance of agriculture for the Baltic Sea and approaches to sustainable agriculture have been studied in two major EU projects - BERAS (2003-2006) and BERAS Implementation (2010-2013). These projects show a sustainable alternative to the undesirable trajectory that agriculture has taken since the Second World War.

Total Baltic Sea nitrogen pollution is at the same level as 15 years ago. Nitrogen surplus leads to both eutrophication of oceans and emissions of nitrogen oxide (N_2O). Phosphorus compound levels are is still high, in addition to the fact that phosphorus increasingly is released from the bottom sediments under anaerobic conditions. Areas of dying seabed due to oxygen deficiency continue to increase.

In Denmark, very high nutrient surpluses with high use of mineral fertilizers and imported feedstuffs have been significantly reduced, leading to a reduction of nitrogen and phosphorus surpluses. But nutrient surpluses are still significantly higher than in other Baltic Sea countries, calculated in kg per hectare. In Sweden and Finland, there has been a decline in nutrient surpluses due to increased area of organic farms. This has been offset by a significant nutrient surplus increase in the other Baltic countries and, in particular, the large agricultural country of Poland. Poland, with a large arable area, has a strong impact on the Baltic Sea nutrient load.

Farm specialization with separate grain farms, and animal farms with more and more animals, has been allowed to continue in Denmark, Sweden and Finland. In Estonia, Latvia, Lithuania and Poland, the same agricultural structural rationalization is now being carried out that was politically enforced in Sweden in the 1960s and 1970s.

The decline in nitrogen surplus in Sweden since 1995 proves to be a direct result of the growing area of organic farming. But in order to save the Baltic environment, decision-makers need to understand the underlying cause of the surplus nitrogen and phosphorus leakage and take the necessary agricultural measures to switch to an Ecological Recycling Agriculture based on local and renewable resources as described here.

Despite our specific suggestions for a sustainable agricultural system - Ecological Recycling Agriculture - the countries surrounding the Baltic Sea have yet to amend their agricultural policy in accordance with our results. Only symptomatic actions have been taken. No country has taken definitive action to support more efficient nutrient recycling that would reduce the unsustainable nutrient surplus in agriculture. Poland has a unique possibility to avoid the mistakes made in Sweden by taking a long-term perspective on agriculture and supporting sustainable Polish farms and farmers.

Politicians at the national level have not yet acquired the knowledge reported in the BERAS projects. Our hope is that regional and local policy makers will join individual initiatives from farmers to consumers to implement sustainable agricultural systems. The school meal project in the municipality of Södertälje, Sweden is an example of support for a sustainable agricultural system. 24,000 meals are served daily in the municipality's schools and in elderly care. About 60% of the meals prepared in the municipality's kitchens come from ecological farms. More vegetarian, local and seasonal food is served without higher costs thanks to skilled, environmentally-conscious chefs in the individual kitchens. This is a clear signal to the food industry and farmers that a transition to Ecological Recycling Agriculture is realistic.

Pending insights and actions at higher levels in the political system, this is the way we as researchers in this project dare to believe that a conversion to Ecological Recycling Agriculture can begin in the Baltic Sea region. Conditions are certainly different in the different countries, and meals are provided to preschools, schools, hospitals, elderly care in various ways. But the principle of creating insight into, and responsibility for, our future food supply is a result of this project.

This report is now presented to readers in the hope that it can disseminate knowledge and insight into the situation of the Baltic Sea environment and impart impulses to those who can contribute to a new orientation for our future agriculture – towards Ecological Recycling Agriculture.

Sheshti's reflection

The real ambition for us scientists working in the field of sustainable development, is to contribute to a positive direction to the interaction between humans and nature. Maybe explain what positive is meant. In all known systems, a positive evolution is created when the system is interacting with other self-organizing (living) systems and they act reinforcing on each other. Agriculture is not a sector on its own, but a product of our society and history, and essentially a product of norms and values. These norms and values have developed from culture, religion as well as how and what we teach in our schools and universities. This overall ambition of life-enforcing interactions is unfortunately not a goal

that monetary assessment of the activity can regulate. The "polluter pays-principle" is flawed because money is only transferred between humans, and losses of ecosystem services, species and whole ecosystems, cannot be paid for with money. This makes it difficult to solve environmental problems with the value that money represent, both bottom-up from consumer, as well as top-down from political level.

If decoupling everyone from everything else, we may come to the conclusion that it is a good solution that food produced in a sustainable manner should be a very expensive. It takes more time and effort, and yields can sometimes be lower or give less bulk due to larger diversity at a farm. But, this means at the same time that our system of reference is a system where those who produce food with large impact on the environment is the norm. We are only, hopefully, making something less destructive within the system that, in itself, is far from sustainable. And we are hoping that people will pay more for adapting to the reference system in a less bad way.

If we look at what more money does in the human-nature interaction in a bigger perspective, we see that it is associated with higher resource consumption somewhere else. An interesting example is my work in China, where I studied the resource consumption during a period of ecosystem rehabilitation. Farmers belonged to the category of most poor people in the world, and they were in a vicious cycle where land degradation that lead them into short-term agricultural practices and ultimately more poverty. This was reversed when large-scale ecosystem rehabilitation was implemented, and the economic situation was becoming better and better, while the agricultural practices where instead reinforcing the soils. The better economy gave the farmers the opportunity to by motorcycles, modernize their homes and use much more fossil oil in their new lifestyles (K. Johansson, 2007).

I am not saying that farmers do not deserve the same standard as everyone else want to have, but I want to show the fact that everything is connected. More money in to our economic system is attached to the activity of resource use somewhere else. Therefore, I am questioning the rationale in pumping in more money to the system at all. Yet, it would mean that economic growth should not be the measure of prosperity. As we have spoken to both farmers and policymakers we see the monetary norms and values as a base of their actions – farmers to maximize their profit, and policy makers to keep the society within the limits of the system of economic growth. In the thesis of Małgorzata Lekan (2017), she raises also the societal values of progress, pointing to the mechanization of agriculture. We heard the same from one of our interviewees who said that he tries to encourage young farmers to go into organic farming by showing all the big cool machines he uses, and that organic agriculture is modern. This is very contradictory to the aim of a better connection between man and nature, as the co-operation between living organisms is the most beneficial form an evolutionary perspective (see Johansson & Rydberg 2017).

These examples show how the cultural norms and values are at a much higher impact-level than both policy or any individual consumer. Norms and values are of-course co-created by all actors involved, but this is why it is so important that change is made on several layers of society. If it is not a mental change from individuals but only from top-down, it may lead to environmental fascism, and vice versa – if mental changes are not made at higher levels of power but only in individuals in the name of "consumer power", we will continue swimming in lava while we should really be looking for water.

Even the words "producer" and "consumer" are decoupled from "coexistence". There is a range of movements that want to reduce the human resource claims on nature, but many of the solutions proposed, also by stakeholders in this report, includes the activity of increased money transfer. More money to organic farmers and more money to the government for reducing use of fertilizers etc., which are actions that work to counteract any economical down-movement as less resource use logically should lead to de-growth of economy. There is no connection where more money is equivalent to less resource use (this only leads to inflation).

Our culture and mainstream scientific understanding does not really address the fact that we are a part of the systems we live in, and it seems that major conceptual changes at all levels of society are required. However, evolution is an on-going process, which takes time. Until we come to a point were change can happen on multiple levels simultaneously, I believe that grassroots movements demonstrating alternatives, cultural and art projects that inspire and awaken our longing for authenticity, as well as research on e.g. developing economic systems that help us have reinforcing interactions with our environment are important steps on the way to a more mature and prosperous coexistence between humans and all systems we are dependent upon.

References

Agricultural and Food Quality Agency. (2015). *Raport o stanie rolnictwa ekologicznego w Polsce w latach 2013-2014 [Condition of organic farming in Poland. The Report 2013-2014]*. (Agencja Reklamowo-Wydawnicza A. Grzegorczyk, Ed.). Warsaw.

Banski, J. (2009). *Historia rozwoju gospodarki rolnej na ziemiach polskich. [History of the development of rural markets in Polish agriculture]*. (Człowiek i Rolnictwo [Humans and Agriculture]). (Z. Górka & A. Zborowski, Eds.). Cracow.

Bengtsson, J., Ahnström, J., & Weibull, A. C. (2005). The effects of organic agriculture on biodiversity and abundance: A meta-analysis. *Journal of Applied Ecology*, *42*(2), 261–269. http://doi.org/10.1111/j.1365-2664.2005.01005.x

Billen, G., Garnier, J., & Lassaletta, L. (2013). The nitrogen cascade from agricultural soils to the sea: modelling nitrogen transfers at regional watershed and global scales. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *368*(1621), 20130123. http://doi.org/10.1098/rstb.2013.0123

Bobik, M. (2010). *Organic Agriculture in Poland: Chances and Challenges, Project Report* (GRIN Verlag). Munchen.

Bochenek, Z., Dąbrowska-Zielińska, Ciolkosz, A., Drupka, S., & Boken, V. K. (2005). Monitoring Agricultural Drought in Poland. In *Monitoring and Predicting Agricultural Drought: A Global Study*. Cambridge, UK: Oxford University Press.

Bowen, S., & De Master, K. (2011). New rural livelihoods or museums of production? Quality food initiatives in practice. *Journal of Rural Studies*, *27*(1), 73–82.

Carstensen, J. (2011). *Hypoxia in the Baltic Sea, BONUS brief*.

Central Statistical Office of Poland. (2016). Central Statistical Office of Poland. Retrieved from stat.gov.pl/en/

Chaplin, H., Gorton, M., Davidova, S. (2007). Impediments to the Diversification of Rural Economies in Central and Eastern Europe: Evidence from Small-scale Farms in Poland. *Regional Studies*, *41*(3), 361–376.

Drangert, J. O., Kiełbasa, B., Ulen, B., Tonderski, K. S., & Tonderski, A. (2017). Generating applicable environmental knowledge among farmers: experiences from two regions in Poland. *Agroecology and Sustainable Food Systems*, *41*(6), 1–20. http://doi.org/10.1080/21683565.2017.1310786

Einarsson, P. (2012). *Policy interventions for ecological recycling agriculture - Available options for governments in the Baltic Sea region* (COMREC Studies in Environment and Development No 5, BERAS Implementation Reports No. 1). Huddinge: Södertörns högskola.

Estonian Organic Farming Foundation. (2016). Estonian Organic Farming Foundation. Retrieved from http://www.mahetoit.eu/ee/mahetootjad-eestis.html

EU. (2008). *Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)*. (Consolidated text). Brussels. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31991L0676

EU. (2009). *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*. Brussels.

European Commission. The Nitrates Directive (1991). Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31991L0676

European Court of Auditors. (2016). *Combating eutrophication of the Baltic Sea: further and more effective action needed (pursuant to article 287(4), second subparagraph TFEU)*. (Special report).

European Union. (2016). Eurostat. Retrieved from http://ec.europa.eu/eurostat/

Eurostat. (2017). Agri-environmental indicator - consumption of pesticides. Retrieved from http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_consumption_of_pesticides#Further_Eurostat_information

Galloway, J. N., Aber, J. D., Erisman, J. W., Seitzinger, S. P., Howarth, R. W., Cowling, E. B., & Cosby, B. J. (2003). The Nitrogen Cascade. *BioScience*, *53*(4), 341–356. Retrieved from http://www.jstor.org/stable/10.1641/0006-3568(2003)053[0341:tnc]2.0.co

Golinowska, M., & Pytlarz-Kozicka, M. (2008). Analiza dopłat do produkcji ekologicznej w latach 2004-2006 w Polsce [The analysis of the subsidies to ecological production in years 2004-2006 in Poland]. *Journal of Research and Applications in Agricultural Engineering*, *53*(3), 75–83.

GRAIN. (2013). *Wake up before it is too late, Trade and Enviornment Review 2013*. (United Nations, Ed.)*Wake up before it is too late. Make agriculture truly sustainable now for food security in a changing climate*. United Nations.

Granstedt, A. (2012). *Farming for the Future: with a focus on the Baltic Sea Region*. Huddinge: Södertörns högskola: Södertörns högskola.

Granstedt, A. (2016). Morgondagens jordbruk - med fokus på Östersjön. Uppdaterad bilaga 2016.

Granstedt, A., Schneider, T., Seuri, P., & Thomsson, O. (2008). Ecological Recycling Agriculture to Reduce Nutrient Pollution to the Baltic Sea. *Journal Biological Agriculture and Horticulture*, *26*(3), 279–307. Retrieved from http://www.jdb.se/sbfi/files/BAH2009.pdf

Granstedt, A., & Seuri, P. (2013). *Conversion to Ecological Recycling Agriculture and Society - Environmental, economic and sociological assessments and scenarios* (COMREC studies on environmental development 8, BERAS Implementation Reports 3). (A. Granstedt & P. Seuri, Eds.). Huddinge: Södertörns högskola.

Grzelak, C., Stańczyk, H., & Zwoliński, S. (2009). Armia Berlinga i Zymierskiego [Army of Berling and Zymierski]. Warsaw: Neriton.

HELCOM. (2017). *HELCOM core indicator report* (Vol. July).

Igras, J., Pokojski, Z., Kowalski, A., Krasowicz, S., Labetowicz, J., Matyka, M., … Wijaszka, T. (2014). *24 years of Polish agriculture*. Puławy, Poland.

IPCC. (2014). *Climate Change 2014: Mitigation of Climate Change. Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press. http://doi.org/10.1017/CBO9781107415416

Johansson, K. (2007). *Energy System of the Loess Plateau – changes during the rehabilitation period*. Uppsala University.

Johansson, S. (2013). *Food or Fuel? – Trade-offs between food and biofuels globally and in small-scale organic agriculture*. Swedish University of Agricultural Sciences.

Johansson, S., & Rydberg, T. (2017). Is and increased use of biofuels the road to sustainability? – Consequences of the methodological approach. *European Physical Journal Plus*, *132*(66).

Jonason, D., Andersson, G. K. S., Öckinger, E., Rundlöf, M., Smith, H. G., & Bengtsson, J. (2011). Assessing the effect of the time since transition to organic farming on plants and butterflies. *Journal of Applied Ecology*, *48*(3), 543–550. http://doi.org/10.1111/j.1365-2664.2011.01989.x

Jørgensen, L. B., Gerber, S., Miik, M., Oxenbøll, K., Peepson, A., Skulskis, V., … Wramner, P. (2013). *Policy Recommendations to Save the Baltic Sea: Conversion to Ecological Recycling Agriculture*. (BERAS rapport). (L. B. Jørgensen, S. Gerber, & P. Wramner, Eds.).

Kozyra, J. (2012). *Wpływ zmian klimatu na rolnictwo [Impact of climate change on agriculture]*. Retrieved from url: http://www.klimat.iung.pulawy.pl/informacje-podstawowe/ogolna-charakterystyka-wplywu-zmiany-klimatu-na-rolnictwo

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.

Larsson, M., Granstedt, A., & Thomsson, O. (2012). Sustainable Food System – Targeting Production Methods , Distribution or Food Basket Content? In M. Reed (Ed.), *Organic Food and Agriculture – New Trends and Developments in the Social Sciences* (pp. 197–216). InTech.

Lekan, M. (2017). *Closing the nutrient loop? Challenges and opportunities for up-scaling of recycling principles within the conventional and organic farming sector Case study: Poland*. Central European University.
Linder, B. P. (2017). Press Release: CETA - MEPs back EU-Canada trade agreement. Brussels: European Parliament. Retrieved from url:http://www.europarl.europa.eu/news/en/press-room/20170124IPR59704/ceta-trade-committee- meps-back-eu-canada-agreement
Micha, M. (2013). Challenges and opportunities of ecological recycling agriculture farms in the Baltic Sea region. In A. Granstedt & P. Seuri (Eds.), *Conversion to Ecological Recycling Agriculture and Society: Environmental, economic and sociological assessments and scenarios*. Retrieved from http://beras.eu/wp-content/uploads/2013/09/Conversion-to-Ecological-Recycling-Agriculture-and-Society-reviderad-utgåva.pdf
Moraine, M., Duru, M., Nicholas, P., Leterme, P., & Therond, O. (2014). Farming system design for innovative crop-livestock integration in Europe. *Animal*, *8*, 1204–1217.
Naturvårdsverket. (2017). Konsumtionsbaserade utsläpp av växthusgaser per område. Retrieved July 30, 2017, from http://www.naturvardsverket.se/Sa-mar-miljon/Statistik-A-O/Vaxthusgaser-konsumtionsbaserade-utslapp-per-omrade/?visuallyDisabledSeries=affc6e1717cd5dd3
Pastuszak, M., Stalenga, J., Kowalkowski, T., Kopiński, J., & Panasiuk, D. (2014). Impact of forecasted changes in Polish economy (2015 and 2020) on nutrient emission into the river basins. *Science of the Total Environmen*, *493*, 32–43.
Pine, F. (2007). Dangerous Modernities? Innovative Technologies and the Unsettling of Agriculture in Rural Poland. *Critique of Anthropology*, *27*(2), 183–201.
PROW. (n.d.). Program Rozwoju Obszarow Wiejskich 2014-2020 [Rural Development Programme 2014-2020] (Prow2014-2020). 2015. Średnia powierzchnia gospodarstwa w 2015 roku [Average size of the agricultural land in 2015]. Retrieved from https://prow2014-2020.pl/2015/11/13/srednia-powierzchnia-gospodarstwa-w-2015-roku/ Prus
Rockström, J., Nilsson, M., Klein, R., Siebert, C., Schipper, L., & Kjellén, B. (2011, January 23). "2011 blir ett viktigt år för en hållbar global framtid ". *Dagens Nyheter*. Stockholm.
Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S. I., Lambin, E., … Foley, J. (2009). Planetary Boundries: Exploring the Safe Operating Space for Humanity. *Ecology and Society*, *14*(2), 32. http://doi.org/10.1038/461472a
Ślązak, R. (2013). *Skutki prywatyzacji polskiego rolnictwa dla społeczności wiejskiej [Consequences of privatization of the Polish agriculture for the rural society]*. Retrieved from url: http://www.klubinteligencjipolskiej.pl/2013/02/skutki-prywatyzacyjne-polskiego-rolnictwa-dla-spolecznosci-wiejskiej/
Staniszewska, M., & Stalenga, J. (2013). Agricultural policy in Poland – facts, legislation and recommendations. In L. B. Jorgensen, S. Gerber, & P. Wramner (Eds.), *Policy Recommendations to Save the Baltic Sea: Conversion to Ecological Recycling Agriculture* (COMREC stu). Huddinge: Södertörns högskola.
Stolze, M., Sanders, J., Kasperczyk, N., & Madsen, G. (2016). *CAP 2014-2020: Organic farming and the prospects for stimulating public goods*. Brussels.
Sutton, M. A., Howard, C. M., Erisman, J. W., Billen, G., Bleeker, A., Grennfelt, P., … Grizzetti, B. (2011). *The European Nitrogen Assessment. Sources, Effects and Policy Perspectives*. Cambridge, UK: Cambridge University Press.
Szeremeta, A. (2005). Organic farming and market in Poland.
Szpak, E. (2005). *Między osiedlem a zagrodą. Życie codzienne mieszkańców PGR-ów [Between commune and farm. Daily life of inhabitans of state-owned farm enterprises]*. Warsaw: Trio.
Trading Economics. (2015). Retrieved from https://tradingeconomics.com/
Watson, C., Laitenberger, K., Wolf, P. de, Prá, A. dal, Stalenga, J., & Bogdanovic, V. (n.d.). *Improving the Technical Efficiency of Mixed Farming* (Minipaper 2: Improving the technical

efficiency of mixed farming.). Brussels.
Wigboldus, S., Klerkx, L., Leeuwis, C., Schut, M., Muilerman, S., & Jochemsen, H. (2016). Systemic perspectives on scaling agricultural innovations. A review. *Agronomy for Sustainable Development*, *36*(46).
Willer, H., Yussefi, M. (2006). *The World of Organic Agriculture. Statistics and Emerging Trends*. Bonn.

Appendix 1

EU-Law for organic production 2007, an overview

In 2007 the European Council of Agricultural Ministers agreed on a new Council Regulation (Council Regulation (EC) No. 834/2007) setting out the principles, aims and overarching rules of organic production and defining how organic products were to be labelled.

The regulation set a new course for developing organic farming further, with the following aims:

- sustainable cultivation systems
- a variety of high-quality products.
- greater emphasis on environmental protection
- more attention to biodiversity
- higher standards of animal protection
- consumer confidence
- protecting consumer interests.

Organic production respects natural systems and cycles. Biological and mechanical production processes and land-related production should be used to achieve **sustainability**, without having recourse to genetically modified organisms (GMOs).
In organic farming, **closed cycles** using internal resources and inputs are preferred to open cycles based on external resources. If the latter are used, they should be

- organic materials from other organic farms
- natural substances
- materials obtained naturally, or
- mineral fertilisers with low solubility.

Exceptionally, however, synthetic resources and inputs may be permissible if there are no suitable alternatives. Such products, which must be scrutinised by the Commission and EU countries before authorisation, are listed in the annexes to the implementing regulation Commission Regulation (EC) No. 889/2008).

URL:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:0023:EN:PDF

Appendix 2

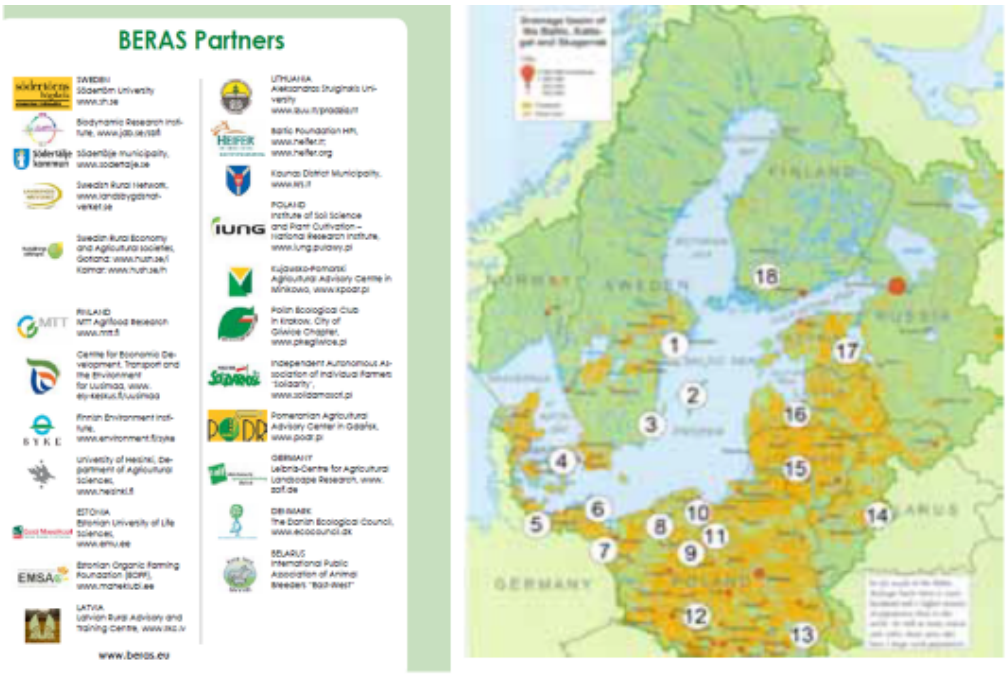


Figure 64 Baltic Sea catchment area with BERAS Implementation partners and model farms. BERAS Implementation 2010-2014 was partly funded by EU; this project was initiated and coordinated Swedish Biodynamic Research Institute (SBFI).

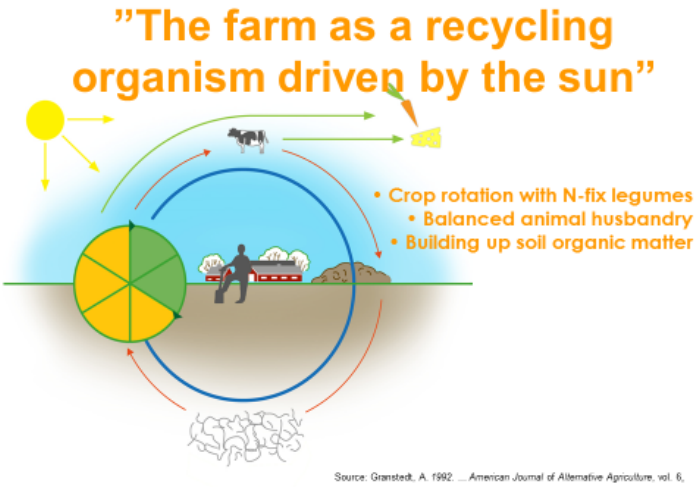


Figure 65 Schematic illustration of the Ecological Recycling (ERA) farm, based on energy flows from the sun, recycled resources, and living organisms.

Three biological cycles described here:

1. The internal cycle: The annual flows of nutrients and organic matter between soil and crops, the roots and remnants of which are continuously returned to the soil, where they contribute to the formation of humus and the mineralization (freeing) of nutrients for coming years' production.

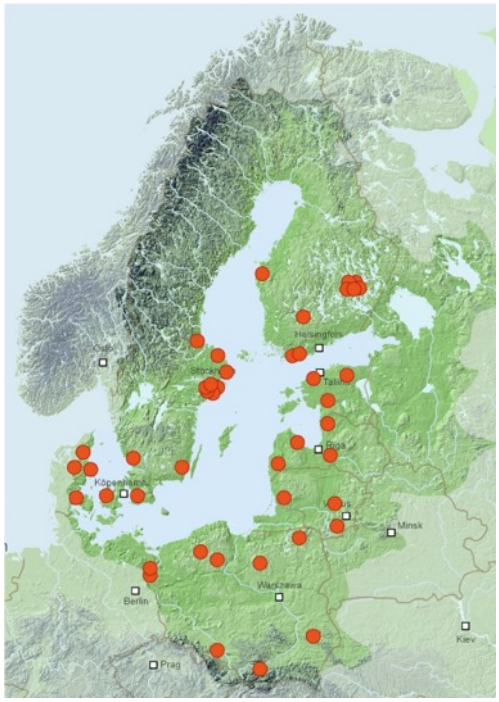
2. The crop rotation cycle: Crop rotation is carefully considered. Ley, consisting of grass and legumes like clover and lucerne, are nourishing; the biomass they build up and the atmospheric nitrogen they accumulate generate and enrich humus in the soil. Cereals, fodder grain and root crops are, on the other hand, extractive; more humus is depleted than is built up.

3. The greater cycle: A larger share of the harvest from the farm feeds its animals, here symbolized by a cow. The animals' urine and manure, rich in nutrients and humus-building matter, are returned to the soil via compost and appropriate application of manure to the soil, from which the nutrients derived. In the center is the farmer, who, by sensible cultivation, can improve the productive capacity of the land, crop quality, and the well-being of the farm's animals and humans alike.

We all play a part.

Opportunities and challenges for a transition to Ecological Recycling Agriculture to save the Baltic Sea environment

The Baltic Sea marine system is strongly disturbed by eutrophication. Agriculture in the countries surrounding the Baltic Sea is the main cause of nutrient deposition leading to eutrophication. Modern, large-scale industrial agriculture also contributes to loss of biodiversity in the entire landscape and depletion of humus in soils. Food is responsible for approximately 30% of the emissions of gasses that cause global warming.



Baltic Sea drainage area with model Ecologic Recycling Farms (in red) in the BERAS project

In this book,

- We provide an update of data on agricultural nutrient surplus, nutrient leakage, climate loading and pesticide use in the Baltic Sea region. The analysis is carried out for all countries in the Baltic Sea catchment area, and compared to the situation in 2003 when the BERAS project was initiated.
- We investigate underlying reasons responsible for current agricultural development through interviews with farmers and other actors.
- We offer policy recommendations to counter current negative trends and realize the goals of the BERAS project, the goals from HELCOM for protecting the Baltic Sea and goals put forward in the climate negotiations in Paris, December 2015.

SBFI
SWEDISH BIODYNAMIC RESEARCH INSTITUTE