BERAS *implementation*

Baltic Ecological Recycling
Agriculture and Society

Conversion to Ecological Recycling Agriculture and Society

Environmental, economic and sociological assessments and scenarios

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Editors

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Preface

Resilience of our ecosystems is at stake

Despite various measures the eutrophication of the Baltic Sea is not decreasing and the resilience of multiple ecosystems is at stake. In this situation business as usual is not an option. New approaches are needed creating a safe operating space within the environmental boundaries. BERAS develops and implements practical examples where innovation and entrepreneurship from a multi sectorial engagement flows into realistic fully integrated ecological alternatives for the whole food chain from farmer to consumer.

BERAS - background and main concepts

The BERAS concepts have been developed through two transnational projects part-financed by the European Union and Norway (the Baltic Sea Region Programme), BERAS (2003 – 2006) and BERAS Implementation (2010 – 2013). It is a common effort from the partnership from nine countries around the Baltic Sea (Sweden, Denmark, Germany, Poland, Belarus, Lithuania, Latvia, Estonia and Finland), Russia and Norway and includes national and local authorities, universities and research institutes, advisory services, ecological and environmental NGOs, farmers' organizations, food chain actors and finance institutions.

The concept of **Ecological Recycling Agriculture (ERA)** is based on many years of research and studies on how organic farms can be organized to be truly sustainable and environment-friendly and has demonstrated its potential related to reduction of nutrient leakage from the farm, soil carbon sequestration/climate effect, biodiversity and increased soil fertility.

BERAS has also successfully started the implementation of fully integrated full scale examples of regional **Sustainable Food Societies (SFS)** in all countries in the Baltic Sea Region.

The consumer engagement concept **Diet for a Clean Baltic** offers a sustainable lifestyle with consumption of enough and good food without threatening the environment of the Baltic Sea or the planetary boundaries.

BERAS future

Following the conclusion of EU project BERAS Implementation in 2013 a Network Agreement has been concluded to further develop BERAS and secure the continuation of the work in the Baltic Sea Region and to share our competence and building alliances with initiatives in other parts of the world.

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1. Strategy for conversion to BERAS system

Introduction

Artur Granstedt

The Baltic Sea is the drainage area for Sweden, Finland, Estonia, Latvia, Lithuania, Poland, and parts of Denmark, Russia and Germany. A total of 85 million people live in this land area of 160 million ha of which 30 million is arable land. Agriculture is responsible for about 50 % of the nitrogen and phosphorus load to the Baltic Sea.

Despite various measures the eutrophication and resulting anoxic conditions of the Baltic Sea is not decreasing. The leaching of nitrogen and phosphorus compounds leads to algae blooms in the surface water and when the algae die in autumn their decomposition consumes the dissolved oxygen in the water. When the dissolved oxygen content goes below zero the deficit favors organisms that release hydrogen sulphide that kills aquatic organisms. This results in marine dead zones. Available data indicate that the area covered by anoxic bottom water is increasing every year.

The updated results for 2011 and the preliminary results for 2012 show that the extreme oxygen conditions in the Baltic Proper continue. Both the areal extent and the volume of hypoxia and anoxia are elevated to the highest levels ever observed. Almost 20% of the bottom area in the Baltic Proper, including the Gulf of Finland and the Gulf of Riga are affected, which corresponds to a water volume of 12% (Hanson et al 2013).

The diffuse load of reactive nitrogen and phosphorus compounds from agriculture is primarily caused by excessive nutrient inputs from specialized farming practices that separate crop and animal production and result in linear flows of plant nutrients. Such specialization is still the predominant system in the north and west of the Baltic Sea Region (BSR), but also increasingly in the new EU member countries in the east and south (Granstedt, A. 2005). BERAS calculations show that a conversion to specialised farming throughout the BSR would greatly increase the nutrient and pesticide load to the Sea. Although organic agriculture advisory services exist, they are too narrow in their approach and not strategically focused on pollution reduction. A farm advisory service with a whole food chain perspective, as BERAS has, is needed.

Pilot studies from 48 farms in the BSR have demonstrated that Ecological Recycling Agriculture (ERA), with recycling of nutrients and integration of crop and animal production, can substantially reduce nutrient input and losses to the Baltic Sea. Agriculture based on these principles would, according to the calculations in the BERAS project, lead to a decrease in the nitrogen leaching by half as well as a significant reduction in the loss of phosphorus (Granstedt, et al 2008). In addition food systems that are regionally oriented with locally based processing for a local market would have a positive effect on rural development. Conversion to ERA has also been shown to have a potential to reduce green house gases and stop the use of agro pesticides (Granstedt 2005, Granstedt et al 2008, Kahiluoto et al, 2006).

In view of the dramatic environmental situation, and the positive results from BERAS, this project has identified specific further actions and target groups. These will contribute to fulfilling the goals set out in the EU Marine Strategy Framework Directive, the HELCOM Baltic Sea Action Plan (BSAP), the EU Water Framework Directive and the EU Strategy for the BSR. The BERAS project contributes to section 9 of the Action Plan by reinforcing sustainable agriculture and rural development. The target groups identified include all food chain actors as well as consumers, politicians and authorities.

Ecological Recycling Agriculture (ERA) is defined as an agriculture system based on local and renewable resources with an integration of animal and crop production (on each farm or farms in close proximity) so a large part of the nutrient uptake in the fodder production (in Europe on about 80 % of the arable land) is effectively recycled. This in effect means that each farm strives to be self-sufficient in fodder production which in turn limits animal density and ensures a more even distribution of animals to most farms.
Achieving this requires structural changes in the agricultural sector in all the countries in the BSR. In each country there are regions with too intensive and concentrated animal production resulting in high surpluses and losses of plant nutrients to the environment as well as regions with too few animals resulting in a high dependence on artificial fertilizers (Granstedt, Seuri, and Thomsson, 2004). Animal production needs to be decreased in some regions and increased in others. The introduction of clover grass needed in the crop rotation will also have the effect of supporting a more ruminant dominated meat production. In a future ecological recycling agriculture the proportion of leys would increase in areas that are now mostly specialised in grain production. Leys with both clover and grass would have to be produced on all farms. Production of meat from non-ruminant animals (poultry, pigs) would decrease while beef production would increase correspondingly – assuming today's level of meat consumption (Granstedt and Thomsson, 2005).

Full-scale implementation of ecological recycling agricultural (ERA) systems and integrated watershed management will lead to increased nutrient recycling, improved soil fertility management and no use of artificial fertilizers and pesticide. This will result in a significant decrease of plant nutrient leaching to the Baltic, mitigating eutrophication as well as increasing biodiversity in the soil rendering the soil more effective as a carbon sink mitigating climate change (Granstedt, 2007).

The vision of the BERAS implementation project is to have ERA farming and locally-based food chains established in the whole BSR building on the collective knowledge within the network and existing ERA farms. In addition to the implementation of ERA with diverse crop production the establishment of ponds and small wetland constructions further decrease nutrient leaching and improves biodiversity through the creation of biospheres. The project has promoted such improvements and developed strategies to support implementation throughout the BSR area.

In the Beras Implementation project the development of strategies for conversion recognises the need to take the different types of farms within the BSR into consideration. These include the former large scale commune farms (east), small scale diversified private farms (south east) and large scale specialized crop or animal farms (north, west). The work to develop these strategies is based on studies of farms in different stages of the conversion process from the different categories of farms in the different countries in the region. The results of this work that take up different aspects of the conversion process (agronomic, economic and social) at farm level, are presented in this report.

The evaluation of the conversion process is based on a number of Ecological Recycling Agriculture (ERA) case studies in the BSR region as well as the establishment of BERAS Implementation Centres (BIC) in all the BERAS countries in the region to promote Sustainable Food Societies (SFS) with the aim to integrate and promote local food chains. In addition to this scientific evaluation, a set of practical guidelines for conversion to ERA farming that also include economic and marketing aspects have been developed (Stein- Bachinger, Reckling and Granstedt 2013). These build on the collective knowledge in the project and present measures and instruments relevant for decision making for farmers, farmers' organizations, advisors, actors in the food chain including consumers, authorities and politicians and NGOs.

In chapter 2, Description of Ecological Recycling Agriculture farm model, a theoretical framework is presented, as well as the principles of crop rotation and an analysis of the elasticity of the ERA production model.

In chapter 3 the ERA farm models from different production lines and countries are described based on the evaluation of practical farm examples included in the project.

In chapter 4 the environmental impacts of the conversion process are evaluated.

In chapter 5 the proposed strategies for conversion on policy level are presented. These are partly based on the previously published policy study by Peter Einarsson (2011). These recommendations aim to integrate BERAS principles in the BSAP within the whole BSR. At national level the recommendations address how BERAS principles can be incorporated into the CAP, BSAP, WFD and the Marine Directive. The recommendations take into consideration the geographical site conditions and agricultural management aspects of crop production and animal husbandry in the respective countries. The economic aspects of conversion of specialized conventional farms with heavy investments is included in this section.

As a supplement to this publication a special list of thematic expertise and contact persons is available.

References

Einarsson, P. 2012: Policy interventions for ecological recycling agriculture. Available options for governments in the Baltic Sea Region. BERAS Implementation Reports No. 1.

Granstedt. A. 2007. Baltic Ecological Agriculture and Society. Executive Summary. www.beras.eu. Baltic Ecological Recycling Agriculture and Society (BERAS) - Executive Summary.pdf

Granstedt, 2012. A. Agriculture for the Future –with focus on the Baltic Sea. COMREC Studies in Environment and Development No 6. Södertörn University.

Granstedt, A. 2005. Plant nutrient Balance Studies. In: Granstedt, Thomsson and Schneider (Eds), Environmental Impacts of Eco-Local Food systems – final report from BERAS work Package 2. Beras report 5. Ecological Agriculture report 46. Centre for Sustainable Agriculture. Swedish University of Agriculture Sciences. Uppsala.

Granstedt, A., Schneider, T., Seuri, P. and Thomsson, O. 2008. Ecological Recycling Agriculture to Reduce Nutrien Pollution to the Baltic Sea. Journal Biological Agriculture and Horticulture, 26(3) 279-307

Granstedt, A., Seuri, P. and Thomsson, O. 2004. Effective recycling agriculture around the Baltic Sea. Background report. Beras report 2. Ecological Agriculture report 41. Centre for Sustainable Agriculture. Swedish University of Agriculture Sciences. Uppsala.

Granstedt, A. and Thomsson 2005. Food Basket Scenarious. In: Granstedt, Thomsson and Schneider (Eds), Environmental Impacts of Eco-Local Food systems – final report from BERAS work Package 2. Beras report 5. Ecological Agriculture report 46. Centre for Sustainable Agriculture. Swedish University of Agriculture Sciences. Uppsala.

Granstedt, Thomsson and Schneider, 2005. Executive Summary. Environmental Impacts of Eco-Local Food systems – final report from BERAS work Package 2. Beras report 5. Ecological Agriculture report 46. Centre for Sustainable Agriculture. Swedish University of Agriculture Sciences. Uppsala.

Hansson, M., Andersson, L., Axe, P. and Szaron, J. 2013. Oxygen Survey in the Baltic Sea 2012 SMHI Report oceanography N0 46.

Larsson, M., Granstedt, A. and Thomsson, O. 2011: Sustainable food systems – targeting production methods, distribution and food basket content? Organic Food and Agriculture, Book 1. ISBN 979-953-307-117-5.

Stein- Bachinger, K. Reckling, A. Granstedt 2013. Guideline in conversion to ecological recycling agriculture. Zalf, Leibniz-Zentre for Agricultural Landscape Research.

2. Description of an Ecological Recycling Agriculture (ERA) farm model – a theoretical framework

Pentti Seuri

Section 3 contains descriptions of some farm models, the aim of which is to illustrate how the single farm functions in terms of crop rotation, quantity and quality of yield and requirements for fodder in animal production.

The farm model can be described as "a simplified picture of reality". In this project some 30 farms are monitored and their activities documented over three consequent years. Some of the farms are described in more detail in the Guidelines, but actual farms naturally have their own individual features. It is therefore very difficult to describe an "average" farm representative of a specific production type. Furthermore, in reality there are so many varying factors and minor details related to main features that the reader might encounter greater difficulties in discerning the key facts from an actual example farm than from a model farm.

In the farm model it is possible to simplify production systems. For example, 30 sheep can be ignored in a case where the main production line is represented by 100 dairy cows, or the crop rotation can be described to be uniform for the whole farm when in reality distantly located fields might have different crop rotations to those fields located near the farm.

There exists a risk however of interpreting a farm model wrongly and drawing erroneous conclusions. In farm models the annual variation in quantity and quality of yield can be disregarded, resulting in an unrealistically optimistic picture of production. In ERA farming the key issue is the integration of crop and animal production. However, there must also be a minimum level of diversity in animal production, which in this connection not only relates to ruminants vs. monogastric livestock, but also includes quality of fodder and intensity of feeding. A good example of such an issue can be described using high yielding milk production. Milking cows are ruminants and can contribute to an optimum crop rotation with a large proportion of leys with legumes although milk production as an independent production line in ERA farming can be extremely fragile with a high risk of failure. For example, whenever the quality of silage is below average (the reason ranging from survival of legumes to weather conditions at harvest time), there are very limited possibilities to use such low quality silage only for dairy cows. In practice in such cases the real farm either can produce marked lower milk yield per cow or merely plough in the low quality silage and buy better fodder for cows. In such cases our model seems to be not valid based on the assumption of quantity of yield and average milk yield. Furthermore, the whole concept of nutrient flows and balances is rendered invalid. However, if there is use for lower quality silage, the variations in fodder quality can be managed with fewer losses and the model will become more valid. Low intensity beef production, for instance, provides much more flexibility and allows increasingly larger amounts of lower quality fodder to be harvested than the single model indicates.

In practice, the solution in the previous example of dairy production means that even the different farm models can be described as independent systems, but there must be some degree of integration between the different production lines. The integration can be organized within the farm or among farms. However, this type of integration represents a challenge not only to describe, but also to be followed by the readers. Thus, in this connection the farm models are described as independent systems, but the quantity and quality of yields are based on the potential integration of other production lines. The next section contains a brief introduction to some basic crop rotations and some potential integration options among different production lines.

2.1. Crop rotation

Pentti Seuri

The two main issues in crop rotation are to produce sufficient crop yields for fodder and human consumption, and improve soil fertility using the nitrogen produced by legumes. In addition, there are several other issues that are strongly correlated with crop rotation, such as weed and pest control, which can be crucial. However, in this connection the main focus is on the first two issues.

There is no primary source of nitrogen besides that from biological nitrogen fixation (BNF) by legumes in ERA farming, although there is a strong correlation between the amount of available nitrogen and the quantity and quality of yield. Furthermore, the nitrogen utilization rate (efficiency) plays the key role from an environmental point of view: nitrogen is the main element in eutrophication of waters.

The total intensity of plant-available nitrogen results from BNF and recycling. Farmyard manure (FYM) is the most important source of recycling nitrogen. The approximate ratio between the BNF and FYM in an ERA system is 2:1. This means that the total intensity of nitrogen in the field can be increased through recycling by about 50% over the total amount of BNF. Thus if the average BNF on a farm is 50 kg/ha nitrogen, there is typically about 25 kg/ha nitrogen in the form of manure, totaling 75 kg/ha nitrogen (on average).

There is frequently a correlation between the intensity and efficiency of production: the higher the intensity, lower the efficiency (the law of diminishing returns). In Finnish circumstances the critical value is around 100 kg/ha nitrogen of total plant-available nitrogen. The national average for total intensity of nitrogen in conventional agriculture is about 130 kg/ha, whereas 80 kg/ha is from nitrogen fertilizers, 35 kg/ha from FYM and some 15 kg/ha is from BNF and atmospheric deposition. The average N-yield is around 70 kg/ha. It is noteworthy that about 100 kg/ha is primary nitrogen, i.e. originates from outside agriculture. The ratio between harvested nitrogen in the yield to primary nitrogen ("primary efficiency") is only 70%. The low efficiency results from high total intensity and poor utilization of recycling nitrogen (FYM).

Thus, the aim in an ERA system is about 100 kg/ha for total nitrogen intensity, which means that the goal for BNF lies at around 60 kg/ha. In addition, there is some 30 kg/ha nitrogen from FYM and some atmospheric deposition (5 kg/ha), the remainder of the total nitrogen intensity origin coming from other external inputs (seed, organic fertilizers from outside organic systems, bedding materials etc.). Seuri (2006) concluded that the goal of primary efficiency could be set to 100%, i.e. around 70 kg/ha nitrogen yield. This is about the same average nitrogen yield compared with the conventional average nitrogen yield, but the yield quality differs.

The BNF varies widely depending on crop species and the availability of mineral nitrogen in the soil. The rule of thumb for BNF is about 50 kg/ha nitrogen per tonne of harvested legume (d.m.). This results if 70% of total legume uptake nitrogen is from BNF (remaining nitrogen is from the soil). However, if there is a substantial amount of mineral nitrogen available in the soil the rate of BNF can fall below 10% of total nitrogen uptake by legumes. According these figures, it can be estimated that under Finnish conditions the BNF typically lies at around 100 – 150 kg/ha nitrogen for perennial legumes (red clover), and is somewhat lower for annual legumes such as peas, vetch and beans.

It is estimated that it is possible to reach an average BNF of 60 kg/ha through a 50% share of legumes in a crop rotation. On the other hand, it is commonly observed that in the long run there is high risk for pathogens to develop on legumes if they are grown too often in a crop rotation. There are no reliable data on the maximum share of legumes in any crop rotation, but generally any annual legume should not represent more than 20% (once in every 5 years) of the crop in a rotation and a maximum of two different annual legumes should occur in the same rotation (most of the legumes have some pathogens in common). Perennial legumes are more tolerant of pathogens because they are grown most often in mixed stands rather than pure stands. The maximum share lies at around 50 – 60% in a crop rotation (three years of legumes out of a five-year rotation).

It can be concluded that the maximum share of legumes in a crop rotation is about 60% and it is possible to reach the average BNF in a rotation with up to 60 – 80 kg/ha nitrogen. The remaining crops in the rotation can be chosen according the production criteria for the particular farming system. From an ERA point of view the optimum could be about a 20% share of the total field area in a rotation incorporating a cash crop (cereals). This reflects the share of crop yield for direct consumption by humans where the remaining yield (80%) is used as fodder in animal production.

2.2. Elasticity of the ERA production model

Pentti Seuri

A common criticism leveled at the models is that in most cases it is immediately apparent that the yield variation makes it impossible to produce adequate fodder quality for the livestock consistently in the model. Therefore, there is a need to secure more details for the whole farm model and the ERA principles.

It is not only a matter of optimizing the efficiency and intensity of crop production (crop rotation), but there is also a need for optimum efficiency and intensity of animal production that means that there must be different animal types to ensure the most efficient fodder (biomass) use. There is a well-documented restriction that applies to monogastric livestock in that they have very limited ability to utilize roughage such as silage. Moreover, less attention has been paid to intensity of ruminant production. The modern high-yielding dairy cow needs almost as high quality fodder as a monogastric. The share of cereal-based fodder is commonly higher than 50%. Even though the quality of protein can be lower for dairy cows,the total content of protein is already even higher for than for monogastrics. This means that even for ruminant-based (dairy cows) animal production integrated with crop production there is no guarantee of a high utilization rate for fodder in the system. If there is any crop failure – especially in quality of the crop – low quality fodder cannot be used. The problem can be solved if low intensity ruminants are incorporated into the system. This represents a more cost efficient strategy to have lower intensity production incorporating meat production rather than lowering the intensity of milk production. If beef production is based only on calves from milk production the intensity of feeding milking animals for beef is not markedly lower compared with straightforward milk production, but represents a step towards a more optimal production system.

Potentially the lowest demand on quality of fodder is for beef-breed animals and low intensity sheep production. If the suckling-cow method is used, a large share of the total fodder is used for the cows, but most of the year their fodder can be of extremely low quality and even straw can be used as a fodder component. During the grazing period these cows can provide high quality feed for young calves and ensure their vigorous growth even if the pasture is not of very high quality. Calves after weaning and bull calves later on may profit from better quality fodder, but even then the quality of fodder can be inferior than that for milk-breed animals.

Probably the two most likely crop failure types in ERA farming systems are the failure to harvest a cereal crop as grain and too low protein content in silage. In both cases there is no use, or very limited use, for such fodder in specialized dairy production. However, the entire crop could be harvested for silage instead of grain and could be used successfully in beef production. Also the protein content of silage can be somewhat lower for beef production compared with milk production.

Both types of failure concern quality – the quantity of total biomass yield is usually consistent. If the crop failure is also one of total quantity of biomass, there must be a possibility to compensate for the failure with adequate stored fodder, including the unused resources such as straw, use of reserved grazing areas or yield of ley regrowth.

In order to be able to compensate for the crop failures there must be adequate area of high quality crops in the crop rotation: e.g. if 20% cereals and 10% protein fodder are needed in the livestock diet, their share must be higher in the crop rotation. If there is no crop failure, the surplus of high quality fodder can be sold or stored, and in case of crop failure the crop can be harvested and used as lower quality feed than that normally used.

If there is less elasticity in crop production it can be compensated for by adjusting the animal production to the yield in any particular year. However, from an economic point of view it is not the optimum solution since unused resources (e.g. empty space in an animal barn) increases the fixed costs per product unit. Also, if the animals have very long life cycles (like dairy cows and beef cattle), it is very difficult to adjust the number of animals over the short term.

3. ERA farm model from different production lines and countries

	Input fertilizers [fodder, F]	Output crop, C [fodder, F]	Output animal, A	Manure, M M= [F]-A	Farm gate balance diff./ratio	Surface balance diff./ratio	Feeding ratio FR=A/F
1	100	80	0	0	20 / 80%	20 / 80%	
2	100	[120]	10	110	90 / 10%	90 / 57%	8.5%
3	100	[80]	20	60	80 /20%	80 / 50%	25%
4	50	35	0	0	15 / 70%	15 / 70%	
5	[100]	0	40	60	60 / 40%	not exist	40%

Table 1. Five different farms (hypothetical figures). For farms 1-4 an input is fertilizer, for farm 5 an input is fodder. Farms 1 and 4 are crop farms, farms 2, 4 are mixed farms, farm 5 is feed-lot farm. Farm gate balance and surface balance are given as a difference between input and output and as a ratio between output and input; animal balance is given only as a feeding ratio.

3.1. Primary nutrient balance

Pentti Seuri

Nutrient balance is frequently used to evaluate the difference between nutrient inputs and outputs in a given system. The most common nutrient balances are farm gate balance (FGB), surface balance (SB) = field balance (FB) and animal balance (AB) = feeding ratio (FR).

Farm gate balance takes account of nutrient input for all the nutrients from outside the system (farm). Typical nutrient inputs are fertilizers, FYM, BNF, fodder, seeds and bedding materials. For nutrient output only the nutrients that exit the farm are taken into account: crops and animal products and manure sold by the farm.

Surface balance takes account of nutrient input for all the nutrients entering the field (fertilizers, FYM, BNF, etc.) and only harvested crop yield is taken account of as nutrient output.

Animal balance takes account of nutrient input for all the nutrients in fodder for livestock and all the nutrients in animal products are included in nutrient output.

Any component of the balance can be given as a difference between input and output, or as a ratio between output and input. The difference indicates the absolute balance (negative or positive) in kilograms, and can be given in kg/ha or kg/farm.

If the balance is given as a ratio between input and output, it can be termed utilization ratio or efficiency rather than balance.

The difference between input and output indicates potential nutrient loading. However, an absolute value (kg/ha or kg/system) is difficult to interpret if there is no information on output production (quantity and quality). On the other hand, the ratio between input and output can be extremely misleading, depending on production type (crop vs. animal) or input type (mineral vs.

organic fertilizers). Table 1 illustrates the difficulties associated with different nutrient balances.

Let us imagine that the figures in Table 1 are for nitrogen in kg/ha. The highest surplus (balance) of nitrogen is on farm 2 (90 kg/ha) and the lowest on farm 4 (15 kg/ha). The farm gate ratio (output/input) is highest on farm 1 (80%) and lowest on farm 2 (10 %). There are three farms (2,3,5,) producing animal products. Farms 2 and 3 produce crops and use the yield as fodder on-farm (mixed farms); farm 5 purchases fodder and feeds livestock (feed-lot). Each of the livestock farms has a different feeding ratio (8.5%, 25%, 40%). The feeding ratio is characteristic for each livestock type: farm 2 illustrates a typical feeding ratio for beef cattle (8.5%), farm 3 is a dairy farm (25%) and farm 5 a pork or poultry farm (40%).

Are we able to rank the farms according the utilization efficiency using nutrient balances above (Table 1)? If we look only at the balance, we get a different ranking compared with the ratio. Comparison of the two crop farms (farm 1, farm 4) illustrates the difference between balance (difference between input and output) and ratio (output /input): the balance is lower on farm 4 (15 kg/ha) and the ratio (70%) is worse compared with that for farm 1 (20 kg/ha and 80% respectively). However, it is easy to understand that utilization efficiency is better on farm 1 compared with farm 4, and farm 1 is able to produce more output per unit of input compared with farm 4 (80% vs. 70%). Obviously the ratio more likely indicates utilization efficiency than balance.

It can be noted that on farms 1 and 4 there is no difference between FGB and SB – they are identical on the same farm. But as soon as we have animal production on a farm (farms 2, 3, 5), the ratio differs although the balance is equal. Are we supposed to choose FGB or SB in order to rank the farms according the utilization rate? If SB is chosen, it does apply to farm 5 since it supports no crop production. Ranking by FGB (ratio) results in farm 5 being the best (40%) and farm 2 the worst (10%), but if we rank them by FGB (difference between input and output) the order is the same. It seems that we are able to rank the farms according the utilization efficiency with the help of the farm gate balance given as a ratio between output and input. The ranking is from the best to the worst: farm 1, 4, 5, 3 and 2. Let us look at closer to see if our ranking is really correct.

The answer is clear that if we accept any quality of output as a final output product, farm 1 is able to produce the most output per unit of input with an efficiency of 80%. However, what happens if only animal products are needed on the market? It seems that farm 5 is the most efficient in producing animal products. But again, if instead of pork or poultry beef is needed, in order to produce 10 units of beef, 100 units of nitrogen must be added into the system on farm 2. Could we be more efficient with the help of farm 1? As we remember, it was earlier ranked as the most efficient farm according the output/input ratio.

Could farm 2 increase the production of beef by 10 units more efficiently with help of farm 1 instead of increasing its own crop production? In order to produce 10 units of beef, 120 units of fodder must be produced. Farm 1 can produce 120 units of fodder using 150 units of input. Farm 2 is able to produce the same amount by using only 100 units of input.

It is obvious that none of the nutrient balances presented here indicate that farm 2 could be any more efficient compared with the other farms but it can produce clearly more efficiently the given amount of beef. The key issue is that none of the nutrient balances is able to differentiate between the origins of the nutrient. However, the total efficiency of nutrient utilization includes two components:

1) utilization rate on the field, FE (= field balance (ratio), FB = surface balance (ratio), SB)
2) circulation factor (=C, how many times the same nutrient has been used in the system)

The circulation factor can be defined only if the origin of the nutrient is known. The origin can be either from outside the farm (external nutrient input = primary nutrient = P), or from inside the farm (internal recycling nutrient = secondary nutrient = M); the symbol for secondary nutrient (M) comes from the word "manure", because manure is just about the only source of secondary nutrient in modern agriculture. Whenever the origin of input nutrients is known the circulation factor, C, can be calculated:

$$C = (P+M)/P$$

Now, after we understand the difference between the primary nutrients and secondary nutrients, we are able to evaluate the nutrient efficiency from a new point of view. If there are only secondary nutrients in the system it is obvious that the system is extremely efficient and there is no nutrient loading from such a system. Put the other way around, if there are no secondary nutrients, all the crop production must be produced with the help of primary nutrients. In such a system the fate of primary nutrients is either to exit the environment and add nutrient to the environment (i.e. cause nutrient loading), or the nutrients must be stored in the system. However, for example, nitrogen is not able to be stored in mineral soil, but can be stored only in organic matter. However, it is well known that there is equilibrium established for organic matter in any given agricultural system, there is no unlimited sink for nitrogen in any agricultural soil. Thus, in theory, the nutrient load from any given system is equal to the long-term use of primary nutrients.

If our aim is to evaluate the efficiency of nutrient use, we have to evaluate only the use of primary nutrients. The fewer primary nutrients needed, the more efficient the system. Why is there still a contradiction between farm 1 and farm 2? They use equal amounts of primary nutrients, but farm 2 seems to be more efficient (120% vs. 80%) but produces much less than farm 1.

farm 1, total input 100, total output 80:
field efficiency, SB = (output from field/input into field) => 80/100 = 80%
circulation factor, C = (P+M)/P => (100+0)/100 = 1
total efficiency = SB x C => 80% x 1 = 80%

farm 2, total input 100, total output 10:
field efficiency, SB = (output from field/input into field) => 120/(100+110) = 57%
circulation factor, C = (P+M)/P => (100+110)/100 = 2,1
total efficiency = SB x C => 57% x 2,1 = 120%

The contradiction is due to different quality of final output. Farm 1 produces crop products and farm 2 animal products. From the nutrient point of view they are not commensurate. However, all the animal production is fully dependent on crop production. If output of a livestock farm is defined in terms of crop production, the outputs are commensurate. The output of farm 2 is 120 units of crop products rather than 10 units of animal products. Now, finally, we can appreciate that farm 2 is more efficient than farm 1 and produces more than farm 1 even though the final product is less than on farm 1. The key issue is that it is not possible to produce the given amount (10 units of given quality of animal product) of animal product without 120 units of crop product. Thus, only crop production is taken into account when evaluating the efficiency of nutrient utilization.

Later on instead of the term output (crop) the term yield (Y) is used. It does not matter if yield is used as fodder or is sold, it is always termed yield (Y), i.e. primary production. Nutrients from outside the system that are used to produce yield are termed primary nutrients (P) and recycling nutrients inside the system are termed secondary nutrients (S).

Now we are able to define the new tool to evaluate the efficiency of nutrient use. Since it is analogous to other nutrient balances given as a ratio between output and input, we can call this new tool primary nutrient balance, or since it is given as a ratio, preferably primary nutrient efficiency (PNE). PNE can be calculated from two equations that give the same result:

(Equation I) PNE = C x FE
(Equation II) PNE = Y/P

Equations I and II are a single equation given in two different forms:

PNE = CxFE = (P+M)/P x Y/(P+M) = Y/P

However, these two different forms help us to understand the difference between PNE and other balances like SB and FGB.

The first formula (PNE = CxFE) indicates that PNE is identical to SB if there is no recycling of nutrients. But as soon as there are secondary nutrients in the system PNE is able to make a difference between the system with or without secondary nutrients – SB is not able to do that.

The second formula (PNE = Y/P) indicates that PNE is also identical to FGB if there are no recycling nutrients. But PNE measures output only in the form of primary production (yield, Y), never any other form (e.g. animal production = secondary production). That is why different types of animal cannot influence PNE even if FGB fully depends on it.

As we earlier noted, it makes a difference if the final product from the system is a crop product or an animal product. FGB (ratio) or SB (ratio) are able to evaluate the efficiency of the system only as far as crop products are produced. Whenever there is also animal production in the system, they are not able to evaluate the efficiency accurately.

Conclusions about PNE are given in Table 2. This can be compared with Table 1 where the other nutrient balances are calculated. As we can note, all the balances - FGB (ratio), SB (ratio) and PNE – are identical as long as there are no secondary nutrients on the farm (farms 1 and 4), but all of the balances differ when secondary nutrients exist in the system.

If the 5 farms (Tables 1 and 2) are ranked by PNE, farm 2 is the most efficient in utilizing nitrogen (120%) even when it has the highest nitrogen surplus (90 kg/ha) and the second lowest field efficiency (57%). Why is that, and what does PNE really tell us?

	Primary nutrient (P) [fodder, F*]	Yield (Y) [fodder, F]	Output animal, A	Secondary nutrient, M M= [F]-A	Circulation factor C = (P+M)/P	Field efficiency FE=Y/(P+M)	Primary nutrient efficiency PNE = CxFE PNE = Y/P
1	100	80	0	0	100/100 = 1	80/100=80%	1x80%=80% 80/100=0,8
2	100	[120]	10	110	(100+110)/100=2.1	120/(100+110)=57%	2.1x57%=120% 120/100=1,2
3	100	[80]	20	60	(100+60)/100=1.6	80/(100+60)=50%	1.6x50%=80% 80/100=0,8
4	50	35	0	0	50/50 = 1	35/50=70%	1x70%=70% 35/50=0,7
5	[100*]	0	40	(60)*	no primary production	no primary production	no primary production

*By definition purchased fodder is not a primary nutrient because it does not contribute towards primary production, only the nutrients which are left from purchased fodder in manure are counted as primary nutrients. However, on this farm manure is not utilized in crop production since there is no crop production. There cannot be any primary or secondary nutrient because there is no crop production.

Table 2. Evaluation of the nutrient flows with the help of primary nutrient efficiency (same farms as in Table 1).

Food production is based on two processes: primary production (=crop production) and secondary production (=animal production). From the nutrient point of view, only primary production produces something (interacts with nutrients in soil, water and atmosphere). Secondary production is totally dependent on primary production, and secondary production only uses the nutrients taken up by primary production and releases nutrients back to environment. Thus, any secondary production is just transforming primary production into secondary products – not adding any nutrients to products or systems. This is why all food production can be calculated solely in terms of crop production.

From the efficiency point of view it makes absolutely no difference if the crop products are used directly as food for humans or as fodder for animals. The most efficient system is that in which the given amount of crop production can be produced with smallest amount of primary nutrients. Of course humans can make the decision if the crop products are used directly as food for humans or as fodder for animals. The more crop products are used directly as food for humans the fewer crop products must be produced and fewer primary nutrients are needed. However, to produce less is a different dimension from producing efficiently.

Farm 2 (Table 1 and 2) is able to produce the highest primary production (120 units) by 100 units of primary nitrogen. At the same time, the surplus nitrogen is 90 units, which is more than on any other farm, from 100 units of primary nitrogen. However, surplus must be calculated per production process, not per farm. Just to illustrate this issue let us calculate the total surplus for equal production on farm 2 in an alternative system. Let us produce the fodder on farm 1 (the most efficient farm according the surface balance) and farm 5 (we just change the feed-lot to produce beef instead of pork).

150 units of primary nutrients are needed to produce 120 units of fodder on farm 1, and the surplus is 30 units. 120 units of fodder are given to beef cattle in order to get 10 units of beef on farm 5, and the surplus is 110 units. As seen, the total surplus is 140 units instead of 90 units on farm 2.

The last example illustrates very well the key problem in modern specialized agriculture. It seems that the use of nutrients is extremely efficient (very high field efficiency) on crop farms, but because the crop products are not the final output of agriculture, there is an additional process required to produce animal products. However, the manure from specialized animal farms is utilized extremely poorly. The present evaluation tools (FGB, SB) barely able to show this, or at least the interpretation of results is most often wrong. Primary nutrient efficiency (PNE) can be used to evaluate any kind of farm (crop farms, animal farms) and is able to indicate total efficiency of nutrient use.

3.1.1 Dairy farm model, Finland

Pentti Seuri

Introduction

As a part of the BERAS Implementation project some 30 ERA-farms all around the 9 Partner countries on the Baltic Sea watershed were observed and recorded. Based on the data from Finnish ERA-farms a farm model was built up to illustrate the characteristics and fundamentals of ERA agriculture. The main focus is on nutrient flows, especially on nitrogen.

The main two ideas of ERA-concept are
1) the balanced ratio between the number of animals and the area of arable land, i.e. minimum 85 % fodder self-sufficiency;
2) running the production system with the intensity based on the local renewable resources and the system itself, i.e. biological N-fixation (BNF), crop rotation and nutrient recycling

The data was collected from 9 ERA farms in southern Finland in years 2011 and 2012, two consecutive years on each farm. Data was collected by personal interview of farmer.

Since most of the farms had not measured the harvested yield from their fields it was estimated with help of number of animals and using feeding tables. This method results the minimum level of harvested yield and most likely slightly underestimate the actual yield level. This underestimation of yield was corrected by adding 10 – 20 % into calculated need of feed as losses in feeding process (losses in storage and in feeding).

The evaluation of nutrient flows based on the concept of primary nutrients developed by Seuri (Seuri 2002, 2008; Seuri and Kahiluoto 2005, also chapter X in this publication). In addition surface balance was calculated and surface efficiency was defined as a ratio between harvested yield to nutrient inputs to the field. The common statistics about Finnish agriculture were used as comparison to model.

3. ERA farm model from different production lines and countries
3.1.1 Dairy farm model, Finland

Farm model

In the farm model the main production line is milk production, but some beef and calves for beef production are produced as an essential part of milk production. The average milk yield is 8000 kg/cow. In addition about 20 % of total crop yield is sold out. It reflects the average share of direct human consumption of crop yield in Finland and commonly around the Baltic Sea region. (Table 1.)

The main primary source of nitrogen into the system is based on biological N-fixation of legumes and the amount of N-fixation determines the maximum yield potential of non-legumes. BNF has been calculated with rough equation BNF = A*B*1/C, where A is average total content of N in legume biomass (A = 3,5 %), B is proportion of fixed nitrogen in legume biomass (B =70 %) and C is the proportion of harvested biomass to total biomass of legumes (C = 50%). Equation results in 4,9 kg BNF/1 t harvested legume biomass; finally, the rounded value 5,0 kg BNF/1 t harvested legume biomass has been used in the model calculations. However, some BNF is not related to harvested yield, i.e. the undersown ley and yield of ley regrowth. Both of them has been estimated to be 20 kg/ha BNF. Within the 5-year crop rotation the average total BNF equals 54 kg/ha. Beside BNF 5 kg/ha N as an atmospheric deposition has been added to total external input, i.e. primary nitrogen is totaling 59 kg/ha.

All the other harvested crops are used as a fodder inside the farm except cash crop yield. The amount of nitrogen in manure has been estimated to be 50 % from total content of nitrogen in fodder (25 % into animal products, 25 % mainly gaseous N-losses from manure before spreading to the fields). Thus, from total harvested N-yield (68 kg/ha) about 9 kg/ha is sold in the form of cash crop and about 30 kg/ha is left in the farm as farm yard manure (FYM). This amount of manure can be spread for one crop in a 5-year crop rotation, i.e. undersown cereal receives FYM (147 kg/ha total N). Evaluation of nutrient efficiency and comparison between model and Finnish agriculture is presented in Table 2.

		legume (d.m. kg/ha)	non-legume (d.m. kg/ha)	N-legume (%)	N-nonleg (%)	N-harvested (N kg/ha)	BNF (N kg/ha)
1. ley	red clover+timothy	2000	2000	3,5	1,5	100	100
2. ley	red clover+timothy	1600	2000	3,5	1,5	86	80
3. cash crop	barley/wheat		2200		2	44	20
4. mixture	pea+oats	1000	1100	4	2	62	50
5.undersown	barley+grass seed		2300		2	46	20

Table 1. Crop rotation, yields (dry matter and nitrogen) and biological nitrogen fixation (BNF) in the farm model.

	model	average in Finnish agriculture
Primary nitrogen, p (N kg/ha)	59	95*
Secondary nitrogen, s (N kg/ha)	30	35
Total N input to the field = p+s	89	130
Circulation factor, c = (p+s)/p	1,5	1,37
N-yield, y (N kg/ha)	68	75
N surface balance = (p+s)-y, (N kg/ha)	21	55
N surface efficiency, S = y/(p+s)	0,76	0,58
Primary efficiency, P = y/p = c x S	1,15	0,79
*80 kg/ha N-fertilizers, 5 kg/ha atmospheric deposition, 5 kg/ha BNF, 5 kg/ha imported fodder		

Table 2. Evaluation of nitrogen flows in model and comparison between model and Finnish agriculture.

Conclusion

The model results about 30 % more efficient nitrogen utilization compared to Finnish average, i.e. primary nutrient efficiency in model is 115% versus 79 % in Finnish agriculture.

According the law of diminishing returns the utilization efficiency decreases when the use of input increases (production intensity increases). The average nitrogen intensity in Finnish crop production is 130 kg/ha whereas in the model it is 89 kg/ha. However, it is not likely that only lower nitrogen intensity explains the difference in N surface efficiency (0,76 vs. 0,58). The biggest difference in nitrogen flows between the model and average Finnish agriculture is the main primary source of nitrogen: in model it is BNF, whereas in Finnish agriculture it is artificial nitrogen fertilizers. It is obvious, that utilization efficiency of BNF is very high, since almost all BNF is related to harvested yield. Only undersown ley yield and yield of ley regrowth are not harvested at all. It can be estimated, that the nitrogen efficiency origin from BNF is around 85 % (total BNF is 54 kg/ha, 8 kg/ha has been estimated to be related to non-harvest BNF yield). A rough estimation about nitrogen efficiency origin from FYM lies around 60 % (the weighted average from BNF and FYM results 76% surface efficiency, when BNF efficiency is 85% and FYM efficiency is 60%). The average nitrogen utilization efficiency of FYM has been estimated around 20 % and efficiency of artificial nitrogen fertilizers around 70 % in Finnish agriculture (Seuri, unpublished).
The nitrogen yield level in model is only 10 % lower than Finnish average. However, the difference is slightly higher (20%), if measured in energy (dry matter) of yield. The difference in cereal yields (dry matter and nitrogen basis) is around 30 %, but ley yields are almost equal to Finnish average. The proportion of leys in crop rotation is slightly higher in model than in Finnish average. The main difference between model and Finnish average is in the protein crops: peas are grown hardly at all in Finland in conventional farming. Rape seed is the main protein crop, but the proportion is less than peas in the model.

3. ERA farm model from different production lines and countries
3.1.1 Dairy farm model, Finland

References

Seuri, P. 2002 Nutrient utilization with and without recycling within farming systems. In: Urban areas – rural areas and recycling – the organic way forward? / eds. Jakob Magid et al. DARCOF Report 3: 175-181.

Seuri, P. 2008. Nitrogen utilization in integrated crop and animal production. In: Cultivating the future based on science: vol. 1 organic crop production / eds. Daniel Neuhoff et al. Bonn: International Society of Organic Agriculture Research p. 142-145.

Seuri, P. & Kahiluoto, H. 2005. Evaluation of nitrogen utilization by means of the concept of primary production balance. In: Shaping sustainable systems: 15th IFOAM organic world congress, 20-23 September 2005 Adelaide, South Australia: congress handbook. p. 92.

Seuri, P., Kuisma, M., Lehto, T. 2005. Nutrient flows in a local food system - case Juva municipality. [p. 1]. (University of Helsinki, Ruralia Institute). Fairness and welfare in rural-urban relations, seminar in Mikkeli, 8th-10th of December 2005.

3.1.2 Beef production model, Estonia

Argo Peepson & Sirli Pehme

Introduction

The main idea behind ERA – recycling of nutrients, integrated production of crops and animals and high level of self-sufficiency characterizes also the beef production of farm under observation. The following is an overview of basics of production of beef cattle following ERA-principles, and nutrient flows, based on the data of Estonian ERA farm. Nutrient model built up is generalization attempting to characterize production type as a whole.

Farm description

Estonian ERA-farm under study is located in West-Estonia, Saaremaa island, about 200 km from Tallinn and about 20 km from the Baltic Sea. The island is characterised by semi-natural meadows and pastures. The soils are quite poor and stony and also quite variable. Low yield levels are typical for this area (e.g. average yield of cereals about 1500 kg d.m./ha). For above mentioned reasons, the beef production under such circumstances is quite suitable.

Farm has in total about 27 hectares of agricultural land, of which about 21 is permanent grassland (not in crop rotation), 1.6 hectares of natural grassland and about 2 ha of cereals. Farm had 5 suckler cows and 4 beef cows in 2011 (Limousin and Belmont breed and some of them cross-breed). Main production of this farm is beef.

Main crop rotation: barley (undersown)-ley-ley-winter cereal-spring cereal. All fodder needed is produced on farm, only salt and minerals are bought in (about 50 kg/year).

Beef farming is characterised by high share of grasslands from total area for production. As for ERA, balance between the number of animals and crop production is essential. By the model calculations, for one suckle cow and calves about 7.2 hectares of land for production is needed (1 suckle cow with 1 calf needs about 8000 kg d.m./year) to cover own fodder need and allow to efficiently use farmyard manure (FYM).

Results

Crop rotation and yields are based on the data of ERA-farm under study, but adjusted to represent average Estonian beef farming system.

As the beef farming system is a combination of crop rotation area and grassland, following results are presented separately for crop rotation land and grassland. Ratio of permanent grassland and field crops is about 5:1 and this is taken into account also for the system average (=crop rotation+grassland) calculations. Harvested N and biological nitrogen fixation (BNF) of crop rotation area are presented in table 1.

BNF has been calculated with equation BNF=A*B*1/C (Seuri, 2013), where A is average total content of N in legume biomass (A=3.5%), B is proportion of fixed nitrogen in legume biomass (B=70%) and C is the proportion of harvested biomass to total biomass of legumes (C=50%). Equation results in 4.9 kg BNF, rounded value 5.0 kg BNF/1 t has been used.

Total BNF of 5-year crop rotation equals 38 kg/ha. Besides BNF, 5 kg/ha N as an atmospheric deposition has been added, i.e. primary nitrogen is totalling 43 kg/ha. Some BNF is not related to harvested yield (the undersown ley and post-harvest ley). Both of them has been estimated to be 20 kg/ha BNF.
As for the grassland, nitrogen input is quite low. Beside of 5 kg/ha nitrogen from atmospheric deposition there is 5 kg/ha nitrogen from BNF (yield level is about 1000 kg/ha d.m.), which makes 10 kg/ha primary nitrogen in total. As for the system average, primary nitrogen is 15.5 kg/ha.

All harvested crops are used as a fodder inside the farm. Total harvested N-yield is 20.5 kg/hain average, whereas for crop rotation area 47.9 kg/ha. From total harvested N-yield about 12 kg/ha is left in the farm as FYM. This can be spread preferably to one crop in a 5-year crop rotation. Evaluation of nitrogen flows in beef model is presented in Table 2.

Table 1. Crop rotation, yields (dry matter and nitrogen) and BNF in the beef production model.

		legume	non-legume	N-legume	N-non-legume	N-harvested	BNF
		(d.m. kg/ha)	(d.m. kg/ha)	(%)	(%)	(N kg/ha)	(N kg/ha)
1. barley (ley u.s.)	barley+glover-grass		1400	3,5	1,75	24,5	20
2. ley	red clover+grass	1600	1800	3,5	1,5	83	80
3. ley	red clover+grass	1400	1800	3,5	1,5	76	70
4. winter wheat	wheat	0	1500	0	2	30	20
5. oats	oats	0	1300	0	2	26	0

Table 2. Evaluation of nitrogen flows in beef model

	Crop rotation	Grassland	System average (crop rotation+grassland)
Primary nitrogen, p (N kg/ha)	43,0	10	15,5
Secondary nitrogen, s (N kg/ha)	24,0	10	12,3
Total N input to the field = p+s	67,0	20	27,8
Circulation factor, c = (p+s)/p	1,56	2	1,80
N-yield, y (N kg/ha)	47,9	15	20,5
N surface balance = (p+s)-y, (N kg/ha)	19,1	5	7,3
N surface efficiency, S = y/(p+s)	0,72	0,75	0,74
Primary efficiency, P = y/p = c x S	1,11	1,50	1,32

Conclusion

The average primary nitrogen in the model is 15.5 kg/ha (43 kg/ha for crop rotation area and 10 kg/ha for grassland), whereas the N surface efficiency is 0.74 and primary efficiency 1.32. N surface balance for system average is 7,3 kg/ha, whereas it is 19,1 kg/ha for crop rotation area and 5 kg/ha for grassland. N surface balance is much lower compared to Estonian average of conventional farms (34.5 kg/ha; ARC, 2012).

There is a balance between the number of animals and area for production (crop rotation and grasslands).

The model shows that low input beef production in ERA system is efficient and helps to reduce nitrogen losses and at the same time is suitable for production of high quality beef.

References

Seuri, P. 2013. Efficient nutrient utilization by ecological recycling agriculture (ERA) – farm model.

ARC. 2013. On-going Evaluation of Axis II of Estonian RDP 2007-2013. Report of 2012. http://pmk.agri.ee/pkt/files/f32/PMK_pysihindamisaruanne_2012_kohta_030613_lisadega.pdf.

3.1.3 Cereal production model integrated with egg and meat production, Sweden

Artur Granstedt

Introduction

The main principles of ecological recycling agriculture (ERA) – the recycling of nutrients, integrated production of crops and animals and a high level of self-sufficiency – also characterize cereal crop production.
The following is an overview of the basic production following ERA-principles and nutrient flows, based on the data from a Swedish ERA cereal production farm.
The nutrient flow model presented is a generalization that characterizes an average ERA cereal farm that produces bread grain for sale and fodder grain for the farms own monogastric animals.

Material and methods

Crop rotation and yields are based on data from an ERA-farm. The data have been adjusted to represent the average Swedish ERA farming system (Granstedt et al 2008).

Farm description

The ERA-farm in this study is located in Central Sweden, about 20 km north of Uppsala. In this part of Sweden specialised crop production, introduced in Central Sweden during early 1960 to 1970, is typical. The soils are heavy clay soil.

This farm was included already in the BERAS the project between 2003 – 2005 and documented as farm number 12 (Granstedt and Thomsson. 2005). The farm has now about 170 hectares of agricultural land, ten ha of which is permanent grassland and not included in the crop rotation. During the study period 2003 - 2004 the farm had 79 ha under production, 6 sucking cows with calves, 8 sows and 1000 layer hens. Today the number of layers has been reduced to 400, the sows increased to 10 and the number of ruminant animals has increased.

The main crop rotation followed over the long term: 1) barley (under sown), 2) ley, 3) ley, 4) winter or spring wheat, 5) oat, 6) peas or faba bean, 7) rye. Most of the fodder needed is produced on the farm, although additional fodder for the layers hens is purchased (Figure 1) as are some seeds, salt and minerals.

Plant nutrient balances

The methods for calculating nutrient balances follow those described in earlier publication (Granstedt, 2000; Granstedt et al. 2004). The differences between input and output of plant nutrients is defined as surplus of plant nutrients and is the same as potential losses. In the farm gate balances the total surplus and potential losses are included including losses from manure before application on the field. In the field balances only the surplus and potential losses on the fields are included and calculated according to the program used by the Swedish Board of Agriculture to calculate plant nutrient balances (STANK in MIND) (Jordbruksverket 1998, 2008).

For the calculation of the farm gate efficiency, surface efficiency and primary nutrient efficiency actual farm data was used (Seuri, 2002 and Seuri 2013). The calculation of the biological nitrogen fixation (BNF) has been done according to the STANK model developed for the actual farm. The generalised farm model was also adopted to the Seuri calculation model (20013). In this BNF = A*B*1/C where A is the average total content of N in legume biomass (A=3.5%), B is the proportion of fixed nitrogen in legume biomass (B=70%) and C is the proportion of harvested biomass to total biomass of legumes (C=50%). The result of this calculation was 4.9 kg BNF/100 kg harvested legume yield (d.m.).

Yield and legume content in the 7 year crop rotation was calculated based on farm data and the nutrient balance calculations for this farm for the period 2003-2005 (Granstedt, 2005).

3. ERA farm model from different production lines and countries
3.1.3 Cereal production model integrated with egg and meat production, Sweden

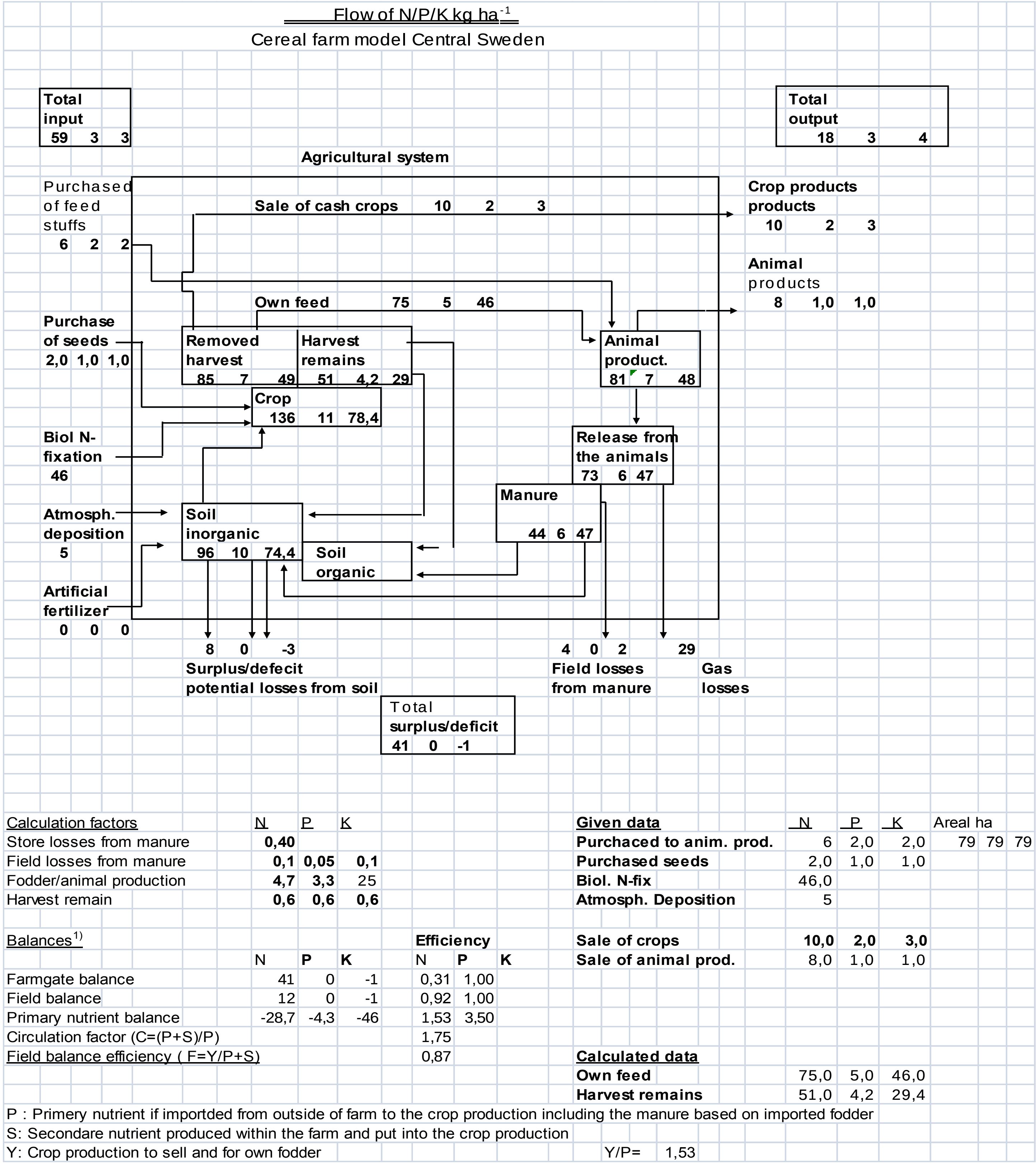

Figure 1. ERA cereal-farm-model Central Sweden.

Crop		legume (d.m. kg/ha)	non-legume (d.m. kg/ha)	N-legume (%)	N-non-legume (%)	N-harvested (N kg/ha)	BNF* (N kg/ha)
1. barley (leyu.s.)	Barley +glover-grass		3500		1,6	56	20
2. ley	red clover + grass	4100	1400	3	1,4	143	114
3. ley	red clover +grass	3600	1900	3	1,5	137	106
4. summer wheat	wheat	0	4500	0	1,7	77	0
5. oats	oats	0	3000	0	1,7	51	0
6 legume/ grain		2800	0	3		84	81
7 Ray			3000		1,6	48	0
Average						85	46

*) Calc. according to STANK

Table 1. Crop rotation, yields (dry matter and nitrogen) and BNF in the cereal production model in ERA agriculture

Results

The calculated nutrient flows for the cereal-farm model are presented in Figure 1.Crop rotation and total yields are based on the data of the actual ERA-farm during study period . The total harvested production of N was 85 kg per ha and year. This was 10 % higher than the average ERA agriculture in Sweden which was 76 kg kg N per ha and year (Granstedt et al 2008). The generalised calculations for each year are presented in Table 1.

Not all the nitrogen that is biologically fixed is related to the harvested yield (e.g. the under sown ley). This has been estimated to be 20 kg N/ha and year. The BNF during this 7-year crop rotation was calculated to 46 kg N/ha and year. In addition to the BNF, 5 kg N/ha from atmospheric deposition has been added

Most of the harvested crops are used as fodder on the farm. Total annual harvested N-yield is 85 kg N /ha in average. From the total annually harvested N-yield about 12 kg/ha is left on the farm in the form of farm yard manure (FYM) which can be spread preferably on one crop in the 7-year crop rotation.

The nitrogen flows in the cereal farm model are presented in Table 2 and compared with the Swedish ERA average and the average for the whole of Swedish agriculture according to results presented in the BERAS studies between 2003 to 2006 (Granstedt, 2005 and Granstedt et al 2008).

The nitrogen yield level in the model farm is 5% lower than the Swedish average and the average for all the studied BERAS farms is 15 % lower than the Swedish average. This difference is somewhat higher if measured in terms of energy content of yield (dry matter). Ley yields are almost equal to the Swedish average, with a difference of 1 percent/year 2010 (SCB, 2011). This is similar to results from Finnish studies. Grain yields

	Model average	Swedish agriculture ERA average	Swedish agriculture average
Primary nitrogen, p (N kg/ha)	54	54	101
Secondary nitrogen, s (N kg/ha)	41	24	39
Total N input to the field = p+s	95	78	140
Circulation factor, c = (p+s)/p	1,75	1,45	1,38
N-yield, y (N kg/ha)	85	76	89
N surface balance = (p+s)-y, (N kg/ha)	12	12	51
N surface efficiency, S = y/(p+s)	0,92	0,93	0,64
Primary efficiency, P = y/p = c x S	1,53	1,38	0,88
Farm gate balance	41	37	84

Table 2. Evaluation of nitrogen flows in the farm model and comparison with average ERA farms and Swedish agriculture.

were about 25 % lower in the farm model compared to average conventional farms (SCB 2011). This difference is less than 40% lower average yield cited in official statistics (average for winter wheat, summer wheat and oats. For barley the difference is higher). The difference between the results from the studied ERA farms and average ecological agriculture in crop yields can be explained by the fact that several ecological farms are under transition and managed extensively without an optimized crop rotation.
The comparison of primary efficiency (Table 2) indicate that the farm model is about 70 % more efficient and the and the average ERA farm50 % more efficient in nitrogen utilization than the average Swedish farm i.e. primary nutrient efficiency in the model is 1.53, in the average ERA farms 1.38 and in average Swedish agriculture 0,88.

According to the law of diminishing returns, the efficiency in utilisation of nutrients decreases as the use of input increases (i.e. when production intensity increases). The average primary nitrogen use in Swedish crop production is 101 kg/ha whereas in the model and for the average ERA farms it is 54 kg/ha. However, this lower intensity in nitrogen use cannot alone explain the difference in N surface efficiency (0.92 vs. 0.64). The greatest difference in nitrogen flows between the model and average Swedish agriculture is the source of nitrogen. In the farm model the main source of nitrogen is biological nitrogen fixation whereas in conventional Swedish and Finnish (Seuri 2013) agriculture and in other similar countries dominated by industrialized agriculture it is nitrogen fertilizers. The utilization efficiency of biologically fixed N is very high since almost all is related to harvested yield.

Conclusions

The lower input/output ratio of the studied ERA cereal crop farm model and the average ERA farms results in both higher efficiency and lower surplus and potential emissions of nitrogen to the environment compared to average Swedish agriculture. The farm gate balance surplus is 41 and 39 compare to 84 kg N per ha and year for average Swedish agriculture.

References

Seuri, P. 2013. Efficient nutrient utilization by ecological recycling agriculture (ERA) – farm model. This report.

Seuri, P. 2002 Nutrient utilization with and without recycling within farming systems. In: Urban areas – rural areas and recycling – the organic way forward? / eds. Jakob Magid et al. DARCOF Report 3: 175-181

Jordbruksverket, 2008. Manual till kalkylprogrammet STANK in MIND.

Jordbruksverket, 1998. Statens jordbruksverks dataprogram för växtnäringsbalansberäkning. Stallgödsel och växtnäring i kretslopp (STANK), Jordbruksverket, Jönköping. (Plant nutrient balance calculation program)

Granstedt, A. 2005. Plant nutrient Balance Studies. In: Granstedt, Thomsson and Schneider (Eds), Environmental Impacts of Eco-Local Food systems – final report from BERAS work Package 2. Beras report 5. Ecological Agriculture report 46. Centre for Sustainable Agriculture. Swedish University of Agriculture Sciences. Uppsala.

Granstedt, A., Schneider, T., Seuri, P. and Thomsson, O. 2008. Ecological Recycling Agriculture to Reduce Nutrien Pollution to the Baltic Sea. Journal Biological Agriculture and Horticulture, 26(3) 279-307

Granstedt, A., Seuri, P. and Thomsson, O. 2004. Effective recycling agriculture around the Baltic Sea. Background report. Beras report 2. Ecological Agriculture report 41. Centre for Sustainable Agriculture. Swedish University of Agriculture Sciences. Uppsala.

3.2 Developing of sustainable organic pig growing in Poland

Jozef Tyburski, Jaroslaw Stalenga, Jerzy Kopinski, Pawel Parowicz

Conversion to organic pig production

In general organic pig and poultry growing demands high grain on-farm production. In consequence, the proportion of cereals in crop rotation tends to be high. From an environmental point of view cereals are crops which deplete humus from soil and degrade soil structure. Therefore in a crop rotation they must be altered with crops which improve humus balance in the soil and improve soil structure. The most efficient for this purpose are perennial legumes. Although the pig farm which we describe below has to have 7 ha of permanent pastures and keeps only 4 cows, it grows more than 10 ha of red clover with the aim to improve N supply and soil conservation. As an additional source of income the farmer harvests 2-3 t of red clover seeds, while the clover straw is incorporated in the soil.

Description of J. Plotta's pig farm

The farm is located in north Poland some 30km south of Gdansk. The total utilized agricultural area (UAA) is 72 ha. Low quality sandy soils predominate (average value ca. 28 points in a 100 point scale) and too low precipitation to meet needs of most crops grown (especially in spring time). The countryside is denuded and soil contains lots of stones, which make mechanical cultivation of row crops more difficult.

The content of available plant nutrients in soil is rather good in P, but the content of K is low to very low. It means that in order to receive good yields the farmer has to use complementary mineral K fertilizers to meet crop demands (e.g. red clover cannot withstand winter time, N fixation is low and grain maize does not form grains at upper part of the cob) and to make crops more resistant to dry periods. The pH values are between 4.1 and 6.1 and on prevailing area are much too low. Regular liming of subsequent fields was initiated in 2012. The family-run farm is specialised in pork production.

Photograph 1. Free range pig raising system at Plotta's family farm.

The conversion process

There have been a few reasons to convert the farm from conventional to organic farming. Before the conversion the farm was run intensively producing cereals for pigs feed. Because of the low quality soils high inputs (mineral fertilizers + synthetic pesticides) did not produce very high yields (3.5 t of cereals per ha) and pork prices were low, so the production was not profitable. Pigs were raised in a close cycle (40 sows) and kept in a building with no bedding system. Utilization of slurry was a big problem resulting in contamination of waters of a small lake bordering the farm's land. Mr Plotta participated in some organic courses and finally decided to convert to organic farming system in 2005, hoping that lower inputs plus state subsidies for organic production would help to increase economic returns, but also to improve working safety (no contact with pesticides) and the environment. For many years he was developing his production method alone and in 2012 he joined BERAS project as a Beras Information Centre (BIC) farm. At the time he was already in a process of improvement of his organic production methods (changing pig race and pig free range system from keeping them in a forest to a clover pasture). Thanks to co-operation with a new adviser he also changed substantially his crop production – paid much more attention to soil chemical properties and improved them by mineral fertilization and liming, replaced some crops and crop rotation system).

Specification	Data for:		
	2004*	2011	2012
No of sows	40	30	12
No of piglets weaned per 1 sow per year	19	12	20
No of weaners sold	-	272	-
No of heavy hogs sold	**684**	**58**	**240**
Days from birth to selling	180	240	-
Mean live weight of heavy hogs, kg	**105**	**105**	**145**
Total live weight sold, t	**72**	**13****	**35**

* last year of conventional management ** including total live weight of weaners

Table 1. Pig production in the last year of conventional farming and in the years of substantial improvement of organic rearing (2011 and 2012).

Changes in pork production

The year 2004 was the last one of intensive conventional production. They were 40 sows kept and 684 heavy hogs sold yearly (table 1). Pigs were fed with farm produced fodder enriched with purchased protein concentrate. In 2011 there was not big decline in no of sows kept (by 25%) and dramatic decline in sold pigs. First of all, it was clear that the Polish pig cross-bred of the Large White Polish x Polish Landrace (WBP♂ × PBZ♀) was not the right one for free range system (phot.1). One of the main problems was low no of piglets weaned per 1 sow – it dropped from 19 to 12 (37%). The farm was close to be bankrupt. It made him to take part in a special course of pig rearing in Denmark. Finally keeping in mind Danish experiences he switched from the Polish to Danish breed Danhybryd x Duroc. Although it was not easy to start (costs of import of young sows, plus half a year feeding without production), it was a very good decision. After the change of breed no of weaned piglets increased from 12 to 20 (the later result is better than achieved during the conventional production). In general, there was a dramatic decline in live weight of pigs sold – from 72 t in 2004 to 13 t in 2011. And in 2012 the buyer demanded finishers to be kept not to 105 kg of live weight but to 145kg. Despite this in general, in 2012 a quite good improvement was observed thanks to change in breed and pasture (from forest to clover pasture) the live weight of sold pork increased to 35 t in 2012 (which is still half of the production during the conventional management). But it is believed that thanks to the changes in crop growing, own grain production will substantially go up leading to increased volume of pork production.

One of the main problems was feed shortage. In table 2 the volume of the bought in feed is shown. The plan is to be self-sufficient in fodder. One has to remember that organic farms usually relies on own seeds for drilling and that means that in the case of Plotta's farm ca. 13% of grain harvest was not utilized for feed and in the period of conventional production 100% of seeds were bought. It is worth mentioning that changing of pig rearing methods positively affected their health – costs of veterinary treatment dropped dramatically.

Specification	Data for:		
	2004*	2011	2012
Cereals grain, t	20	12	10
Pulse seeds, t	-	10	8
Mineral supplements, t	3,5	1,5	1,5
High protein concentrates, t	15	-	-
Costs of veterinary treatment, €/herd/year	1 700	12	12

* last year of conventional management

Table 2. Feed purchase during conventional and organic pig rearing.

Changes in crop production and self-sufficiency in fodder

During conventional management mainly winter triticale was grown. After conversion it was clear that on poor soils it is not easy to meet fertilisation demands of the crop so its growing was stopped. One of the main crops was blue lupine being a major source of protein for pigs, but after outbreak of anthracnose (Gloesporium sp.) its yields dropped from almost 2 t per ha to 0.5 t per ha, so it did not make any sense to grow it any more (table 3). So as one might see no pulse crops were grown in 2011. As a consequence in that year 100% of pulses were purchased (table 4). In 2012 the farmer successfully started to grow soybean – he harvest over 2 t of seeds per ha. In 2013 soybean acreage was increased to 4.5 ha and as yields are very promising it is believed that self-sufficiency in protein will be reached (table 4, 5, photo 2).

There are also changes in cereal production. The main one is introduction of grain maize. It was first introduced in 2012 (along with soybean) on experimental scale of 2.2 ha. The yield was very high – ca. 8.5 t of grain per ha (and the average grain yield of other cereals grown on the farm was 1.9 t per ha). Therefore it was decided to increase acreage of grain maize to 6.5 ha in 2013 and in the coming years to ca. 12-14 ha (one field in a 5-course crop rotation). Also this year (2013) maize grows remarkably well, so it is believed that self-sufficiency in cereals will be reached (table 5).

Livestock density during conventional management was higher than it is acceptable in organic farming (table 5). It is worth noting that it was reached not only due to intensive fertilisation but also due to feed import (both grains and proteins). In a critical 2011 livestock density dropped 4-times, but after adjustments both in animal and crop sector of the farm, it was possible to increase livestock density to 0.94 LU per ha. It is assumed that this density is appropriate and it is not planned to increase it.

Specification	Data for:			
	2004*	2011	2012	2013
Winter triticale	40	-	-	3,5
Winter rye	-	26	-	4.5
Cereals mix	11	-	21	18.5
Spring wheat	-	2.5	3.2	-
Grain maize	-	-	2.2	6.5
Buckwheat	-	-	-	2.5
Cereal / pulses mix	-	21	17	12
Total cereals	**51**	**49.5**	**43.4**	**47.5**
Blue lupine	14	-	-	-
Soybean	-	-	0.5	4,5
Total pulses	**14**	**0**	**0.5**	**4.5**
Red clover	-	14.5	21.3	13
Total pulses and legumes	**14**	**14.5**	**21.8**	**17.5**
Total arable land	**65**	**64**	**65**	**65**
Permanent pasture	7	7	7	7

* last year of conventional management

Table 3. Changes in arable land cropping structure, ha

Specification	Data for:			
	2004*	2011	2012	2013
Winter triticale	140	-	-	6
Winter rye	-	30	-	5
Cereals mix	40	-	38	45
Spring wheat	-	6	9	-
Grain maize	-	-	16	43
Buckwheat	-	-	-	3
Cereal / pulses mix	-	43	25	18
Total cereals	**180**	**79**	**88**	**120**
Blue lupine	25	-	-	-
Soybean	-	-	1	10
Total pulses	**25**	**0**	**1**	**10**
Purchased grains	20	12	10	0
Purchased pulses	15**	10	8	0
Purchased seeds for drilling	12	-	1	0,3

* last year of conventional management ** high protein concentrates

Table 4. Changes in volume of harvested crops, t

Years	Cereals, %	Pulses, %	Legumes, %	Imported cereals/pulses, %	LU per ha
2004*	78	22	0	10 / 38	2,03
2011	77	0	23	13 / 100	0,50
2012	67	1	32	10 / 89	0,94
2013	73	8	19	0 / 0**	0,94

* last year of conventional management ** protein concentrates

Table 5. Cropping structure of arable land, share of purchased cereals and pulses and livestock density.

Photograph 2. Soybean plantation in July 2012 on Plotta's farm.

Conclusions

Feed self-sufficiency of the farm was fluctuating. Thanks to the introduction of new crops (soybean and grain maize) it was possible to resign form purchasing grains and proteins. Livestock density was also fluctuating. From being too high during conventional management, it dropped 4 times in a critical 2011 year. Thanks to adjustments both in animal and crop sector livestock density rose to 0.94 LU per ha, which is assumed to be right one. It should be added that during conventional management the lake bordering farm fields was seriously eutrophicated, and thanks to organic management it is now clear enough to be used for swimming by the local community.

References

Granstedt A., Tyburski J., Kooker W., Stalenga J. 2007: Zagrożenie Bałtyku eutrofizacją w świetle bilansu składników pokarmowych [The danger of Baltic See eutrophication in the light of farm nutrients balance]. Fragmenta Agronomica 3(95): 126-135.

Kirstensen I.S., Kirstensen T. 1997. Animal production and nutrient balances on organic farming systems. Resource use in organic farming: 189-202.

Tyburski J., Parowicz P., Obremski K. 2010: Fattening of organic pigs fed with on-farm vs. industrial palletized organic feed. Pollution and organic aspects of animal production. Monograph. Cracow: 105–119.

4. Impacts of ERA farming

4.1 (INCA-) Model description

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The INCA-N (Integrated Nutrients from Catchments – Nitrogen) model (Whitehead et al. 1998, Wade et al. 2002, Wade et al. 2004) is a process-based and semi-distributed model that integrates hydrology, catchment and river N processes to simulate flow and daily concentrations of nitrate-N (NO3-N) and ammonium-N (NH4-N) in the river system. It has been applied in many European catchments with different ecosystems and used e.g. for scenario analyses investigating the impacts of deposition, climate and land-use changes on N dynamics at catchment scale.

The catchment can be divided into sub-catchments. INCA-N simulates key terrestrial N processes (nitrification, denitrification, mineralization, immobilization, N fixation and N uptake) in six land use classes. Fertilizers and N deposition constitute the N inputs to the land use units. INCA-N does not model N transformation processes in soil organic matter in detail, for instance different decomposition rates of fresh and more stabilized crop residues are not included. However, by varying the mineralization rate coefficients the intensity of management practices (e.g. tillage) or manure application (higher content of organic matter) can be taken into account for different crops. Rate coefficients of N processes are temperature- and moisture-dependent. N processes in the river include nitrification and denitrification.

All catchments were divided into sub-catchments for the INCA-N model application. For this study, the calibration periods were 2003–2009. Calibration of N transformation processes in catchment soils of different land use types was based on information about current agricultural practices (e.g. fertilizer and manure application, yield rates) of different crops (conventional farming, Baseline case). This information was available from a farmer interview study, which analyzed the environmental impacts of the Finnish agri-environmental support scheme (Mattila et al. 2007). In all catchments, the five agricultural crops included winter and spring cereals, green fallow, grass and a special crop. Cultivated winter cereals were winter wheat (Triticum aestivum L.) and winter rye (Secale cereale L.); spring cereals were barley, spring wheat and oat. Grasses and green

4. Impacts of ERA farming
4.1 (INCA-) Model description

fallow typically consist of mixtures of different grass species. In Lepsämänjoki the special crop was cabbage and in Lestijoki potato. Fertilizer amounts of different crops were set according to allowed maximum levels defined in the agri-environmental program, e.g. 100–120 kg N ha-1a-1 for spring cereals. Next, a theoretical crop rotation was developed to represent potential ERA crops and cultivation practices in the study catchments. It was assumed that crop production and animal husbandry are integrated in the catchments. The crop rotation (five years) was assumed to consist of leys (including red clover Trifolium pratense L, capable of biological N fixation), cash crop (barley, sold out from the farm), mixture of barley and pea (Pisum sativum L.), and a fodder cereal (barley, undersown with ley). As INCA-N does not model individual fields, it was assumed that during each year all five crop types were cultivated, each of them covering 20% of the total field area. N fixation and soil N mineralization were assumed to provide sufficient N for all crops except for fodder cereal which was assumed to receive cattle manure in spring. It was assumed that animal husbandry is based on cattle, as they utilize effectively leys as fodder. Values for N fixation and mineralization were based on Finnish field studies about N dynamics of organic farming (e.g. Nykänen 2008). The N fixation rate was assumed to be highest (100 kg N ha-1) during the first year of the rotation (red clover + timothy Phleum pratense L.). On average, the number of feed units (FU) during the crop rotation was 2248 FU ha-1a-1, as estimated by the yield of different fodder crops. This corresponds to 0.45 AU ha-1. In Lepsämänjoki this was much higher (0.45 vs. 0.08 AU ha-1) and in Lestijoki lower (0.45 vs. 0.64) than in the Baseline case.

The crop parameters in the INCA-N model were modified to describe ERA crops and related N uptake, N fixation, soil N mineralization and manure application rates (ERA Scenario). Other model parameters and the hydrological input were similar to those in the Baseline case.

Agricultural phosphorus (P) losses were estimated by an empirical model (Ekholm et al. 2005), which is based on empirical equations to calculate P loss from different farming systems estimated from soil surface P balance. In ERA Scenario, inputs to the P model were based on applied amount of manure and crop yield, but current soil P status.

4.2 Results of plant nutrient balances on the studied ERA and BIC farms

Artur Granstedt

Plant nutrient balances

The methods for calculating nutrient balances follow those described in earlier publication (Granstedt, 2000; Granstedt et al. 2004). The difference between input and output of plant nutrients is defined as surplus of plant nutrients and is the same as potential losses. In the farm gate balances the total surplus and potential losses are included. This includes losses from manure before application on the field, according to the program (STANK in MIND) used by the Swedish Board of Agriculture to calculate plant nutrient balances (Jordbruksverket 1998; 2008). Farm gate balances for the BERAS Implementation farms have been calculated based on data collected on the farms for the years 2010 or 2011 in the partner countries.

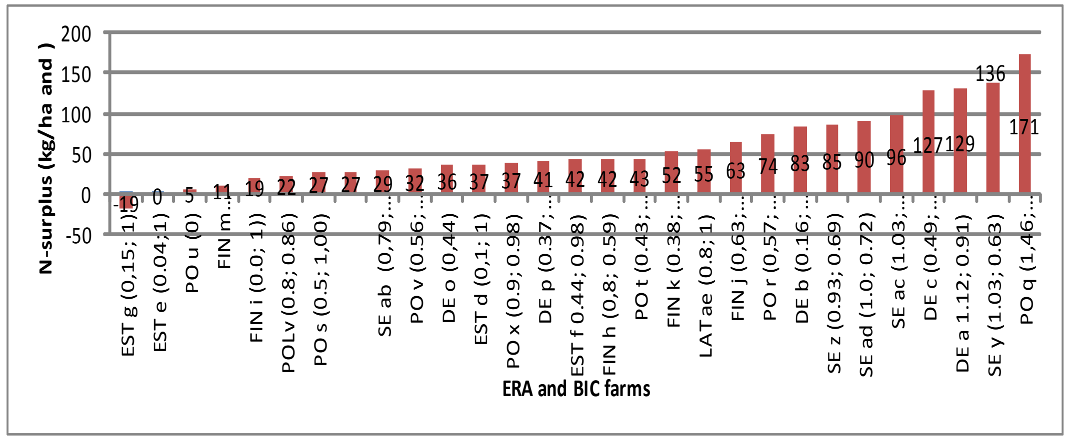


Figure 1 a. The average nitrogen farm-gate balance surplus for 29 studied ERA and BIC farms in the project BERAS implementation between 2010 -2012 sorted after farm gate N-surplus. Each individual farm specified with country code, farm code and, within brackets, animal unit per ha and rate of own fodder.

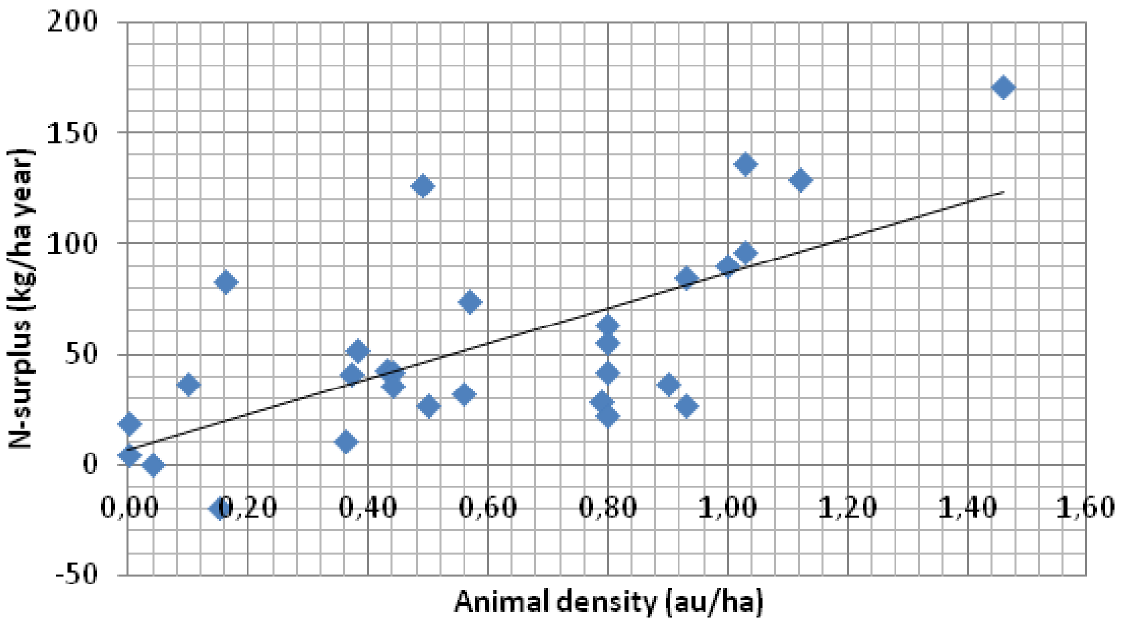


Figure 1 b. The average nitrogen surplus and animal density for the studied ERA and BIC farms in BERAS Implementation project based on farm gate nutrient balances 2010 and 2011. The line describes the nitrogen surplus for the farms as a function of the animal density (R2=0,45).

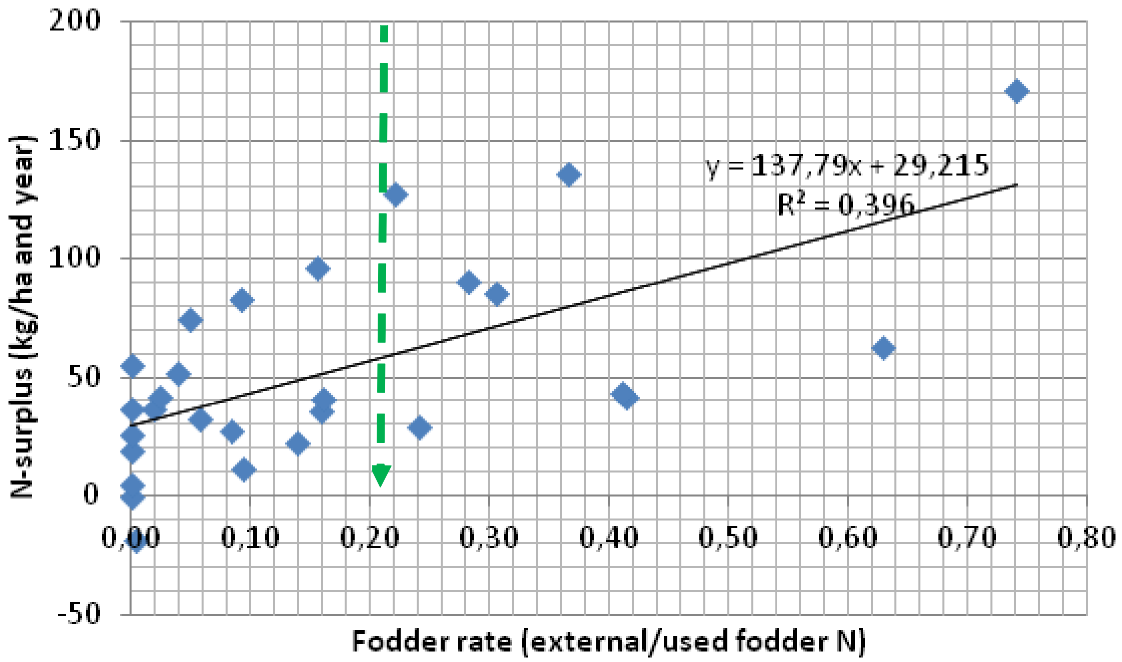


Figure 1 c. The average nitrogen surplus and animal density for the studied ERA and BIC farms in BERAS Implementation project based on farm gate nutrient balances 2010 and 2011. The line describes the nitrogen surplus for the farms as a function of the fodder rate external/ used fodder N (R2=0,4). The vertical line criteria for converted ERA farms (maximal 20 % external fodder), the farms on the right hand in the figure are yet under transition.

Results

The average annual nitrogen surplus on the 29 farms was 55 kg N per ha and year. It ranged between a value lower than zero for one extensive managed Estonian farm with 0,15 AU per ha and 136 kg N per ha and year for an ecological Swedish farm not yet converted to ecological recycling agriculture with an animal density of 1 AU per ha and only 63 % own fodder. The results presented in figure 1 aand1b describe the relation between animal density and surplus of nitrogen. The farms with an animal density lower than 0,8 animal unit per ha are, with an exception of three farms, based on 80-100 % own fodder. These three farms have cooperation with farms delivering clover grass fodder. In the case of Mykyla farm in Finland this is based on an agreement between the farmswith recycling of manure, as described in this report. The farm with a higher animal density and a surplus of more than 100 kg N per ha and year are still in the process of conversion. More details about the farms, including complete nutrient balances and descriptions of the internal recycling will be available on www.beras.eu.

4.3 ERA farming benefits biodiversity

Karin Stein-Bachinger

Impacts of agriculture on biodiversity

The diversity of species, genes and ecosystems is the basis for human life. A rich biodiver-sity plays a key role for sustainable farming systems, e.g. as natural pest regulation or polli-nation of fruit blossoms by insects (i.e. Pfiffner & Balmer 2011). Numerous soil inhabiting organisms (e.g. earthworms, bacteria and fungi) decompose organic matter into humus and maintain soil fertility. The diversity of locally adapted crop varieties and livestock breeds contribute to a healthy farm organism through a greater resistance to diseases and resil-ience to climatic stress.

According to Kristensen (2003) about 50 % of all European species are bound to agricultural land use. The segetal flora, usually referred to as weeds, would not exist without soil tillage. Some Latin names illustrate the relationship of ground breeding birds and segetal plants to arable farming, like *Alauda arvensis* (Skylark) or *Nigella arvensis* (Field Nigella) and *Lithospermum arvense* (Corn Gromwell). Therefore, farming practices have a major impact on species diversity of wildlife, the diversity of habitats in agricultural landscapes as well as on the genetic diversity of varieties and breeds.

During the last decades the increase in intensity and specialization in land use as well as the abandonment of extensively farmed habitats has led to a significant loss of biodiversity. The decline in biodiversity is among the biggest challenges, along with climate change, that we face today (BfN 2013). The European Environmental Agency assessed the status of biodiversity in 2010 (EEA 2010a) and concludes that 76 % of farmland habitats and 70 % of European farmland species have an unfavourable conservation status. Among many other declining populations, 36 of the common farmland bird and grassland butterfly populations have substantially declined in the last decades (EEA 2010b).

Although there have been a lot of activities worldwide within the last decades, the goal for 2010 to achieve a significant reduction of the current rate of biodiversity loss has not been met (CBD 2010). Within the International Year for Biodiversity 2010 governments agreed on a new Strategic Plan for Biodiversity within the period 2011-2020 (BfN 2013). The need to reconcile agricultural production and production-dependent rural livelihoods with healthy ecosystems has become more important than ever.

4. Impacts of ERA farming
4.3 ERA farming benefits biodiversity

Benefits of organic and ERA farming

Over the last 30 years, numerous studies have shown that organic agriculture makes a sig-nificant contribution to environmental protection (e.g. Hole et al. 2005; Bengtsson et al. 2005). These analyses of more than 70 scientific studies confirm that organically managed areas have on average 30 % more species and 50 % more individuals than non-organic areas. A literature overview including the positive effects on soil organisms is given in Stein-Bachinger et al. (2010). Because these results are not new, the conversion to organic agri-culture has long been recommended by policy makers (Stern 2003, FAO 2002).

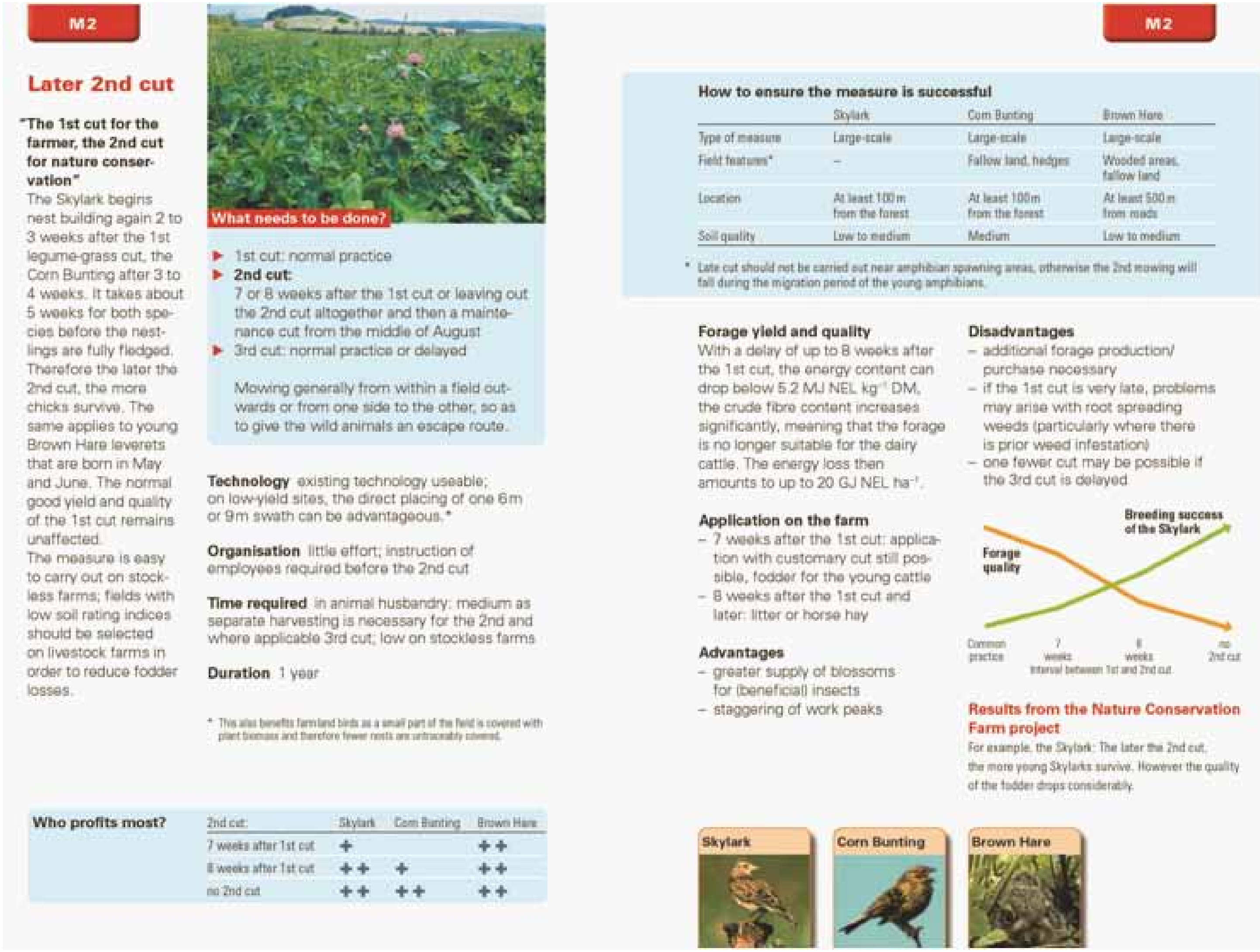
As ERA farming is based on organic farming including additional criteria (e.g. at least 30 % legumes in the crop rotation, balanced livestock/land ration and more than 80 % self-sufficiency in fodder and manure (Stein-Bachinger et al. 2013)), many features overlap ide-ally with nature conservation goals. For example, the preservation of soil fertility through various crop rotations at the same time also creates diverse habitats for wild animals. The renunciation of synthetic pesticides and mineral nitrogen fertilizers brings about crop stands in which segetal flora can also thrive well. Animal husbandry must match the fodder basis of the farm and therefore generally provides a rather low nutrient level, which fits very well with the habitat requirements of almost all of the typical animal and plant species in the ag-ricultural landscape. The integration of landscape elements not only promotes beneficial insects, but rather also offers food, cover and refuge to numerous other animals and plants.

Implementing nature conservation measures

As a result of increasing economic pressure, there has also been a trend towards intensifi-cation and specialization in organic farming. Examples are the continual improvement of mechanical systems for weed control and the early and frequent utilisation of arable fodder, meadows and pastures. This may lead to objectives conflicting with nature conservation. Thus, the first nationwide 'Nature Conservation Farm' long-term research project (2001-2008), in cooperation with the demeter farm Ecovillage Brodowin, addressed deficits in or-ganic farming and landscape conservation whilst reducing points of conflict between eco-logical and agricultural goals (Stein-Bachinger et al. 2010). The farm Brodowin is one of the German BERAS Implememtation Centres for regional Sustainable Food Societies (SFS) (www.brodowin.de, www.beras.eu).

The fact that targeted nature conservation measures are highly effective in organic farming because of their proven valuable preconditons was used when focusing on improving the living and reproductive conditions of typical farmland species (farmland and hedgerow birds, amphibians, insects, mammals and segetal flora). The impact of modified farming procedures on target species and simultaneously on plant production (yield and quality) and economic parameters (cost benefit analysis) was examined. Compromises between the demands of nature conservation and the fundamental principles of organic farming have been worked out within the context of the whole farm organisation (Stein-Bachinger & Fuchs 2012).

As a result, a manual with concrete recommendations for action for farmers, advisors and authorities was compiled in cooperation with the end-users (Fuchs & Stein-Bachinger 2010). Twenty profiles of the measures describe how measures for the protection of species are to be implemented, how to estimate costs and losses incurred during implementation, and what advantages or risks arise for the farmer (figure 1). Measures like a higher or delayed cut in legume-grass or drilling gaps, delayed stubble breaking and blossom strips in grain crops or structural measures like field margins, buffer strips around water bodies to support wild fauna and flora are described.



M2

Later 2nd cut

"The 1st cut for the farmer, the 2nd cut for nature conservation"
The Skylark begins nest building again 2 to 3 weeks after the 1st legume-grass cut, the Corn Bunting after 3 to 4 weeks. It takes about 5 weeks for both species before the nestlings are fully fledged. Therefore the later the 2nd cut, the more chicks survive. The same applies to young Brown Hare leverets that are born in May and June. The normal good yield and quality of the 1st cut remains unaffected.
The measure is easy to carry out on stockless farms; fields with low soil rating indices should be selected on livestock farms in order to reduce fodder losses.

What needs to be done?

- 1st cut: normal practice
- **2nd cut:** 7 or 8 weeks after the 1st cut or leaving out the 2nd cut altogether and then a maintenance cut from the middle of August
- 3rd cut: normal practice or delayed

Mowing generally from within a field outwards or from one side to the other, so as to give the wild animals an escape route.

Technology existing technology useable; on low-yield sites, the direct placing of one 6m or 9m swath can be advantageous.*

Organisation little effort; instruction of employees required before the 2nd cut

Time required in animal husbandry: medium as separate harvesting is necessary for the 2nd and where applicable 3rd cut; low on stockless farms

Duration 1 year

* This also benefits farmland birds as a small part of the field is covered with plant biomass and therefore fewer nests are untraceably covered.

Who profits most?

2nd cut:	Skylark	Corn Bunting	Brown Hare
7 weeks after 1st cut	+		++
8 weeks after 1st cut	++	+	++
no 2nd cut	++	++	++

M2

How to ensure the measure is successful

	Skylark	Corn Bunting	Brown Hare
Type of measure	Large-scale	Large-scale	Large-scale
Field features*	–	Fallow land, hedges	Wooded areas, fallow land
Location	At least 100 m from the forest	At least 100m from the forest	At least 500 m from roads
Soil quality	Low to medium	Medium	Low to medium

* Late cut should not be carried out near amphibian spawning areas, otherwise the 2nd mowing will fall during the migration period of the young amphibians.

Forage yield and quality
With a delay of up to 8 weeks after the 1st cut, the energy content can drop below 5.2 MJ NEL kg^{-1} DM, the crude fibre content increases significantly, meaning that the forage is no longer suitable for the dairy cattle. The energy loss then amounts to up to 20 GJ NEL ha^{-1}.

Application on the farm
- 7 weeks after the 1st cut: application with customary cut still possible, fodder for the young cattle
- 8 weeks after the 1st cut and later: litter or horse hay

Advantages
- greater supply of blossoms for (beneficial) insects
- staggering of work peaks

Disadvantages
- additional forage production/ purchase necessary
- if the 1st cut is very late, problems may arise with root spreading weeds (particularly where there is prior weed infestation)
- one fewer cut may be possible if the 3rd cut is delayed

Results from the Nature Conservation Farm project
For example, the Skylark: The later the 2nd cut, the more young Skylarks survive. However the quality of the fodder drops considerably.

Figure 1: Profil of measures: Later 2nd cut in legume-grass (Fuchs & Stein-Bachinger 2010)

As a counterpart, the profiles of species provide information on habitat requirements, biology and threats, whereby both the advantages and potential conflicts of organic agriculture are explained. Information is additionally provided on the relevant crops, time periods and the most favourable locations for the species. It is also made clear which species or species groups especially benefit from the measure. This makes it possible for the user, according to his interests and the situation of the farm, to target suitable fields and where appropriate to select practical combinations of measures.

The proved optimisation strategies were used in a subsequent step to prepare a whole farm nature conservation plan. Rules to identify fields with a high potential (e.g. high territory densities or reproductive success, figure 2) for farmland birds, brown hare, segetal flora and amphibians are given in order to concentrate the implementation on these locations. The aim is to achieve the highest benefit for nature conservation with the least expenditure of effort by the farm. The scope of measures to be aimed at for

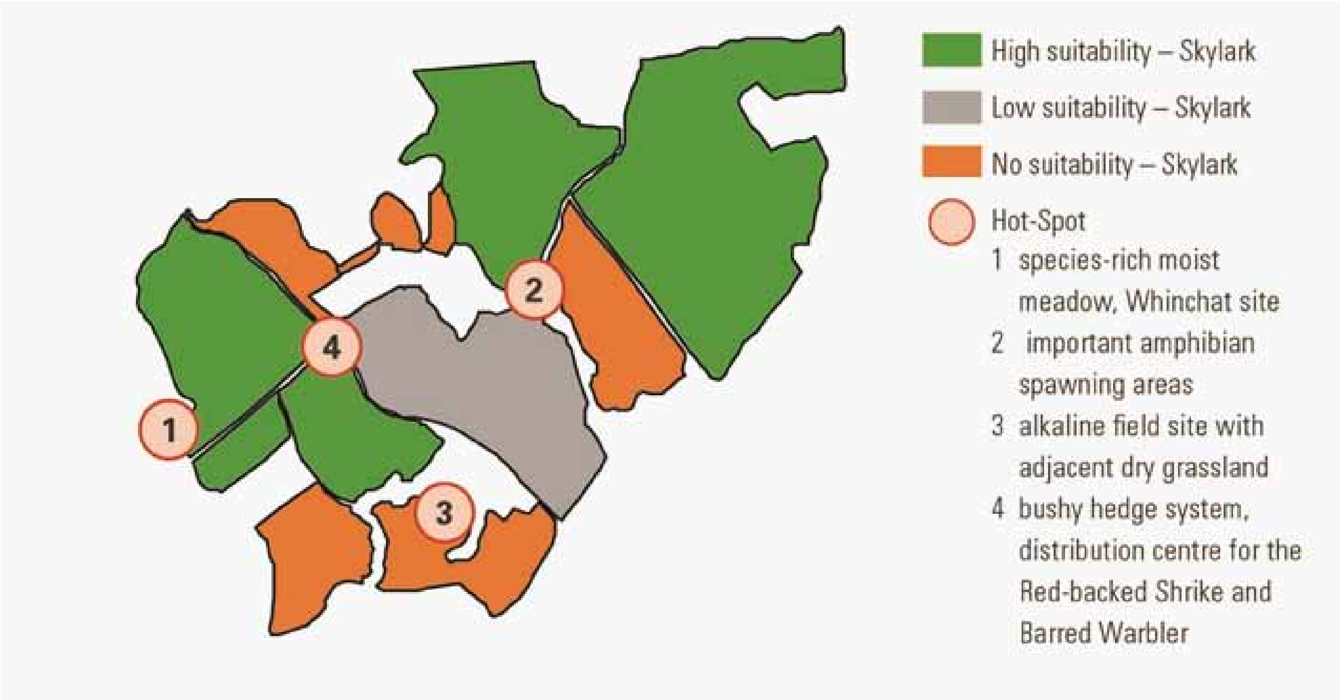


Figure 2: Biotic potential map and hot spots of the demeter farm Ecovillage Brodowin (ex-tract) (Fuchs & Stein-Bachinger 2010)

the whole farm is a target fig-ure of 10 to 30% of upgraded arable land (Fuchs & Stein-Bachinger 2010).

Since the end of the project phase in 2008, the farm Ecovillage Brodowin implements sev-eral measures every year and promotes itself with information boards for visitors, on the farms' website, and with newsletters for 1700 subscribers of the vegetable box scheme. Selected measures regularly are explained on the milk bags as well. Since 2011 further investigations together with organic farmers are performed to adapt the existing and develop additional measures for arable farming as well for grassland on a larger scale of more than 200 farms in different parts of Germany (Stein-Bachinger & Gottwald 2012).

Conclusions

According to our experience and that of other authors (Noe et al. 2005), a lot of farmers do not disagree with conservation criteria, but they often do not know what to look for and how to integrate modified production measures into their farm business. The manual (Fuchs & Stein-Bachinger 2010) as well as further investigations inlcuding the Nordic-Baltic-Belarus study (Reihmanis 2010) have shown that it is possible to farm for biodiversity while perform-ing in an economically viable manner in an increasingly competitive agriculture market. To combine and further develop the ERA farming approach with these initatives will contribute at a high extent to the nature conservation goals of 2020.

It can be foreseen that demands for the successful integration of conservation goals into farm management will increase across-the-board. As money is generally scarce, new strategies to increase the effectiveness of agri-environmental programmes will be neces-sary in the future. At the same time it will become more difficult for farmers to acquire suffi-cient knowledge of the complex biotic connections required. Therefore, developing and im-plementing a nature conservation consultancy will be a key step for the future. The estab-lished network of BERAS Implementation Centers (SFS) in 18 locations around the Baltic Sea can ideally serve as a starting point for the promotion of biodiversity issues in the long-term.

References

Bengtsson, J., Ahnstrom, 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.

CBD (2010): Secretariat of the Convention on Biological Diversity Global Biodiversity Outlook 3 – Executive Summary. Montréal, pp 12. www.dbd.int

EEA (2010a): Assessing biodiversity in Europe – the 2010 report. www.eea.europa.eu/publications/assessing-biodiversity-in-europe-84

EEA (2010b): Abundance and distribution of selected speices (SEBI 001). www.eea.europa.eu/data-and-maps/indicators

FAO (2002): Organic agriculture, environment and food security. Environ. Nat. Res. No. 4, FAO Rom.

Fuchs, S. & Stein-Bachinger, K. (2010): Nature conservation in organic agriculture: A manual for arable organic farming in north-east Germany. www.bfn.de, pp 144.

Hole, D. G., Perkins, A. J., Wilson, J. D., Alexander, I. H., Grice, F. & Evans, A. D. (2005): Does organic farming benefit biodiversity? – Biological Conservation 122: 113–130.

Kristensen, P. (2003): EEA core set of indicators: revised version April 2003. Technical report. EEA, Copenhagen. Cited in Herzog et al. (2012): Biodiversity Indicators for European Farming Sys-tems. ART-Schriftenreihe 17, p 9.

Noe,E., Halberg,N., Reddersen,J. (2005): Indicators of biodiversity and conservational wildlife quality on danish organic farms for use in farm management: A multidisciplinary approach to indicator development and testing. Jorunal of Agricultural & environmental Ethics, 18, 383-414.

Pfiffner, L. & Balmer, O. (2011): Organic Agriculture and Biodiversity. FIBL-order Nr. 1548, www.fibl.org

Reihmanis, J. (2010): Nordic-Baltic-Belarus solutions in farming for biodiversity. pp160. www.ldf.lv

Stein-Bachinger, K., Fuchs, S., Gottwald, F., Helmecke, A., Grimm, J., Zander, P., Schuler, J., Bachinger, J. (2010): Naturschutzfachliche Optimierung des Ökologischen Landbaus - "Natur-schutzhof Brodowin". Naturschutz und Biologische Vielfalt, Heft 40, ISBN 978-3-7843-3990-0, pp 409.

Stein-Bachinger, K. & Fuchs, S. (2012): Protection strategies for farmland birds in legume-grass leys as trade-offs between nature conservation and farmers' needs. Org. Agr. 2, Springer, pp 145–162.

Stein-Bachinger, K. & Gottwald, F. (2012): Neue Strategien zur Integration von Naturschutzmaß-nahmen in ökologisch bewirtschaftete Betriebe. Forschungsreport Ökologischer Landbau, SAG-Tagungsband, Konferenz der Senatsarbeitsgruppe im ZALF, Jan. 2012, 8-9.

Stein-Bachinger, K., Reckling, M., Hufnagel, J. & Granstedt, A. (Eds.) (2013): Ecological Recycling Agriculture - Guidelines for farmers and advisors. Vol. 1-4. Järna, Sweden, www.beras.eu

Stern, K. (2003): Überlegungen zu einem zukünftigen Agrarumweltprogramm. Ber. Ldw., 5-27.

4.4 Economical Consequenses

4.4.1 Economic perspective on ERA farming

Kauko Koikkalainen, Elina Nurmi, Maria Kämäri, Tanja Rajala, Kim Westerling and Pentti Seuri

Definition of ERA farming

Ecological Recycling Agriculture (ERA) is defined as an agricultural system, which is based on local and renewable resources, as well as the integration of animal and crop production (on each farm or farms in close proximity). ERA farming must comply with the EU organic production conditions, as well as a farm''s production which should be based on integrated crop and animal production; AU should be <0.75 ha-1, as well as the purchased fodder from outside of the farm should be less than 15 % (<0.15 EFR) of the total fodder amount (calculated from the nitrogen content of the fodder) (Granstedt et al. 2008). The intensity of the nutrients (nitrogen) in ERA farming is based on biological nitrogen fixation within the farming system(locally). In Finland it is based in particular on red clover leys. Utilizing grass fodder is limited in animals other than ruminants. Therefore, the base of ERA farming depends on the red clover grass farming and the use of ruminants, such as cattle and sheep (Saari 2013). Ruminants can also eat the lower value output fodder and take advantage of the grazing the areas outside of the actual farming area. The objective of the ERA farmingis more abundant yield/output than in current organic production relative to the farming area.

From the point of view of ERA farming, specialized organic crop production is inefficient because the utilized yield is low in relation to hectares used for farming. Especially in the current organic system based on green manure and cereals the area profit is small, if the green manure is used as a fertilizer for the following crop. From an economic perspective the financial results can be acceptable, because the economic result is not primarily dependent on the amount of the output, but the subsidies that are paid to the farmers. In EU agricultural policy the farming area-related subsidies have a significant importance in the farmer's income formation, especially at marginal farming areas which include Finland. The current subsidy policy strives to maintain the same subsidy levels within different crops. Thus, the farming areas such as green fallows have almost the same subsidy level as cash crops. The farming conditions are created with the help of the subsidies and the prices dictated by markets are driving the farmers to cultivate the crops which are currently in demand. In this case, the paid subsidy is not be considered to distort the markets.

4. Impacts of ERA farming
4.4 Economical Consequenses

Costs

In ERA agriculture more costs per product unit is incurred compared to specialized agriculture. This is because in specialized agriculture the farm can concentrate on aspecific field of know-how which is usually transferred into higher economic profits. In specialized agriculture the farm is able to invest in better technology which in turn increases the production level.

In the current business environment the farm might end up in a situation that low-quality crop harvesting is not profitable because the price of the yield is not enough to even compensate the costs of harvesting. Costs in beef production are particularly high, because the production is based on dairy cow breeds. Dairy cows compete for the same high quality fodder with chickens and pigs, but their biological efficiency of converting energy into meat is much lower. The situation is no different in ERA agriculture; harvesting low quality fodder is unprofitable when harvesting and energy costs are high. The only profitable solution to utilize low quality feed is through grazing/ pasture farming animals such as suckler cow, beef, or lamb. However, pasture farming has diminished, mainly because intensive production with high daily output (meat and milk) is much more competitive.

Income

The prices for agricultural commodities are determined in the global markets. Fluctuations in global market prices are quickly reflected in domestic market prices. This has an effect on the profitability in the agricultural sector in marginal areas. Therefore, in order to sustain production in marginal environment, such as Finland, different kinds of subsidies are needed to compensate for higher production costs. The price of specialty organic groceries, i.e. ERA products is not as easily influenced by the changes in global market prices as are the prices of bulk products.
For example, the cereal production subsidization system has led to a situation where it is more profitable to feed cereals to dairy cows than producing coarse feed. In consequence the relative proportion of coarse feed in dairy production has decreased. In the current subsidy system, economic returns from low quality harvest is the same as from non-cultivated areas (environmental fallows, green fallows, pastures, buffer zones..

In the ERA farming model the allocation of the cultivated areas would be defined by the quality of the soil and its ability to produce a variety of crops. Areas of low production potential are utilized for grazing and pasture whereas better areas are suitable for crops that are directly for human consumption. This kind of land allocation is suitable for organic system where the use external inputs are limited.

The economies of scale

The development in production technology has enabled the growth of the farm size. In plant production the work saving methods have had an effect on the possibility to cultivate larger areas with a smaller workforce. This is increased considerably the productivity of the workforce. A similar development is also evident in animal production. However, the economies of scale are still reachable in agriculture as the production technology is developing and the financing is forming. In the most important competitor countries the production units are noticeably larger when compared to Finland.

When shifting from intensive farming into versatile ERA farming the economies of scale are no longer valid. However, an ERA farm can still gain economics of scale and competiveness with certain products the amounts produced by the farm (or a group of co-working farms) are relatively substantial.

The advantages of specialization in production from the economic point of view are undisputed in the current cultivation systems. Nevertheless, one of thedisadvantages of specialization has been the loss of agricultural biodiversity and the eutrophication of water systems. The economic impacts are usually viewed from the perspective of production costs. Since the environmental costs have not been taken into account the specialization has been seen in a largely positive way. When converting from conventional to organic production the diversification of production is needed which inevitably leads to higher production costs. In addition ERA principles also involve the combination of crop and animal husbandry. When combining the two production lines, all economic benefits provided by the specialisation are being lost. Thus, to gain reasonable and profitable ERA production it is vital to look for co-operation between farms to gain farm units that are substantial enough.

Even though the Finnish agriculture is based on small farms and low profitability, the competiveness of a substantial farm can be poor because of the rapidly evolving multinational food markets. If combining the crop cycles and using common husbandry techniques builds on co-working ERA farms, competiveness and lower costs of production can be achieved. Due to a combination of building costs and labour – cost per unit is lower. Thus, groceries coming from organic ERA farms can be offered to the market leading companies where the buying is based on competitive bidding and large batches of products. Since the EU food market is very competitive, organic production has to use all these measures to maintain its market niche.

Production intensity

The intensity of production in ERA farming is slightly higher than usually found in organic farming, but lower than in conventional farming. The presence of animals in ERA farming improves the nitrogen use efficiency which enables this technique to achieve better yields compared to other forms of organic production. In this case the green manures are also needed less. The renewable and local resources, including recycled fertilizers and local markets, are preferred in ERA farming.

The essential objective of competitiveness in agricultural production is the reduction of production costs and the augmentation of production volume. The decline of production intensity is not closely related to this objective. Organic production is more expensive than conventional production because the costs are higher. The input of the farmer and the annual variations of yields make a large impact on the outcome. Therefore,the premium to cover the higher costs of the organic products should be derived from the market. There are several methods to improve the position of organic production in the growing and increasingly competitive EU markets. They include expanding the range of products, increasing the production volume and availability, as well as improving the quality of products. In this respect the ERA production could add some value.

Through specialization it is possible to achieve better know-how which can usually be seen in the economic outcome. The specialization enables farmers to invest in a more efficient technology, thus enhancing the production potenial.

4.4.2 The development of profitability in organic production compared to conventional production based on MTT farm accounting data in profitability

Pentti Seuri

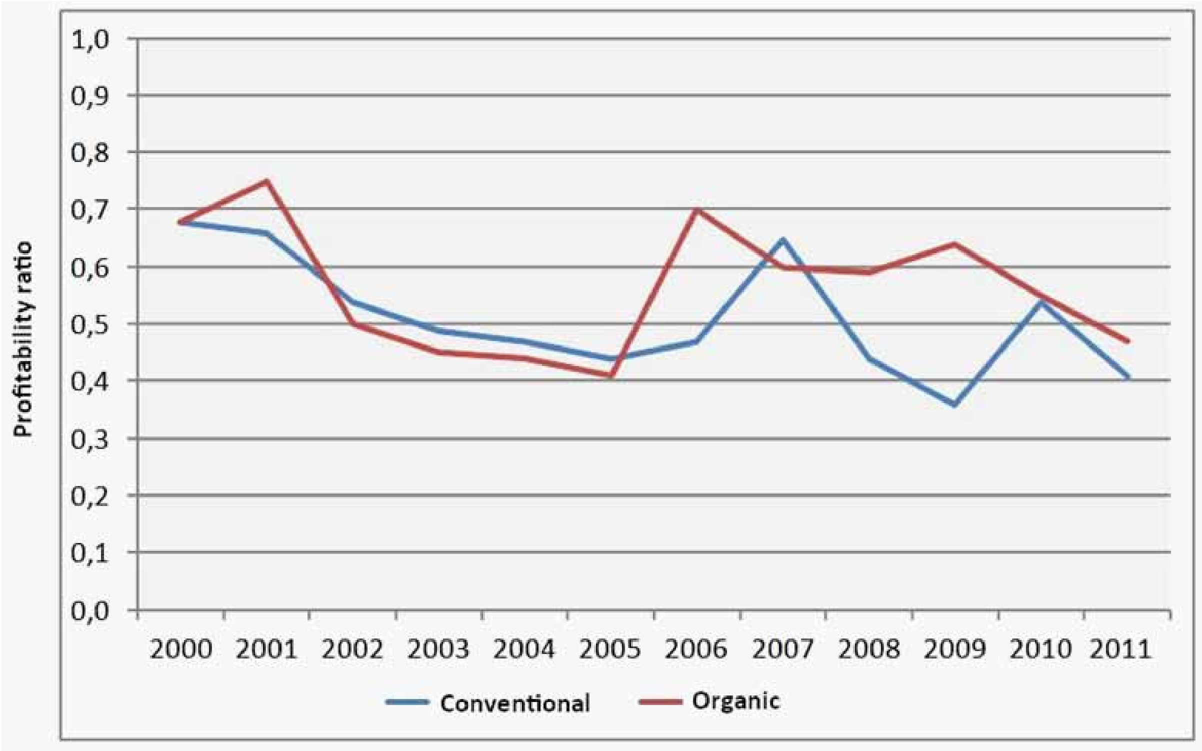


Fig. 1. The development of profitability of the conventional and organic production in the last decade

The profitability of agriculture has been declining throughout the 21st century in Finland. On average, the profitability has declined for both conventional and organic production. In the last few years organic production has been more profitable than conventional production on average (Fig. 1). The slightly better profitability in organic production can be explained by the higher prices of organic products, better subsidies, and about 15 % larger farm size in terms of cultivated area compared to conventional farms. The farm size is an essential part of profitability. The farm size has increased both in conventional and organic production. This alone has not been enough to keep the profitability at the same level, because input prices have risen faster than the prices received from the products in conventional farming.

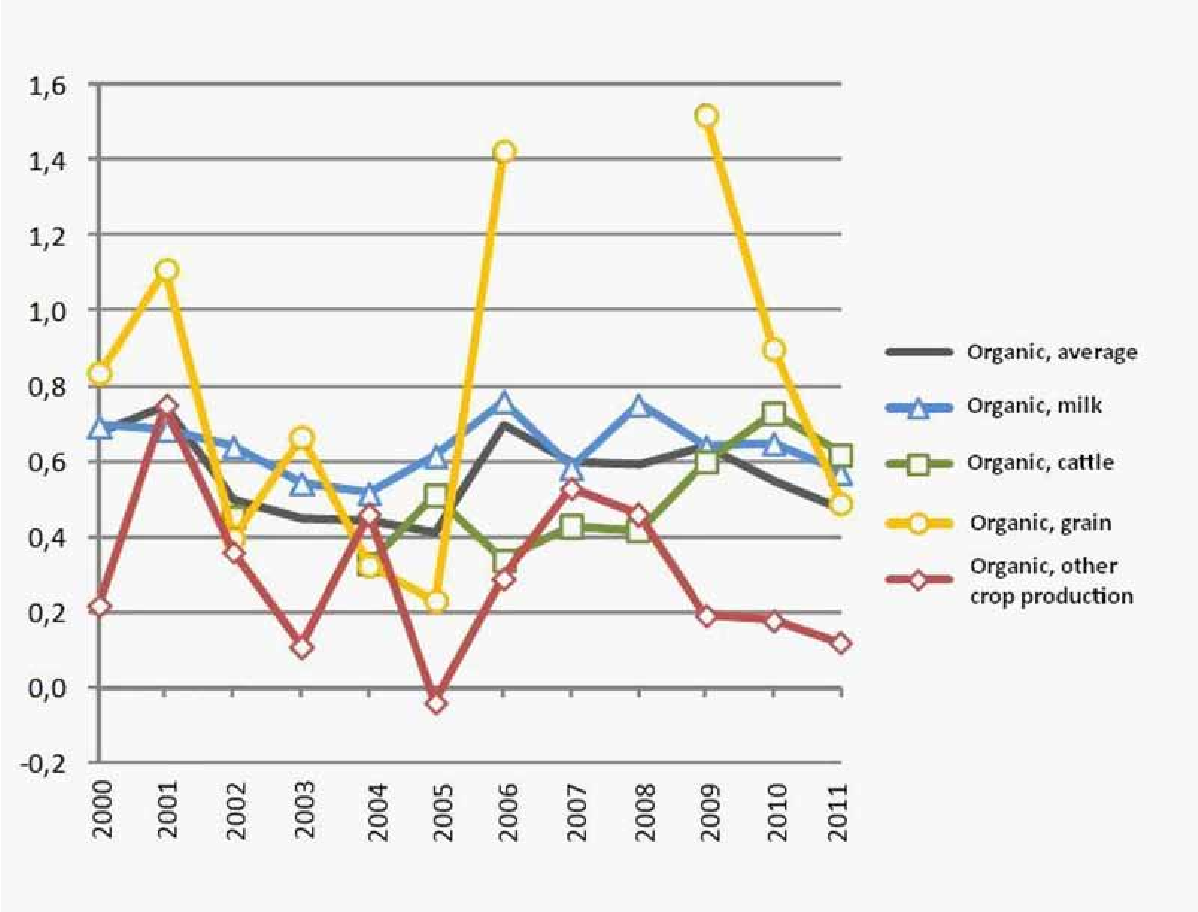


Fig. 2. The development of profitability in different production sectors of organic production. Organic milk, cattle and other crop production - groups comparable to ERA-production.

Sector-specific profitability analysis

From the point of view of the production sector profitability of organic milk production has been steady throughout this period (Fig. 2). The profitability coefficient has been about 0.6 which means indicates that the farm's work capital has been about a 60% remuneration of the set target (a 5% interest rate for the capital and about 14 euros for its own work hour). These targets have been exceeded only in organic grain production in three years. In the analyzed data, there have not been a sufficient number of organic grain producers in order to report the results for the years 2006 and 2007 (reporting limit is at least five farms). The good results in organic grain production can mostly be explained by the large size of grain production farms and in some years by good prices. In the groups "cattle production" and "other crop production" (representing mixed production sectors) profitability has been the weakest. These production forms are mainly ERA-production. However, in these production sectors the farm size was also the smallest, which partly contributes to the poor result in profitability.

4. Impacts of ERA farming
4.4.2 The development of profitability in organic production compared to conventional production

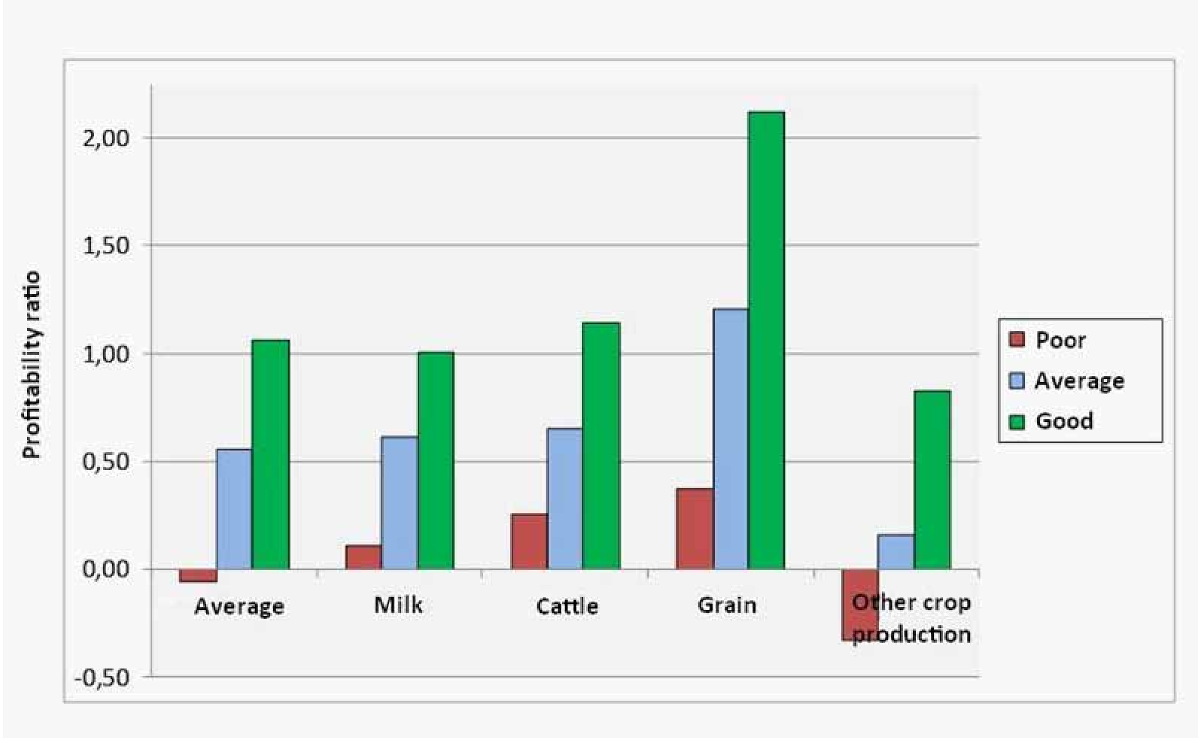


Fig. 3. Three years' (2009-2011) average profitability ratio of all Finnish organic farms (average, milk, cattle, grain and other crop production). Profitability is divided in to three profitability groups (poor, average and good).

Variation in profitability among organic farms

However, the average profitability analysis possibly gives too gloomy picture of the economics of organic production. When the data is grouped into three groups of the same size in terms of profitability (poor, average, and good), the picture is a lot brighter. In all other groups (excluding group "other crop production"), the most profitable third of the farms has reached the set profitability targets. Also the best third of group "other crop production" has reached close to the set targets. The best one-third of organic grain production has more than duplicated the set target. On the other hand the worst quartile has fallen away from the set target, and the worst-third of group "other crop production" has made a remarkable loss (Fig. 3).

4.4.3 The strategy of conversion into ERA system

Mariusz Matyka, Jerzy Kopinski,
Andrzej Madej and Jaroslaw Stalenga

Introduction

According to the requirements of ERA (Ecological Recycling Agriculture) system, a sustainable farm should maintain animal and crop production with a maximally closed recycling of nutrients (especially nitrogen and phosphorus). The number of animals in the farm should be maintained at a reasonable level so that their feeding can be mostly based on own fodder. Farming in the ERA system should be also based on diversified crop rotation and resignation from use of industrial inputs (synthetic mineral fertilizers, chemical plant protection products, etc.). It is assumed that the farm income should be more diversified.[1]

Most of the existing farms in Poland do not implement the requirements of the ERA system. Consequently, any implementation or adaptation of production to these standards will have to be connected with a number of management and investment actions. However, if they are to be effective, they must be based on clearly defined objectives, methods and measures. This process can be described as a strategy. In accordance with the definition formulated by A. Chandler's "A strategy is an identification of major, long-term objectives of the company and adaptation of actions and allocation of resources in a way which are necessary for the realization of its objectives."

In order to present the direction and scope of the conversion processes, the present overview shows a strategy of converting of four different types of farms into ERA system.

1 *http://www.rolnictwodlabaltyku.pl/warunki.html*

Methodological assumptions

The selected types of farms were defined on the basis of standard results obtained in 2011 by Polish farms which participated in the European system of the collection of accountancy data (FADN).This system covered more than 11 thousand farms of an economic size equal to, or greater than 4 thousand Euros. This group was representative for over 738 thousand of the total number of farms in Poland.[2] Strategy of conversion was prepared for the following types of farms:

- Specialized in cropproduction,
- Specialized in animal production (dairy cows),
- Specialized in animal production (grain livestock – mainly pigs),
- Mixed animal and crop production.

The characteristic of the initial status of the farms was prepared on the basis of mean values for the entire group within a given type of farming.

In accordance with the ERA system requirements, it was assumed that the analyzed farms after the end of the conversion process will:

- not use industrial crop production inputs (synthetic mineral fertilizers, chemical pesticides, etc.),
- keep livestock density at the level of 0,6-0,8 LU/ha,
- not exceed the 15%share of the purchased fodder[34].

It was also assumed that after the completion of the conversion process, the yields achieved by a farm will be lower compared to the initial status. The decrease in the production value will be compensated, however, by lower production costs (no purchases of industrial means of production, restrictions on purchasing of animal feed), higher prices obtained for crops and animal products and subsidies obtained within the framework of the Common Agricultural Policy (CAP) for organic production.

2 Goraj L., Mańko S., Osuch D., Bocian M., Płonka M. 2012. Wyniki standardowe 2011 uzyskane przez gospodarstwa rolne uczestniczące w Polskim FADN. IERiGŻ-PIB, Warszawa.

3 Granstedt A., Schnelder T., Seuri P., Olof T. 2008. Ecological Recycling Agriculture to Reduce Nutrient Pollution to the Baltic Sea. Biological Agriculture and Horticulture, Vol. 26, pp. 279–307

4 Granstedt A. 2012. Farming for future – with a focus on the Baltic Sea Region. TrosaTryckeri AB.

Table 1. Characteristics of farms before conversion into ERA system

Specification		Type of farming			
		Field crops	Dairycows	Grainanimals	Mixed
Area of agricultural lands (own + leased) [ha]		70,1	27,0	24,6	20,1
Economic value expressed by the value of standard production [Euro]		25 761	22 823	40 800	14 623
Wheatyields [t/ha]		5,3	5,1	5,1	4,7
Maizeyields [t/ha]		8,8	8,5	8,7	8,8
Livestockdensity [LJ*/AL]**		0,02	0,74	1,66	0,54
Cost of fertilizers**	Euro	9248	2187	1184	1679
	Euro/ha	132	81	48	83
Cost of crop protection products**	Euro	4612	564	358	645
	Euro/ha	66	21	14	32
Total cost of feed [Euro]		825	7053	3912	5133
Ownfeed [Euro]		579	3712	2897	3565
The share of own feed [%]**		70	53	74	69
Income from a farm	Euro	20628	13963	15097	7438
	Euro/ha	294	517	614	370
Income from a farm per a fully employed family member[Euro]		13210	7780	9210	4547

Source: Own studies on the basis of the data from FADN
**LJ- livestock (large) unit,*
*** indicators included in the strategy of conversion to ERA system*

Characteristics of farms

Among the analyzed farms, cropfarms had the biggest agricultural area (own and leased), while mixed farms, the smallest (tab. 1). The biggest economic value was recorded for the farm with pigs. All these farms achieved similarly high yields of maize and wheat. The level of livestock density was compatible with the objectives of the ERA only at the milk farm, while in a mixed farm, it slightly differed from the ERA standard. It was, however, far too low in the crop farm, and too high in grain livestock (pig) farm. All these farms used industrial means of agricultural production, which is incompatible with ERA standards. In each farm, the share of the purchased fodder exceeded the 15% threshold for the ERA system. The largest share of the purchased feed was found on the milk farm.

The highest total income from the farm per a fully-employed family member was recorded for the crop farm. It was more than two times higher than in the case of mixed farms. In 2011, the farm specializing in dairy production achieved a similar income, while it was slightly higher in the case of grain livestock farm. The highest productivity expressed as an income in Euro/ha was found for the farms specialized in animal production, whereas in crop and mixed farms the profitability was significantly lower.

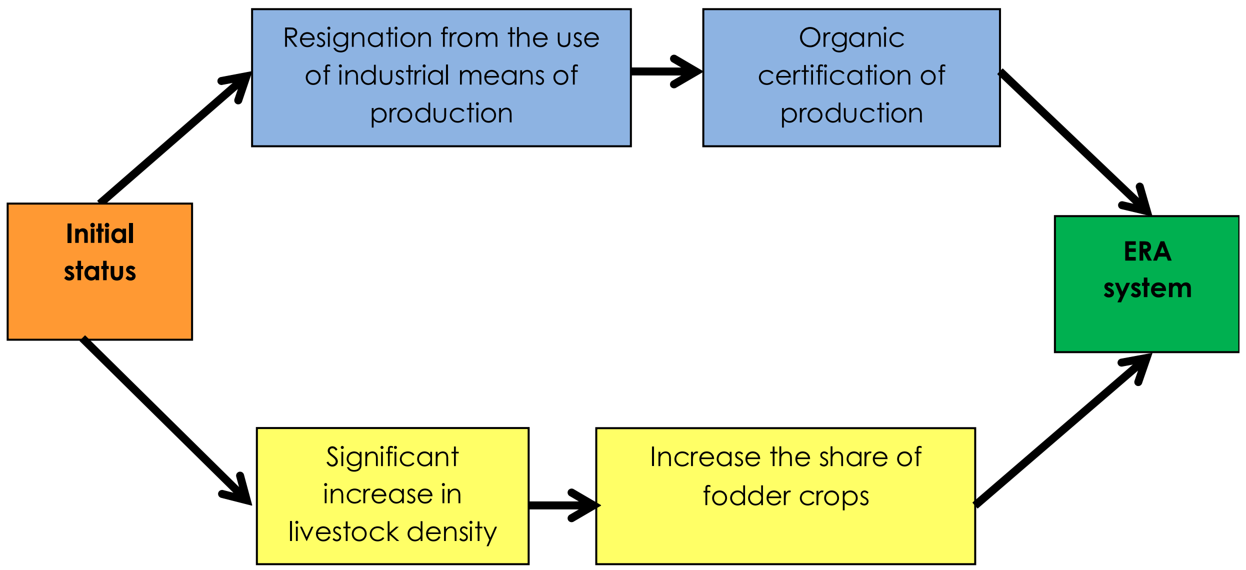


Figure 1. Strategy of conversion of crop farm into ERA system

Individual strategies of conversion into ERA system

On the basis of the presented characteristics of farms, a strategy of conversion into the ERA system was developed for each of the agricultural type.

All of the analyzed farms should resign from the use of industrial means of production, what should reduce the related costs from 1,5 thousand Euro in the grain livestock farm to 13.9 thousand PLN in the crop farm.

The farms should also certify their production in accordance with the EU organic standards, what should allow them to use special subsidies within the CAP.
Crop farms should also significantly increase livestock density and use most of the agricultural area for feed production and to reduce area for market crops (fig. 1).

Milk production farm should significantly increase the share of own feed. Considering that the livestock density in the farm is close to an optimal level, it may be implemented only through the purchase or lease of land and increasing the area with fodder crops (fig. 2).

Grain livestock farm should reduce the livestock density by more than 50%. It can be accomplished in two ways: by reducing the number of animals which may have adverse effects on economic performance or by increasing of the agricultural area. These actions should result in a further increase in the share of own feed to the level of at least 85% (fig. 3).
A mixed farm has to slightly increase the livestock density and the share of own feed. It could be achieved through increasing animal density and use of agricultural land for feed production at the expense of market crops (fig. 4).

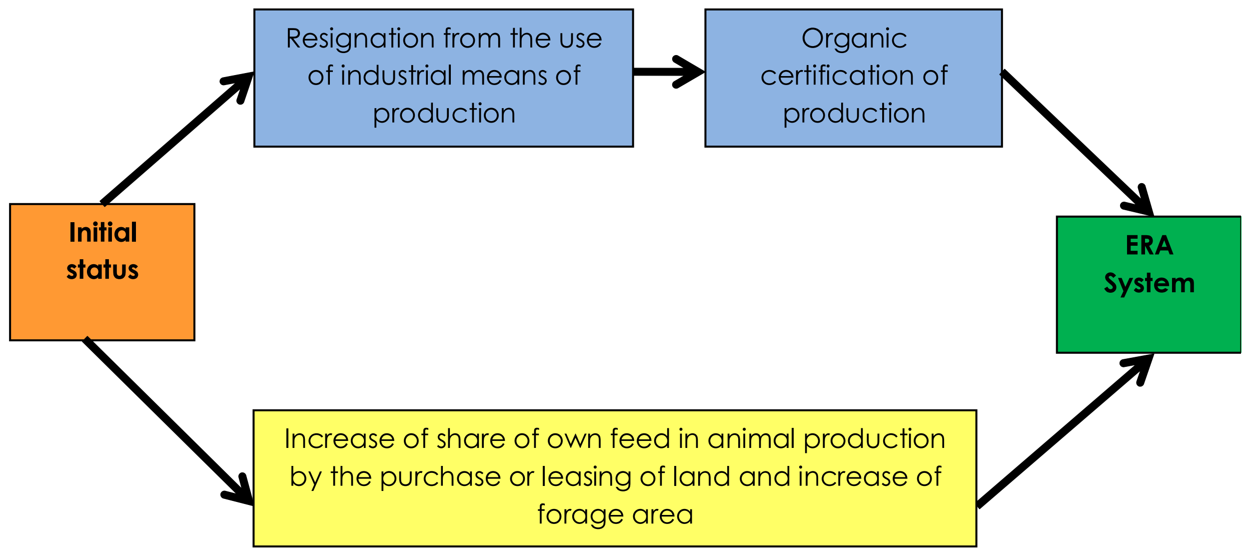


Figure 2. Strategy of conversion of dairy farm into ERA system

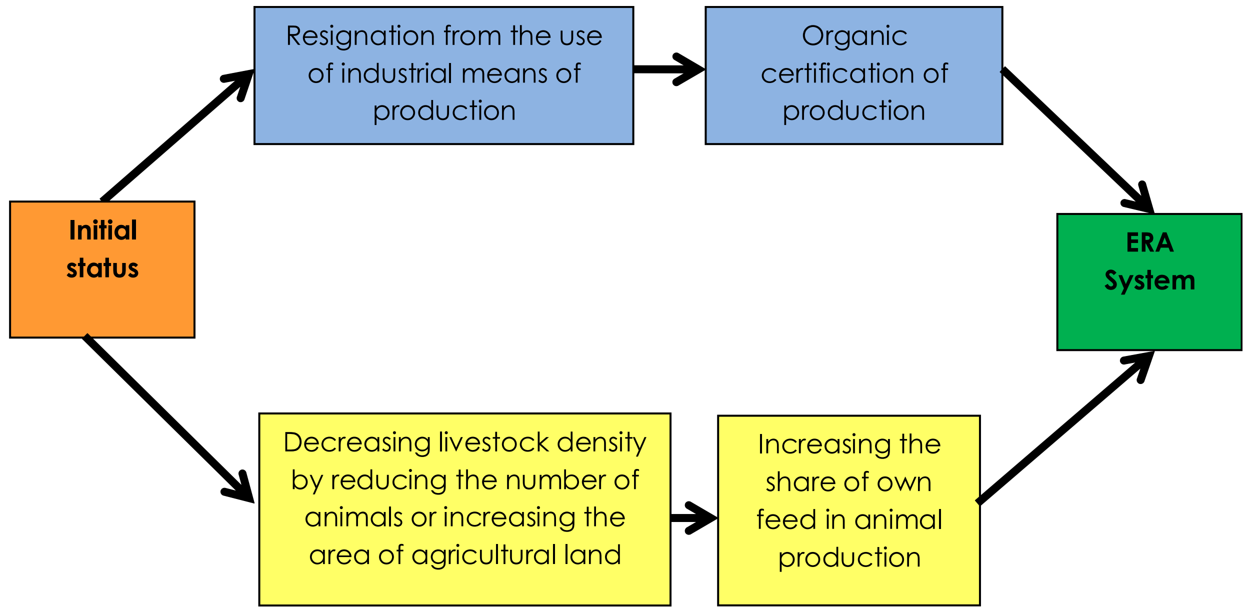


Figure 3. Strategy of conversion of grain livestock farm into ERA system

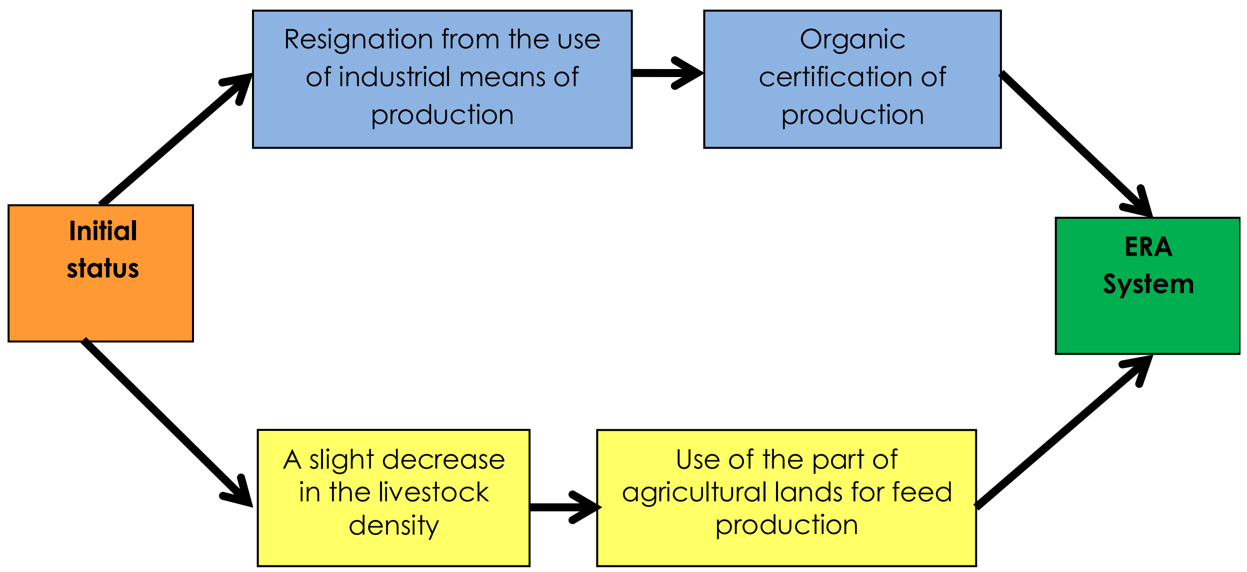


Figure 4. Strategy of conversion of mixed farm into ERA system

Photo 1. A rape and sugar beet cultivated in the farm being in the process of conversion into ERA system.

4.4.4 A business plan to convert highly specialized farms into Ecological Recycling Agriculture (ERA) system

Jerzy Kopinski, Andrzej Madej, Mariusz Matyka and Jaroslaw Stalenga

Introduction

Operating in the ERA system without commonly used industrial means of agricultural production, with balanced crop rotation and livestock density at a reasonable level, requires a vast knowledge and experience. Because of lower yields and due to the fact that ERA system requires much more labour inputs it seems to be less competitive than the conventional systems. However this situation can be compensated by lower production costs, usually higher prices obtained for crop and animal products and also by special subsidies for organic production.

Before taking a final decision, farmers, who plan to implement ERA system, should use a special business plan which would justify the success of the whole initiative. A properly developed business plan should establish a set of objectives and should identify ways to achieve them. It should also facilitate functioning of the farm on the market.

Business plan is especially helpful at the start and during the conversion, as well as during its financing and management. In the case of applying for credit or a loan, it is also necessary to start or develop the planned economic activity.

Despite many stimulators for development of this system, there are still many barriers. High production costs and low profitability are the key arguments against this system for potential participants[1].

Conversion from conventional into ERA system is connected with a number of organizational and economic challenges. This brochure shows some elements of a

1 Kopiński J., Stalenga J.: Ocena ekonomiczno-organizacyjna grup gospodarstw ekologicznych i konwencjonalnych. Studia i Raporty IUNG-PIB, 2007, 7: 151-169.

business plan for a sample conventional crop farm from Lubelskie region (Poland) that converts into ERA system.

This business plan is a part of a strategy to convert the crop farm into ERA system (fig. 1)

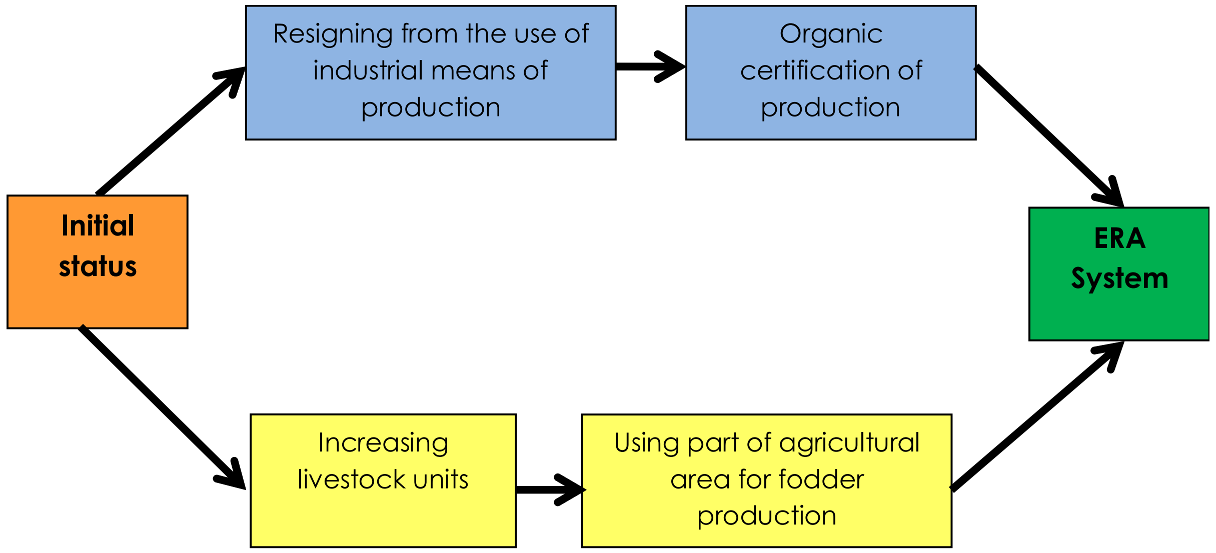


Figure 1. Strategy of conversion of a crop farm into ERA system

Methodological assumptions

This business plan includes both management, production and environmental impact. It was assumed that the conversion into the ERA will be conducted over during 4 years. The year of 2011 was the base year in the analysis. The data necessary to carry out analyses came from interviews and surveys developed especially for the survey. Part of the data, mainly concerning the internal market, has been estimated.

The analysis was performed using a number of criteria and indicators commonly used in agricultural economics. Economic indicators were calculated according to the current prices recorded in the base year on the basis of the data obtained from the farm.

It was assumed, in accordance with the requirements of the ERA system, that the farm after the end of the conversion process:

- will not use industrial means of production (pesticides, synthetic mineral fertilizers, etc.),
- will maintain the livestock density at the level of 0,6-0,8 LU /ha
- share of own feed (in terms of cereal units) will be more than 80% in its total consumption.

It was assumed that there is a strong demand for products of high quality, which may be offered by organic farms, especially those functioning in the ERA system.

A final customer of the main product of the farm (pork) should be a company dealing with processing of organic products according to the old, traditional recipes, and looking for suppliers that offer high quality raw material for processing in larger quantities.

During and after conversion to ERA system, the farm will employ the previously owned workforce and will use seasonal employment only in specific periods of time. Due to increased livestock production, the demand for external service related to veterinary care will increase.

It was also assumed that during and after the conversion, there will be a 25% decrease in yields of cereals, potatoes and rape. Due to increasing scale of animal production and a need to maintain the required level of own feed, a farm will resign from sugar beet. At the same time, it was assumed that after the transition into the ERA system, the farm will offer a 30% price discount on the sold products. The planned investments related to the conversion (such as modernization and construction of pig production sector and livestock buildings) will require a long-term investment credit (20 years). It is expected that the farm will benefit from subsidies obtained within CAP in the form of direct funding and subsidies for organic production.

Characteristics of the farm and the activities associated with the conversion into the ERA

The process of conversion into the ERA system as presented on this sample farm was connected with the change of the current crop production into animal production (fattening pig). The existing organization of crop production, including crop rotation, had to be changed and adjusted to the increasing needs of livestock production. Due to the increased demand for own feed for pigs farm had to resign from sugar beet even though its production was quite important because of the possibility of obtaining high profits. In the first year "after conversion ', the share of cereals in the sowing structure increased to 65%, while the share of rape decreased to 17%. A similar share was recorded for faba bean which was introduced during the process of conversion as a valuable source of protein in feed, and a perfect pre-crop. The whole harvest of rape will be sold, while only a surplus of cereals (tab. 1) will be destined for the market.

During the period of conversion, despite the decrease in crop yields due to extensification of production and resignation from the industrial inputs (fertilizers, pesticides) and in the context of the increasing scale of livestock production, the farm did not need to increase its size by purchasing or leasing the land. The share of own feed during the conversion period amounted to over 80%, while in the year after the conversion, increased to 85%. The only purchased fertilizer which was applied on the farm during the conversion period was ground phosphate rock, a mineral approved for use in organic farming, which had to be used to balance the amount of this component in the soil.

During the conversion period, the level of livestock density of animals (pigs) gradually increased until it achieved a minimum level required by ERA.

4. Impacts of ERA farming
4.4.4 A business plan to convert highly specialized farms into Ecological Recycling Agriculture (ERA) system

Table 1. Characteristics of the farm during conversion to ERA system

Specification	Period of conversion			
	Base year	**I year of conversion**	**II year of conversion**	**After the conversion**
The area of agricultural lands AL (own + leased); [ha]	39,2	39,2	39,2	39,2
Share or utilized agricultural area (UAA) in the area of AL [%]	100	100	100	100
Structure of sowings [%]:				
Cereals (wheat, barley)	57	56	56	65
Oil crops (rape)	26	26	26	17
Legumes (faba bean)	-	17	17	17
Root crops	1	1	1	1
Industrial (beetroot)	16	-	-	-
Yields of cultivated plants [t/ha]:				
Yields of wheat [t/ha]	66,0	49,5	49,5	49,5
Yields of barley [t/ha]	45,0	33,8	33,8	33,8
Yields of rape [t/ha]	38,0	28,5	28,5	28,5
Number of livestock units [LU*/UAA]	**0,13**	**0,26**	**0,36**	**0,56**
The cost of mineral fertilizers [Euro]	10 295	167	167	167
The cost of pesticides [Euro]	4 419	0	0	0
Total value of feed [Euro]	10 046	16 746	23 148	44 088
The share of own feed [%]	**85**	**91**	**84**	**85**

Source: own research

LU- livestock (large) unit,

*** indicators included into the strategy of conversion into ERA system.*

Photo 2. Siloses for cereals in the farm being in the process of conversion into ERA system.

Economic indicators and planned cash flow at the farm during the period of conversion to the ERA system

The most important calculation when planning and converting the existing production of the farm is a cash flow. Cash flows are real indicators of the profitability of the farm. They show whether its activity consumes or produces cash (tab. 2).

During the conversion to the ERA system, there was a significant increase in the direct costs of livestock production, while the costs of crop production decreased. A change in the sowing structure led to a reduction in the total direct surplus and an increase in operating expenses (steady costs). As a result, after conversion, the farm's income was decreased from 17 879 to 5 543 Euro.

Agricultural income has decreased to a much lesser extent which was due to the other farm income in the form of subsidies for organic farms and grants to the investments carried out in the framework of the CAP and taking a long-term loan (for 20 years). Obtaining a loan was essential in order to maintain financial liquidity of the farm, especially in the first year of the conversion when the decisions on modernization and construction of pig sector with infrastructure (manure plate and slurry tank) were taken. After a period of conversion, despite repaying the debt, the farm doubled its balance of cash.

Table 2. The planned cash flow of the farm during the period of conversion to ERA system in Euro (per farm)

Specification (per farm)	Period of conversion			
	Base year	I year of conversion	II year of conversion	After conversion
Initial status of financial means	7 109	26 787	7 387	42 779
Gross margin from crop production	40 887	28 931	28 931	31 098
Gross margin from animal production	-2 259	-1 182	-4 957	-2 081
Total gross margin	38 628	27 749	23 974	29 017
Operating expenses (steady costs)	20 749	22 010	22 797	23 474
Gross added value	20 545	8 404	3 842	8 209
Gross farm income (revenue)	17 879	5 738	1 177	5 543
Other farm income	744	8 547	36 035	8 319
Investments on the farm	0	70 284	0	0
Long-term loans	0	35 545	0	0
Gross Agricultural income (revenue)	18 623	-20 454	37 212	13 862
External income	1 055	1 055	1 055	1 055
Repayment of debts	0	0	2 874	2 874
Agricultural farm income (personal)	19 678	-19 400	35 392	12 042
State of finances at the end of year	26 787	7 387	42 779	54 822

Agro-environmental indicators of a farm after a period of conversion into the ERA system

Converting the farm into ERA system has led to a reduction of pressure from agricultural production on the environment, which was confirmed by the nutrient balance. The balance of nitrogen, according to the method used by the OECD, has been reduced from 54 to -9kg/ha of AL, while phosphorous from 2 to -4 kg P/ha of AL. Also, the balance of potassium has decreased from 41 to 7 kg K/ha of AL (fig. 2). There was also a significant improvement in the balance of organic matter.

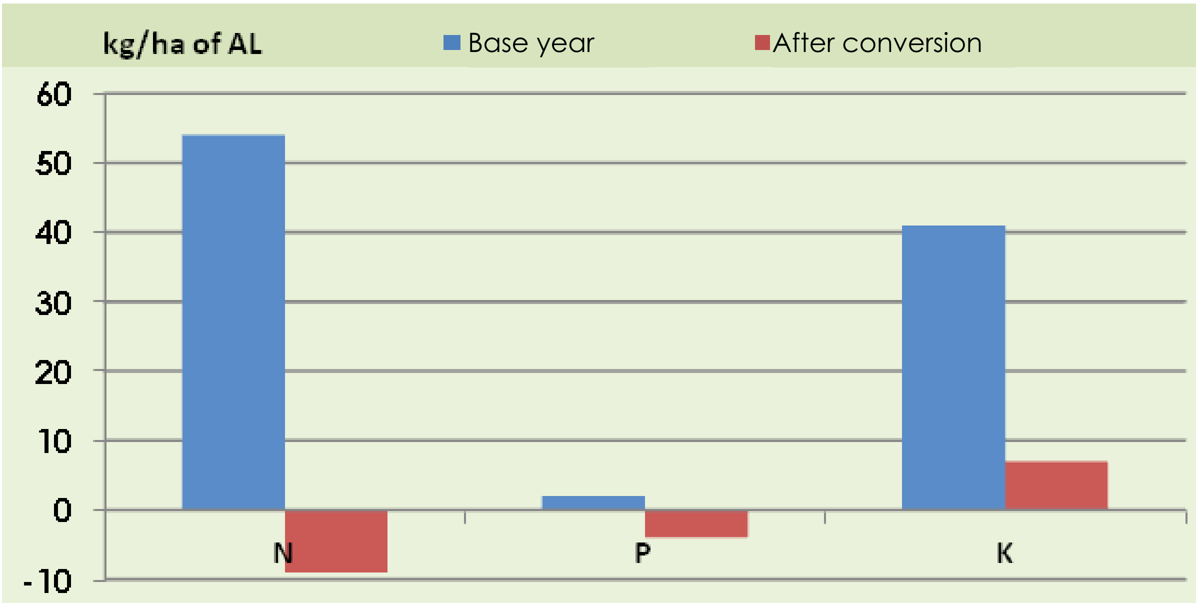


Figure 2. Changes in the NPK balance during the period of conversion into ERA system

The range of investments connected with the conversion into the ERA system

A major challenge connected with the conversion into the ERA system will be to carry out the investments. They will include the modernization of the existing livestock building to be suitable for rearing 10 sows with piglets and construction of the new equipped pig production sector for 160 effective units. The animals will be kept in the deep (sows, piglets) and shallow litter (pigs). Therefore, it was necessary to increase the sizes of the manure plate and slurry tank. The surface of the manure plate will be increased from 25 to 60 m m2, and the slurry tanks from 35 to 80 m3. The total cost of the investment will amount to 70 294 Euro.

Summary and the effects of implementation of a business plan of conversion of the farm into the ERA system.

The development of a business plan allowed determine the scope of activities and assess financial situation of the farm in relation to its decision to convert into ERA system. A pig production has become the main activity of the farm. After the period of conversion, despite a reduction of agricultural income, the farm should improve its financial status. The process of conversion into the ERA system will involve additional investment and due to the insufficiency of own funds it was necessary to take a long-term investment loan. It should be emphasized that that the direct and organic area payments as well as the investment grant received within the CAP were very important for the overall financial situation of a farm.

After the process of conversion, the farm will reach the required criteria for the ERA system, and at the same time it will greatly improve its agro-environmental indicators (balance of NPK and organic matter).

When assessing the plan of such a project, possible risks must be taken into account, such as possible fluctuations in the prices of pigs (despite the current contract with the customer) including changes in the whole market. If the manager of the farm does not have experience in financial planning, it is recommended to use the support of agricultural or financial advisors.

Organic farm and the processing factory of natural oils belonging to Tomasz Obszanski.

4.4.5 Investment Plan for a local food processing and distribution

Mariusz Matyka, Jerzy Kopinski,
Andrzej Madej and Jaroslaw Stalenga.

Introduction

Due to the existing conditions, agricultural production is mainly based on raw materials. In recent years, this tendency has been significantly strengthened. Intensive development of the processing industry and trade networks has significantly reduced direct trade between producers and consumers of food. Despite its many advantages, this process is also a source of many adverse economic and environmental consequences, such as weaker economic position of farms in relation to much larger members of food processing and distribution chain. As a result, a large part of the added value expressed by the income is taken over by stronger market players. This weakens the economic viability of farms and very often results in disproportionate differences between prices obtained by farmers and those paid by the consumers. From the environmental point of view, excessive expansion of the processing and distribution chains involves considerable consumption of energy for storage and transport. This is directly connected with greenhouse gases emissions and with the increase of the "carbon footprint" of food products. For this reason, it is fully justified to develop local chains of processing and distribution of food, which will create a partial counterweight to large industrial units and networks. Thanks to this, it will be possible to limit the adverse effects of globalization of the food market.

Supporting and promoting local systems of production, distribution and consumption of food is one of the main objectives of the BERAS Implementation project. In this project, environmental benefits associated with the implementation of such systems are measured in relation to the quality of the Baltic Sea environment. Deteriorating water status of this sea is indirectly linked to the existing energy-consuming food processing and distribution chain. The majority of agricultural farms is not able to get adequate cash surpluses to finance investments in small processing, therefore, the financing of new investments has to be supported with an external capital obtained in the form of a loan. For this reason, it is essential to define own potential of a given farm, possibilities of getting funds from external sources and the determination of the viability of the proposed project. This should allow create a rational plan of the investment and significantly reduce the risk associated with it.

Preparation of an appropriate investment plan should support implementation of these goals.

Main functions and elements of the investment plan

Investment Plan which is a document based on historical data and a diagnosis of the current situation allows to project inputs and financial effects associated with the planned activities. A thoroughly prepared investment plan allows analyze all aspects of a new business. It also allows verify what material and financial measures will be necessary to accomplish the intended purpose[1].

A properly prepared investment plan[2] should include:

1) 1. Basic data about investor
2) 2. A description of the planned investment
3) 3. Synthetic description of the holding and the possessed resources.
4) 4. An analysis of the needs and benefits
5) 5. Analysis of how to finance the planned investment
6) 6. An analysis of the cost of investment
7) 7. Financial analysis
8) 8. Selected financial indicators

1 *Michalak J., Kozłowski W. 2010: Krok po kroku, czyli jak przygotować dobry biznesplan. UWM Olsztyn.*

2 *http://www.arimr.gov.pl/fileadmin/pliki/zdjecia_strony/278/WZPI_141009.pdf*

4. Impacts of ERA farming
4.4.5 Investment Plan for a local food processing and distribution

A sample investment plan

The basic data about the investor

The Organic Farm "Barwy Zdrowia" belonging to Thomas Obszański has functioned since 1998. It is located on the Tarnogrod plateau in the eastern part of Sandomierz Basin and south-eastern part of Lublin voievodeship in Biłgoraj district.

Address:

Biłgorajska 150, 23-420 Tarnogród,
tel. 791 444 070, fax: (84) 689 76 03
info@barwyzdrowia.pl
http://www.barwyzdrowia.pl/

The description of the planned investment

The farm plans to take up activities in the field of cold pressing and distribution of plant oils from organic raw materials. For this purpose, it is necessary to purchase a complete Plant Oil Press and lorries. Technological line of the Press includes: press for pressing vegetable oils-2 PCs , complete installation -1 set (cumulative bath for the pressed oil-1 PC., sedimentary containers-2 PCs., rotary pump-PCs, installation piping and armature -1 set, installation for oil bottling -2 sets, technological tables (production hall and warehouse of products)-4 PCs, storage tank for seeds-2 PCs, shifting tank (supporting the presses)-2 PCs, a rotational frame construction of sedimentary tanks -1PCs. Pressing of high quality oils will take place at low temperature (of about 20 ° c). After the pressing, the oil will be subjected to the process of sedimentation (automatic natural cleaning of oil) for a period of 72-96 hours, and then bottled.It is assumed that oil production will take place for at least 15 days during the month. Due to the fact that the farmer will handle the technological line and distribute the final product on their own, the price will be competitive. In addition, it

Brand, typeorkind	Parameter(s) characterizing the item (power range or capacity range etc.)
Presses for pressing oil	60 kgseeds/h
Complete installation	bath, containers, pump, piping, bottling
Technological tables –production hall	850 x 3050
Technological tables –storage of products	600 x 2000
Containers - storage of seeds	4 m3
Shiftingcontainers	supporting the presses
Construction of the frame	rotation – bending of the washing container
Mercedes-Benz Sprinter 316 CDI	163 kM

Table 1. The list of elements of planned investment

will be possible to gain additional revenue from the sale of oil cake, which is a by-product of the technological process.

In order to ensure proper distribution of the product it is necessary to purchase a delivery car with isothermal load bed.

It is assumed that realization of the investment will allow for an increase in non-agricultural income in the farm, significantly shortenthe distribution chain and will allow for the implementation of the idea of food consumption from local sources.

A synthetic description of the holding and of the possessed resources

The farm owns about 19 ha of agricultural lands (AL), and its structure is dominated by berry plantations (10.7 ha) and arable land (7.9 hectares). There is also a farm building, which will eventually become a location for the line of oil and the cooler for the storage of the obtained products. The farm is very well equipped with tractors and agricultural machinery.

The analysis of needs and benefits

In order to carry out the investment, the holding needs to purchase machinery and a vehicle in accordance with the list in table 1.

In order to build and develop the sale network of plant oils, it is planned to place ads in the local press, create a website and distribute leaflets.

A calculated increase of income after a period of five years from the commencement of the investment should amount to at least 6 751 Euro/year.

4. Impacts of ERA farming
4.4.5 Investment Plan for a local food processing and distribution

Analysis of way of financing of planned investment

The planned investment will be financed from own financial means and a loan according to the scheme presented in tables 2 and 3.

Annual net income of the farm, including:		Base year -1	Base year	Base year +1	Base year +2	Base year +3	Base year +4	Base year +5
From the agriculturalactivity		15643	15643	15643	15643	15643	15643	15643
From non-agricultural activity covered by the operation		0	0	876	4876	5657	6282	6751
From other sources	savings	6667	11190	17143	0	0	0	0
TOTAL INCOME		22310	26833	33662	20519	21300	21925	22394
The state of finances for financing the investment		22310	26833	33662	20519	21300	21925	22394

Table 2. The value of own measures devoted to financing of the investment (in Euro)

Lp.	*Kind of indebtedness*	*Year of incurrence of debts*	*Amount of debt*	*The use of external measures to finance the costs of the operation during its implementation*						
				Base year - 1	Base year	Base year + 1	Base year + 2	Base year + 3	Base year + 4	Base year + 5
1	Bridgingloan	Base year+ 1	47 619			47 619				

Debt service in subsequent years (capital + interests)														
Lp.	Base year - 1		Base year		Base year + 1		Base year + 2		Base year + 3		Base year + 4		Base year + 5	
	Capital	Interests	Capital	Interests	Capital	Interests	Capital	Interests	Capital	Interests	Capital	Interests	Capital	Interests
1	0	0	0	0	0	2619	23810	2857	9524	1905	7143	1143	7143	571

Table 3. The value of external measures devoted for financing the investment (in Euro)

Brand, typeorkind	Value Euro
Presses for pressing oils	15 238
Complete installation	9 167
Technological tables –production hall	1 333
Technological tables –storage of products	1 048
Containers – storage of seeds	2 286
Changingcontainers	857
Frameconstruction	429
Mercedes-Benz Sprinter 316 CDI	26 489
Total value of the investment	56 846

Table 4. The costs of the investment according to the list of elements

The analysis of the costs of the investment

The total cost of the investment will amount to 56 846 Euro, and will be paid in the following year (base + 1) after the preparation of the investment plan, according to the list presented in table 4.

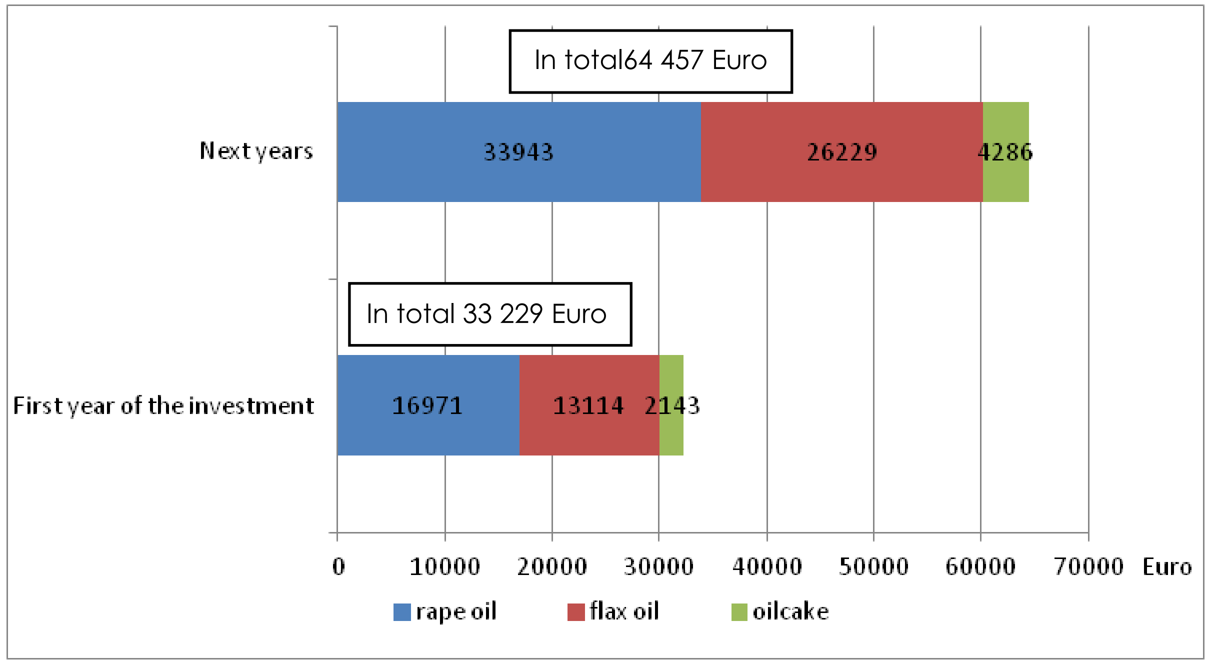


Figure 1. The value and structure of income (in Euro) from the press of plant oils

Financial analysis

It is assumed that in the year of the launching of the investment, the production of rapeseed oil will amount to 6480 l, linseed oil - 3240l and oil cake (a by-product)- 225 dt.In the subsequent years, the production of rapeseed oil will amount to 12960 l, flaxseed oil – to 6480 l and oil cake (a by-product) – to 450 dt. The assumed prices of the product should amount to, respectively: rapeseed oil 2.62 Euro/l, linseed oil 3.33 Euro/l, rapeseed oil cake 9.52Euro/dt.

The main component of income will be the sale of rapeseed oil (52%), while a value of oil cake will have the smallest share (7%) (fig. 1).The consumption of materials and energy (73%) and amortization (15%) will have the largest share in the structure of operating costs of the planned investment (tab. 5). The planned net income from the investment shows a clear upward tendency during its operation (fig. 2)

Cost item	Base year + 1	Base year + 2	Base year + 3	Base year + 4	Base year + 5
Amortisation	4774	9548	9548	9548	9548
Use of materials and energy	21259	42517	42517	42517	42517
External services	490	981	981	981	981
Taxes and charges	411	821	821	821	821
Salaries and derivatives	0	0	0	0	0
Financial costs	3333	2857	1905	1143	571
Purchase of goods	0	0	0	0	0
Propertyinsurance	298	595	595	595	595
Othercosts	595	1190	1190	1190	1190
TOTAL	31160	58510	57558	56796	56225

Table 5. Operating costs (in Euro) of the press for plant oils.

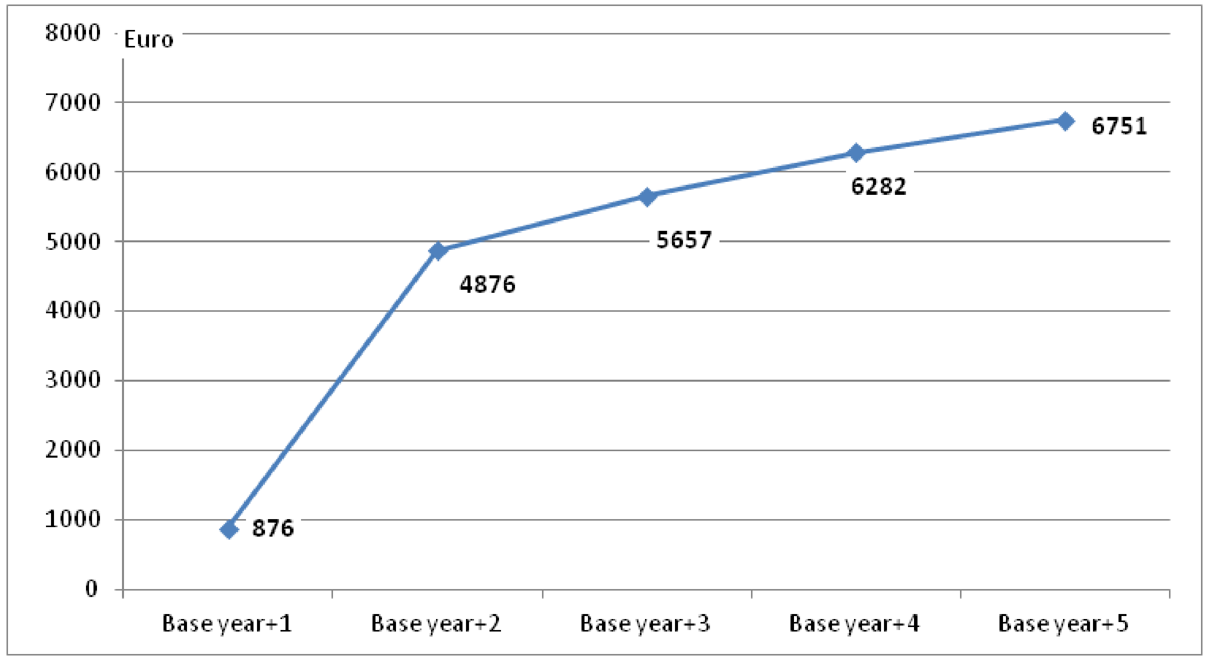


Figure 2. Net income (in Euro) from the press of plant oil in 5 years' perspective.

Specification	Base year	Base year+ 1	Base year+ 2	Base year+ 3	Base year+ 4	Base year+ 5
Costs of the investment	0	56846	0	0	0	0
Income from sales	0	32229	64457	64457	64457	64457
Costs of operatingactivities	0	31160	58510	57558	56796	56225
Gross income	0	1069	5947	6899	7661	8233
Incometax of 18%	0	192	1070	1242	1379	1482
Net income	0	876	4876	5657	6282	6751
Finalvalue	0	0	0	0	0	13881
Amortisation	0	4774	9548	9548	9548	9548
Currentbalance	0	-51196	14424	15205	15830	30180
Discount rate (7,78%) / discountingfactor	1,0000	0,9278	0,8608	0,7987	0,7410	0,6876
NPV		9 543 Euro				

Table 6. The analysis of the value of NPV indicator for the planned investment (in Euro)

Selected financial indicators

To assess the effectiveness of the investment, one of the measures of discount rates was used, namely the Net Present Value (NPV), which is a measure of the total surplus of the sum of the discounted income over the sum of the discounted expenditures. This indicator allows compare the ratio of inputs anticipated for implementation of the investment with the sum of money surplus which can be obtained from the planned project in subsequent periods of its exploitation.The future value is reduced to the current level (discounted) taking into account the cost of the engaged capital (required rate of return).

All these investments, in which the amount of the discounted cash-flow covers at least the necessary investment and the NPV ratio reaches a positive value, are considered to be successful [3].

The performed analysis showed that the planned investment meets this condition, and the value of NPV ratio is more than 9 500 Euro (tab. 6). On the basis of the calculations, it can be concluded that the investment is fully profitable.

3 Felis P., 2007. Metody dyskontowe. 415-423. Szczepański J., Szyszko L., Finanse przedsiębiorstwa. Pol. Wyd. Ekon., Warszawa.

Table X. Fundamentals of economics and ERA farming.

ECONOMICS	ERA farming
Economy of scale	Crop rotation
Economy of specialization	Balance between crop and animal production
Intensity according economic laws (marginal costs = marginal returns)	Intensity according local resource availability
Free use of non-renewable resources	Recycling and renewable resources
Global market	Local market
Low affiliation to externalities	High affiliation to externalities

Table X outlines some of the apparent contradictions between some fundamental aspects of economics and some fundamental issues related to ERA farming.

4.4.6 Calculating costs of restructuring agriculture

Pentti Seuri

The two principal issues are the diverse production and the environmental impacts. In this paper we don't look at the economics of environmental impacts and externalities in detail, but they do represent the key political issues addressed in section 5. In this section we focus on the economic impact of diverse production.

The diversity of production is a fundamental component of ERA farming in that if the system is not sufficiently diverse it can no longer be described as an ERA system. The economy of scale and economy of specialization are closely related: even a small enterprise can profit from economies of scale even if it only produces very few products. In reality modern farming is based on very high levels of specialization (farm-wise production lines) and some production lines fulfill ERA criteria more than others. There exists an indicative list of the most common production lines and their suitability to ERA farming. Evaluation can be described with the "ERA-index", which can be interpreted: as "how independently a particular production line can work or how efficiently a production line is able to utilize the resources". The main criteria in the ERA index are the BNF and crop rotation. An index higher than 100% indicates that a system is able to support even supra-optimal production intensity, i.e. some crop yield can be sold outside the system.

ERA index >100%: beef (based on suckler-cows), sheep, goats
Basically fully independent from other production lines: cereals and protein crops potentially for sale (unless the intensity of crop production is very low), nitrogen is not limiting (legume leys up to 50-60%), high amount of low quality biomass can be utilized.

ERA index 100%: dairy production, beef production from dairy cows
Limited possibilities to sell cereals and protein crops: lower the intensity of crop production and raise the intensity of animal production, less potential to sell cash crops. Nitrogen is not limiting (legume leys up to 40-50%), some low quality biomass can be utilized.

ERA index 80%: sows and pigs
Because only limited amount of ley yield can be utilized (20% from total area) some green manure fallows are needed, or alternatively up to 20 – 40% fodder must be purchased, marginal use of low quality biomass.

ERA index 60%: pork (fattening only), poultry meat, laying hens
Green manure fallows are needed, dependent on purchased high quality fodder.

ERA index 40%: cash crops only
Large areas of green manure crops are necessary in addition to nutrients other than nitrogen that must be replaced with external nutrient input (manure, mineral sources).

Even ERA index puts biological limitations of some products in first place, also indicating production costs – the lower the index, the higher the production costs. This statement comes directly from fundamentals of economics – the lower the index, the less profit from economies of scale and specialization because of the increased need for more diverse production.

A low index indicates that a specified product does not utilize resources efficiently, or the index can be interpreted as indicating the maximum share of a specified product in the system. In addition to such a product something else must be produced. For example, if the ERA index of cash crop production is 40%, only 40 % of total production (area) can be used to produce cash crops and 60% of total production must come from elsewhere to support the system (improving crop rotation, utilizing unused resources).

Thus, ERA farming of cereal-based products is strongly tied to ruminant-based production. The production costs are dependent on how this integration is organized. The two main alternatives are that diverse production is organized on-farm or among farms. Organizing it among farms potentially gains from economies of scale and specialization.

It is not possible to evaluate the total costs of diverse production compared with those for specialized production, but to decrease production costs in ERA farming the focus should be on cooperation and networking among neighboring farms.

4.5 Social aspects

4.5.1 Challenges and opportunities of ecological recycling agriculture farms in the Baltic Sea region

Maria Micha

Introduction

The two BERAS[1] projects 2003-2006 and 2010-2013 (BERAS Implementation) have developed three core concepts. Ecological Recycling Agriculture (ERA)[2] provides guidance for farmers wanting to increase environmental benefits and decrease negative impacts of agriculture. Diet for a Clean Baltic (DCB)[3] offers orientation for consumers, be they individual, institutional or operating in the private sector, in what to eat to decrease the environmental impacts of food production and consumption. And, thirdly, the concept of Sustainable Food Societies (SFS) aims at integrating and promoting local ERA food chains.

This section of the report presents the concept of Sustainable Food Societies and summarises some information about ERA farms in relation to the SFS concept. The purpose is to identify spheres of activity undertaken by the farmers which correspond or contrast with the food chain integration theorised in the SFS concept. It is thus also to shed light on the challenges, opportunities and possible further directions of development of SFS in the Baltic Sea region. This text is an excerpt of a more extensive study on diversification strategies employed by ERA farmers (Micha, 2013).

While the SFS concept is based on interaction between a multitude of actors, this study focuses on one link in the food chain, the farmers. This choice is motivated by, firstly, the central role afforded to farmers within the SFS concept, secondly, that many of them have experience in operating diverse, multifaceted farming entities and, thirdly, presuming their interests and needs as important points of departure for further development of the concept and implementation of SFS. A fourth reason is that several of the farms are in themselves close to the idea of locally integrated SFS with their own processing and marketing. However, as SFS continue unfolding it will be important to include different actors in the food chain and their interactions in SFS studies.

1 Baltic Ecological Recycling Agriculture and Society.
2 For ERA principles see Introduction to this report.
3 For an overview of the DCB concept see Introduction to this report.

Figure 1. Schematic overview of the Sustainable Food Societies concept.

Sustainable Food Societies in practice

The creation of Sustainable Food Societies is a long term project initiated in the period 2010-2013 in nine countries around the Baltic Sea. During the starting up period main focus has been on identifying farms and farmers which practice ecological recycling agriculture and are willing and able to function as information centres. Being an information centre entails having a permanent exhibition which presents the farm as well as the state of the Baltic Sea and the impact of agriculture in general. As for now (July 2013) a total of 18 SFS information centres are established in the following countries Finland (1), Estonia (1), Latvia (1), Lithuania (1), Belarus (1), Poland (6), Germany (3), Denmark (1) and Sweden (3). All but two of the information centres are located on farms. One is located in a research centre and another in an advisory centre.

In addition to being points of information and meeting places for knowledge exchange, in particular locally but also transnationally within the Baltic Sea region, these centres are in many cases nodal points through their connection and relationships to other farmers, processors, retailers, customers etc. Furthermore, in several cases the farms in themselves resemble sustainable food societies in their management of the different steps from agriculture via processing to retailing and with the farm being a centre for multiple other activities as well.

The concept of Sustainable Food Societies

The SFS concept is close to the features of 'the integrated and territorial agri-food paradigm' as described by Wiskerke (2009) which aims at re-embedding food in its place of production, creating closer connections between producers and consumers, increase consumer trust, locally sourced food, regional diversity of food, local breeds and varieties, local or regional nutrient cycles, integration of farm management with e.g. nature conservation, maintenance of open landscapes, agritourism, education and other social engagements.
The development of Sustainable Food Societies (SFS) includes both horizontal and vertical integration within the food chain and has the purpose of

3) connecting actors from farm to fork – producers, processors, distributors, restaurants, consumers – in order to strengthen the local provision and consumption of food produced organically and in particular at ecological recycling agriculture farms – see figure 1

4) establishing information centres which demonstrate ERA in practice, provide information about Diet for a Clean Baltic and Sustainable Food Societies,

5) encouraging local innovative cooperation between the business sector, authorities, NGOs, research and education in what is termed 'triple helix' to undergird the establishment and functioning of the networks and facilitate knowledge exchange,

6) forming a transnational network of local SFS for exchange of competence and cooperation between the centres.

These general guiding principles apart, each SFS is encouraged to develop its local characteristics based on present resources, interests and capacities. For their pivotal role as primary producers and stewards of the environment farmers have a central position in the SFS.

Anticipated benefits of deepened integration within the local organic food chain are making ERA economically viable for farmers and thereby promoting ecologically sustainable farming practices, raising awareness about consequences of food choices and support for environmentally friendly food among consumers, strengthening local economies and rural development through making farming socially attractive and supporting other local business initiatives within the organic food sector, and decreasing food miles.

To address features of the case study farms that relate to the concept of Sustainable Food Societies a multifunctional agriculture approach is adopted. Through this approach areas are identified in which the case study farms differ from the modernising agricultural trajectory of industrialisation and specialisation and attempts are made at exploring their rationales for opting for farm diversity or not.

Multifunctionality in agriculture

A hundred years ago farms were per definition and out of necessity multifunctional, serving multiple purposes for rural communities and farm families (Noe et al., 2008, Milestad et al., 2011). Part of this multifunctionality was self-sufficiency and closed cycles of resource circulation within the farm. By keeping a number of animals that was balanced with the amount of fodder the farm produced the farm also had the fertiliser needed for crop production through animal manure and ley cultivation. Ley with clover had the double function of animal fodder and nitrogen fertiliser through the N-fixating properties of legumes included in the crop rotation to the benefit for e.g. cereals (Granstedt, 2012).

As a theoretical concept multifunctional agriculture (MFA) has been applied in various research areas during the last decades.[4] This study is based on more inclusive perspectives on MFA which take into account the whole agri-food system and share many affinities with the SFS concept. Characteristic of these are attention to agricultural systems which are more locally oriented in their use of resources as well as in their promotion of closer relationships between producers and consumers (Van Huylenbroeck et al., 2007). Cultural and social aspects are included in the conceptualisation along with agency and behavioural perspectives at the same time as more attention is afforded to environmental issues (Wilson, 2007). Possibly all goods, products and services related to agricultural practice are included in a broad conceptualisation of MFA (Marsden and Sonnino, 2008). This includes 'goods, services and functions' that are not directly linked to food, feed and fibre production, in the words of Renting et al. (2009: 116):

> Apart from public goods (landscape, biodiversity, etc.) this includes goods and services produced for non-food markets (energy, care, tourism, etc.) and 'functions' provided by agriculture as distinctive product attributes on niche food markets (food quality, animal welfare, environment friendliness, etc.). Moreover, also functions that can not be directly associated with goods, services or product attributes, but rather represent non-marketable public benefits of agriculture, are considered relevant for the analysis of MFA (e.g. quality of life, food security, maintenance of dispersed settlement patterns, etc.).

Based on these premises and on multifunctional features highlighted by van der Ploeg (2008, 2010), Darnhofer et al. (2010, 2011), Wilson (2007, 2008, 2010) and Marsden and Sonnino (2008) three broader themes and 16 indicators have been delineated for the purpose of this study (see table 2). Some theoretical breadth is sought by combining van der Ploeg's more structuralist approach, close to political economy, with resilience perspectives present in Darnhofer et al. and Wilson which put more emphasis on social and behavioural aspects. Some basic distinctions which add clarity to the concept of multifunctionality are to distinguish it from diversification and pluriactivity. Thus while multifunctionality implies that an activity has more than one output, diversification points to the combination of different activities within the same unit (e.g. the farm) and pluriactivity means one person (or a group of people) engage in different activities (Van Huylenbroeck et al., 2007).

4 For an overview see e.g. Renting et al., 2009; Marsden and Sonnino, 2008; and Van Huylenbroeck et al., 2007.

Theme I: Ecological Recycling Agriculture and self-sufficiency

In the ERA system mainly environmental advantages of animal husbandry integrated with crop production and self-sufficiency in fertiliser and fodder are highlighted, prioritising high quality roughage from grass land (Granstedt, 2012; Granstedt et al., 2008). In addition to commitment to environmentally sustainable production, unwillingness or lack of financial capacity to take part in the race for increasing scale and specialisation with intensified production through inputs sourced outside the farm may also be important reasons for practicing ERA. van der Ploeg (2010) describes it as a conscious reconnection with nature expressed through renewed focus on increasing soil fertility and thus investing in ecological capital. He argues this to be a strategy to decrease dependency on external inputs. A strategy which may also be positive for production and income levels while simultaneously enhancing efficiency and sustainability.

Being organic and having integrated animal and crop production, are ERA principles and often correspond with what Wilson (2008) terms strong multifunctionality. It is the basis for nutrient recirculation and self-sufficiency. Seeking to integrate alternative energy sources or engaging in strategies to reduce energy consumption, reflect similarly an ideal of including more of the energy needs in the natural resource cycle within the farm thus saving on environmental burdens as well as cutting down on major costs for farmers and a dependency on outside resources (Jones et al., 2011). Landscape and biodiversity conservation are central concepts to MFA approaches which seek to evaluate and sustain multiple functions of farm landscape and agricultural practices (Renting et al., 2009). In this study the indicator of engagement in nature conservation is understood both as a formal participation in different schemes which may also generate some compensation for the farmers, as well as farmers' own initiatives to the benefit of e.g. biodiversity on their farms.

Theme II: Diversity and pluriactivity to increase farm viability

The aforementioned strategy of actively decreasing dependency on upstream inputs could facilitate and be accompanied by efforts to increase the number of marketable outputs (van der Ploeg, 2010). Production diversity may be sought in e.g. varieties with the potential of increasing robustness and spreading risk, meeting different tastes and needs, as well as achieving an optimal balance between varieties in the crop rotation (Darnhofer et al., 2011). Similarly, to establish processing and direct marketing, to private consumers as well as for public procurement, can be ways to keep a larger share of the value within the farm economy (Marsden and Sonnino, 2008). Other ways of taking advantage of additional income from pluriactivity are locating other activities to the farm, including non-traditional commodities like agritourism and green care, thus creating synergies between different activities (van der Ploeg, 2010).

Pluriactivity, in the sense of part-time jobs outside the farm, can be a way to begin farming without having to rely on outside sources or make heavy investments (van der Ploeg, 2010). Off-farm employment can also be interpreted as a symptom of poverty and a survival strategy by farmers who are not able or willing to adapt to market conditions which may be impossible to adjust to (Marsden and Sonnino, 2008).

This theme includes multifunctional strategies related to production diversity, on farm processing, direct marketing, on-farm tourism, cultural and social engagement and activities on farms and related to them.

Theme III: Cooperation and networks

The creation of cooperation and networks which transcend the individual farm can also be ways to increase autonomy. These can take many forms, examples are knowledge exchange and sharing machinery (van der Ploeg, 2010). The resilience perspective as put forward by Darnhofer et al. (2011) emphasizes learning and knowledge integration as crucial for farm survival and growth. Learning often occurs in discussions with others, and engagement in off-farm work, associations etc. can be important sources of information (ibid). Others have emphasized how important relationships and networks are for farmers in their role as business managers of strongly multifunctional farms (Wilson, 2009).
The result section will also relate some findings regarding the farmers' relationships with research and local authorities. These last two categories are also important in the triple helix model advanced in the SFS concept.

Just as all of these themes and indicators could be much more deeply explored, many more factors of importance could also have been added to the list of indicators, such as ownership status, geographical location, natural constraints (e.g. soil and climate), financial situation, generational shift etc. (Wilson, 2008). The delineated indicators reflect themes brought up in the interviews as well as aspects of agricultural multifunctionality as presented in scientific research. Furthermore, the acknowledgement of a broad spectrum of benefits, environmental, economic and social, deriving from agriculture is mirrored in the ERA and SFS concepts. Also the importance attached to local markets for organic food found in much social scientific research on multifunctional agriculture has a close resemblance to the SFS concept.

Case study

The case study is based on 18 semi-structured interviews with farmers from Finland, Estonia, Latvia, Lithuania, Poland, Germany, Denmark and Sweden. This data is combined with otherwise collected information from study visits, presentations, information folders, websites and the publication Farm examples edited by Koker and Stein-Bachinger (2013). This way another six farms have been added to the survey which totals 24 farms. However this is not an exhaustive list of all farms engaged in BERAS Implementation, which totals around 38 farms.

Eight of the 24 farms in this study are currently SFS information centres. Farmers at seven of these eight farms were interviewed. All the farms are certified organic and most

FARM	COUNTRY	FARM SIZE IN HA TOTAL/ARABLE LAND	YEAR OF CONVERSION TO ORGANIC PROD. (B=BIODYNAMIC)	PRODUCTION ORIENTATION	LIVESTOCK	EMPLOYEES	ON FARM PROCESSING	MARKETING
F1	FI	88	2008	Dairy cows	100 (72 cows + heifers and calves)	1 fulltime + one summer trainee	No, but would like cheese or ice cream processing	All milk sold to Valio as organic
F2	EE	370/354	2001	Dairy cows	50 dairy cows	5	No, but plans for dairy	Most milk exported as conv. Some raw milk sold in Tallinn
F3	EE	900/150	2001	Dairy cows, beef cattle	70 milking cows, 100 suckler cows	6	No	10% raw milk sold in local shop, rest sold as conv. 30% meat sold as organic and exported, rest exported as conv
F4	EE	123/60	2002	Beef cattle, layers, vegetables, potatoes	95 beef cattle incl. 39 suckler cows, 50 layers	1 (relative)	No	Mainly through Organic cooperative, vegetables direct sales
F5	LV	100	2000	Dairy cows	53 milking cows	0	No	Organic milk sold as conventional
F6	LT	40	2010-2011	Sheep	36 sheep aiming at 100. 2 dairy cows	1 extra during lambing	No	Milk, seven lambs (increasing herd), raspberries, honey
F7	LT	100+50 conv.	2010	Buckwheat, soya, cumin, sheep, dairy cows + conv. grain	3 dairy cows +12 calves, sheep	1 (will need 2 more now)	No	Mostly export, some milk to neighbours
F8	LT	250/50	2010	Beef cattle, grain	150 beef cattle	1	No	Mostly exported, some sold as conv. in Lithuania
F9	LT	300 (sons 310 resp. 200))	2005	Beef cattle – meat and breeding, grain	100 beef cattle	2-4 depending on season	No	Mostly export, but meat informally sold to ca 200 friends
F10	BY	100/81	founded1992	Dairy goats	212 goats	6-9 depending to season	Dairy under construction	Internet shops
F11	PL	136/82	2005	Pigs	30 sows + recruitment, up to 600 porkers/year	No data	No, but would consider meat processing	Almost all exported to Germany via Denmark
F12	PL	1900	2000 **B**	Dairy cows, grain, vegetables, bread syrups, herbs	680 cows (350 dairy cows)	95 + 40 with disabilities	Fruits and herbs, plans for butchery, dairy, bakery	Most exported to nearby Berlin, organic shops, restaurants, veg sold on farm
F13	PL	158/114	2009	Beef cattle, pigs, poultry	24 cows + recruitment, 30 sows + piglets and fattening pigs, 1500 broilers, 20 layers	No data	Family butchery and meat processing	Meat mostly sold in organic shops in the voivodship

Table 1. Case study farm data.

are documented Ecological Recycling Agriculture farms or farms in conversion to this system. This means they are organic with mixed production (crop and livestock), employ crop rotation with ley and are at least 80% self-sufficient in feed and fertiliser. Data is or has previously been collected to evaluate the nutrient flows within the farms and calculate potential losses of nitrogen and phosphorous. Beyond that commonality they span a rather broad spectrum in terms of e.g. size, production orientation and opportunities and constraints connected to national settings. A summary of farm data is presented in table 1.

FARM	COUNTRY	FARM SIZE IN HA TOTAL/ARABLE LAND	YEAR OF CONVERSION TO ORGANIC PROD. (B=BIODYNAMIC)	PRODUCTION ORIENTATION	LIVESTOCK	EMPLOYEES	ON FARM PROCESSING	MARKETING
F14	DE	133/130	2009	Grain, dairy goats	35 goats	2	Not yet, plans for goat milk dairy	So far mostly grain through several possible channels. Plans for farm shop
F15	DE	160/100	1991 **B**	Dairy cows, pigs, grain, vegetables	30 cows, 50 pigs	25	Dairy, meat, spelt dehulling, close cooperation with bakeries	Farm shop, prod.-cons.cooperative, external retailers
F16	DE	1200	1991 **B**	Dairy cows, goats, poultry, vegetables, grain	250 dairy cows + 250 offspring, 200 goats, 400 chickens	85	Dairy products cow and goat, vegetables, salami, bread, sunflower and linen oil	Farm shop, box scheme, farmers markets, organic retailer, kindergarten, restaurants
F17	DK	49/39	1997	Vegetables, potatoes, layers, sheep	250 layers, 44 ewes with lambs	Trainees in social care	No	Farm shop, box scheme, caterer, social care centre
F18	DK	100/55	end of 1990s	Beef cattle, poultry, layers, fruit, vegetables, potatoes	25 cows, 1200-3000 layers	6	No	Farm shop, meat to private customers
F19	DK	115/101	1995	Vegetables, potatoes, pigs, beef cattle, layers, sheep, canola oil	50 layers, 150 porkers, 8 suckler cows with breeding, 180 steers, 28 ewes with lambs	2-3	Butcher's shop	Farm shop, box scheme, internet shop
F20	SE	120	2007 **B**	Grain, heifers (dairy cows and vegetable prod under establ.)	A few heifers	0	Not yet, dairy planned	Not yet
F21	SE	500	1998	Beef cattle, sheep	300 cattle, 120 mothers	1 (+hired labour)	No	All beef sold to big retailer. Lambs sold directly to consumers
F22	SE	43	1971 **B**	Dairy goats, vegetables, grain, cattle	120 dairy goats, 6 beef cattle	1	Goat milk dairy	Farm shop, farmers markets, institutions
F23	SE	72/42	ca 1980	Sheep, grain, canola	Ca 50 ewes	0	Canola oil, jams, pickles, etc.	Organic retailer, producer cooperative, neighbour farm shop, farmers markets, other shops
F24	SE	125/100	2003	Beef cattle, pigs, sheep	25 sucklers, 150 pigs, 55 ewes	1/2	no, would like to establish butchery	Meat sold in farm shop, farmers markets, box scheme, and other shops

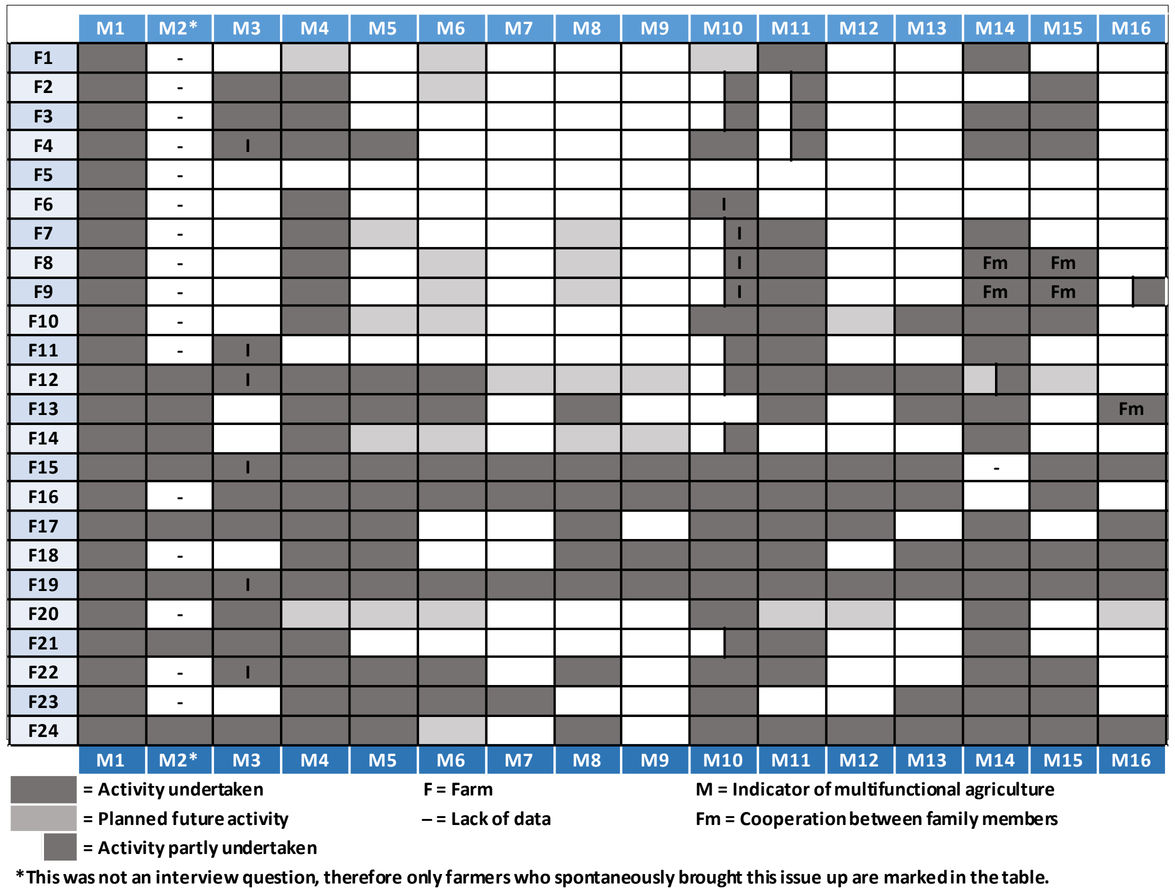


Table 2. Indicators of multifunctional agriculture

Multifunctional aspects of case study farms

The indicators of multifunctionality are listed below along with the results presented in table 2. This overview is in the following supplemented with excerpts exemplifying how the farmers relate to some of the topics at hand.

Indicators of multifunctionality

Theme 1

1) Integrated animal and crop production based on mainly own fodder (ERA)
2) Alternative energy sources/reducing energy consumption
3) Engaged in nature conservation

Theme 2

4) Producing more than one product for the market
5) Producing more than 4 products for the market
6) On farm processing
7) Processing other farmers' products
8) Own farm shop and/or box scheme
9) Marketing other producers' products
10) Selling to local markets, shops, restaurants, institutions etc.
11) Receiving visitors at the farm, organising guided tours
12) On farm tourism, cultural events, social work
13) Use of internet and social media for marketing

Theme 3

14) Cooperation with other producers – land, machinery, labour, produce, manure
15) Cooperation with other producers – marketing
16) Cooperation with local, small-scale processing

Environmentally informed agricultural practices and striving for self-sufficiency

(Indicators of multifunctional agriculture 1-3, table 2.) Among the reasons for converting to organic agriculture are natural constraints in the form of poor soils where application of chemical fertilisers does not result in any significant increase in yields; environmental concerns with pollution; having witnessed negative impacts of conventional practices, in particular on animal welfare; an integrated, holistic perspective on the farm in relation to the environment and within the farm and its parts; the possibility of getting better value for the products and the professional challenge of doing without inputs in the form of pesticides and chemical fertilisers. Of course rationales for taking a big decision like converting to organic agriculture are complex and can be expected to depend on multiple motives connected to economic viability, social and physical wellbeing including personal ethics, wanting to develop one's professionalism, and so on. The farmers' answers show this breadth and the overlapping of motivations. Arja, dairy farmer in Finland (Farm 1), explains her reasons for being organic in this way:

> It's the way I do things, it's natural for me. I want the animals to have a good life and I want to have clover in the field. (…) it's natural for me that what goes into the cow comes out and there must be a circle (…). And the clover is good for the structure of the ground and I want to see worms in the fields and I want to see birds, and I want to see butterflies (…). And I hate pesticides and I am happy that I don't have to be busy with those pesticides and fertilisers. And I think of what is good for the children as well, that this [is a] kind of farm which I want to leave when my son is old enough.

Torbjörn, a farmer in Sweden with pork, beef and lamb production (F24), summarises some of his incentives:

> It's more of a sport! And then it's more profitable (…) So that's the main reason, that it has been more profitable [to convert to organic agriculture]. And then it's nice not to have to deal with those toxins… its crap to have to deal with them. So that's the main reason. And then it's more sport to do it organically. There is less chance of influencing so you have to do it right from the beginning.

As mentioned earlier all farmers in this study are engaged in multifunctional strategies with regard to their integrated farming system with livestock and crop production. Most emphasized the naturalness of this nutrient circulation system for organic farms. Some highlighted the economic aspects of producing their own organically certified fodder which otherwise would neither be available nor affordable to purchase. Yet others spoke of quality and a holistic perspective on the farm, such as Sebastiaan, farm manager at a large biodynamic farm in Poland (F12). He emphasised the importance of feeding cows with roughage and described the integrated system in the following manner. Breeding cows that are adapted to organic production, kept healthy and fed with high quality grass and hay will give high quality milk and good manure. The manure is treated and composted to give healthy soils with good humus content, also supported by crop rotation with 40% leguminous plants and herbs with deep root systems that are simultaneously healthy for the cows. The soil is worked as little as possible, with shallower ploughing as far as possible, and the livestock of the soil is fed which in turn feeds the plants. A challenge that is affronted with e.g. solar panels and wind power is how to integrate sustainable energy supplies in this system.

Dependency on non-renewable energy such as electricity and diesel was mentioned spontaneously by many interviewees both as an environmental challenge, in many cases yet to be faced, as well as a major cost. Remedies mentioned in the interviews are installing solar energy, wind power and biogas plants, and decreasing fuel use by minimum soil tillage. These alternatives are brought up either as current strategies or as plans for the future in order to make farming truly sustainable.

While only seven farmers state that they are formally involved in nature conservation projects for which they receive some compensation, many tell of things they do for the sake of the environment and biodiversity. For example many are engaged in planting trees, in particular apple trees, planting hedges, making a later cut of grass to give ground nesting birds a chance, restoring wetland, creating buffer zones, having permanent pastures, etc. Furthermore, with more or less emphasis several talk about thinking and taking into account the ecosystem as a whole. Louise, beef cattle and sheep farmer in Sweden (F21):

> (...) That the way we do it can be continued. That our grandchildren also should have it fair and clean. Yes, I often think of the totality. About how what I do fit in a broader context. (---) To let things grow where they want to grow and where they can. And also that you have on the farm what fits with the environment so you don't force things too much but you do what nature wants. And that's the way it was with those pastures that had been converted to arable land. It was stony ground and it didn't give much when cultivated. [By reconverting it to pasture] you have done it more the way it wants to be. That's the way I think. I think it's fun to think this way.

She goes on listing many ways in which they support the environment by different methods. In addition to the various measures employed to realise low impact farming, reduce nutrient leaching, and increase the carbon storing humus content in the soil, for example, the farmers also engage in other activities to preserve and restore the environment. Many also express an active interest in and love for nature.

Marketing, processing and other ways to generate income

(Indicators of multifunctional agriculture 4-13, table 2). An integrated farming system with animal husbandry and crop production is obviously more prone to generate more than one marketable output than the specialised system. The farmers' stated reasons for production diversity are: it is a requirement for nutrient circulation within the farm; different agricultural activities support and fit each other (e.g. animal husbandry and row crops); desire to offer their customers a range of products, either within the same line (e.g. different meats) or to be able to furnish several or as many dietary requirements as possible (e.g. cereal products, dairy, cheese, meat, vegetables); different outputs create stability when prices fluctuate or a bad year hits; combining intensive and extensive production; and, diversity also in tasks is seen as enjoyable, some added activities are hobbies, like bee keeping.

Just a few farmers market just one main product, some more have just a few products on the market. These are primarily farmers who lack a local customer base and/or are forced to sell their produce as conventional due to lack of organic processors and/or a market for organic produce. For the most part they are located in the Baltic countries and most of them marketed a more diverse range of products before conversion.

One such case is Jacek in Poland (F11) who used to have beef cattle, pigs, horses, potatoes and different crops. The farm was run conventionally and all types of products produced at the farm were marketed. Through profits from this production he was able to increase his farm from 27 ha to 136 ha between 1982 and 1990. From 1990 prices for farm products went down, the financial situation became difficult and Jacek opted for pigs as the primary production orientation. Low returns on marketed crops made it more profitable to reserve these for the pigs and only sell the animals. After conversion he kept this scheme, in part because he likes the pigs. Relying almost exclusively on export, since he cannot find a market in Poland for the more expensive organic pork, also means he is at the mercy of the exporting company. On one hand he is glad he got a good contract with a large organic company in Denmark which exports his pork to Germany. On the other hand he notices how they function according to the conventional market rationale which constantly demands production increases

> Everything connects to the size of production. (…) If we have a great quantity of products it's easier to sell. The kind of farm, multidirectional [diverse production], that has a lot of products but in small quantities, [has a hard time selling their products]. They have a problem to sell because buyers want to buy commodities. The minimum part per contract is 80 pieces or items [80 pigs according to Jacek's current contract]. (…) I know they predict this amount will grow soon. They would want more than 80 animals, and that would be a problem. In the future this situation will quarrel with self-sufficiency because I would have to increase production to fulfil the contract. That threatens my contract and [increasing the production] threatens the ecological principles. I don't want to increase the farm scale and get treated as a conventional farmer. I had the same situation as a conventional farmer. They wanted more and more, every year they need to buy more products from one supplier. That [pushes] organic farming to be the same [as conventional].

Jacek makes a drawing of a line on a piece of paper to illustrate the conventionalisation of the organic sector. On one end of the line he puts organic production and marketing, where he says costs rise rapidly, and on the other he puts conventional production and marketing. He places the company he sells to very close to the middle, as just barely organic. He also writes the number 0,0001 to illustrate the narrow space within which the company operates, possible from an economic point of view and still legally organic production.

On farm processing

Seven of the 24 farms currently have on-farm processing, and most of these also engage in direct marketing (see table 1 for details). Of the 17 farms without on-farm processing seven either state that they have plans or would like to establish their own dairy, butchery and/or bakery. The basic reason is to keep more of the value-added in marketing processed products. However motivations differ somewhat in the empirical material. For example Susanne and Alfons, who are one of the founding families of their farm community in Germany (F15), express a desire to engage closely with their customers, which was one of the guiding principles in establishing their farm with processing and farm shop.

For Erika and Torbjörn, cattle, pig and sheep farmers in Sweden (F24) who sell meat products under own label but processed by external companies, the main reason for wanting to process their own meat is to have more control over it and be able to offer their customers meats that have been cut and cured in customised ways according to demand. An added benefit would be to be able to utilise the whole animal, e.g. blood and bones, which is not possible under the current scheme.

For others it can have more the character of a necessity. Arthur (F22) says that a prerequisite for having dairy goats, which is an old dream of his, is that they process the milk into cheese themselves. There is no one in their area in Sweden that will take the milk and do it for them. On the other hand it makes them dependent on having someone at the farm who is able to produce good cheese, since cheese making is not their prime interest and it is too much work for which they do not have the time.
Similarly lack of time, money and knowledge may be the biggest hindrances in establishing on-farm processing. For example Arja in Finland (F1) would welcome and is hoping someone will turn up who would like to build up cheese or ice cream making at her farm with the milk she produces. Apropos how to earn better money from her farm she says:

> I think actually there is a possibility to make ice cream or cheese but I don't have time for that, I don't have money for that but I'm totally open if someone would come and say 'give me some milk and I will do ice cream of that' but no one has come yet. (…) I don't know the recipes for cheese or ice cream, and I don't have time, but if there would be someone who can, who knows those things, I'm really open for the cooperation.

Obstacles to on-farm processing and direct marketing

A rather different story is told by Julius in Lithuania (F7). Before conversion the family farm was a conventional dairy farm making their own butter, cottage cheese and sour cream which was sold locally. The keeping of dairy cows was discontinued when the milk prices plummeted in 2007-2008 and Julius decided to convert to organic agriculture:

> And also I had an idea when I wanted to start with the organic farm. In the beginning I wanted to keep the animals because we already had a system of selling. We were quite known and if we would get this organic status it would be some prevalue [higher value] of these products. (…) [However] there is a problem with lack of education, with society education [consumer awareness] and people are looking for the cheaper products.

Another important reason was that organic animal regulation pertaining to drug use against disease at that time was very strict. Since conversion production orientation has changed and now almost all farm produce is exported to Poland, Latvia and Germany.

Added benefits of on-farm processing and direct marketing

Having on-farm processing also means more employment opportunities which are important factors for two of the German farms with dairies, farm shops, etc. In this vein Sören and Julia, farmers at a newly converted farm, also in Germany (F14), are planning for a goat dairy as a way to extend their business and increase their economy without acquiring more land:

> Keeping dairy goats is very labour and land intensive – similar to row crops. This makes it possible to increase the farm's income

> by increasing the amount of labour but not increasing the amount of land. This is unlike cereals, where little labour but a large area is needed to gain sufficient income. Agricultural land has recently become very expensive making it difficult to expand production through land purchase. Therefore the start of the goat farming allows for internal growth. (Koker and Stein-Bachinger 2013: 43).

Susanne (F15) tells the story of how she and her husband Alfons together with two other families (later one more joined) were able to rent a rundown state farm and rebuild it. Direct marketing through a farm shop was part of the plan from the very beginning in 1991. The main reason was a strong wish to establish contact with customers in the area which was new to them. Direct marketing was developed step by step. First they just put up a roadside sign and a street stall selling cottage cheese. A little later they constructed a small shop selling more of the farm's products, such as vegetables. Now they have professional marketing of the farm products and a new farm shop with lots of products also from other organic producers. The new shop attracts significantly more customers as it is light, modern and has a wide range of products ('all' grocery shopping can be done here). In the old shop there was an atmosphere of intimacy which prevented some customers who might not have felt that they 'belonged' to visit. The professionalism of the new shop has made a large difference and it now employs 11 people. Thus the whole farm employs 25 people on 100 ha arable land.

To give an overview, the following market channels are present among the case study farms: private selling to consumers and friends, farm shops, internet shops, box schemes, selling at farmers' markets, retail in city shops, selling through network cooperation, selling to public institutions, restaurants, cafés, selling to large-scale organic or conventional companies, and to exporting companies, large or small. Many of the farmers sell through several channels. Eight of the famers have their own farm shop and four of these are rather big shops selling many other products than the ones produced at the farm. Eight farmers sell their products via internet, sometimes connected to a box scheme, and through farmers' markets. Seven sell most or all through export and four have not found an organic market or processor for their products and are selling them as conventional products without the price premium. The farmers which export all or a big share of their products are located in Poland (2), Lithuania (3) and Estonia (2). The ones who sell some or most of their products as conventional on their national market or through export are located in Lithuania (1), Estonia (2) and Latvia (1).

Farms open for visitors

Almost all farmers in this study receive visitors at their farm. Many are formal or informal meeting places for organic farmers in their area, which several emphasize as very valuable to them. Many also organise guided tours for the general public and receive students on educational study visits and trainees. At least three farms are engaged in green care, receiving people with special needs to take part and get training in farm and household work.

Three biodynamic farms, two in Germany and one in Poland (F15, F16 and F12), have a special focus on social interaction and organise cultural events for all ages. One farm in Sweden (F24) offers the possibility for people to rent a house and have a stay on the farm, experiencing farm life. This turned out to be rather popular so they have plans to expand the housing offered. One farm in Lithuania (F6) also has plans for similar eco-tourism on their farm. One farm in Denmark (F19) has a first year trial with leasing land plots to families wishing to do their own gardening. The farmers provide land, tools, seeds and advice.

Farm development step by step

Almost all interviewed farmers currently have fulltime employment in their farms, though several spouses have other occupations outside the farm. In some cases this seems to be by choice, but in others it is a transitional strategy while building up the farm to have an economy that can support the whole family. Some have found paid jobs closely connected to the farm activities, e.g. as advisors or consultants in farming and marketing, which may create some synergy effects.

Some farmers, notably the three Danish cases (F17-19), built their farms in this step by step manner. By keeping their paid jobs while taking up agriculture, and until a customer base was established for their produce, they could avoid taking loans and always had some economic security and freedom. They also emphasize the importance of listening closely to their customers' needs and produce the kind and amount that they are sure to sell. Farmers at two more newly established farms in Sweden (F20, F22) and one in Lithuania (F6) also speak of this gradual approach to growth, allowing time for the different parts of the farm to develop. Another one (F24) talks about the fine-tuning involved in having just the right number of animals for the available land, like the tailor fitting a suit to one particular body.

Relations with producers, processors, local authorities and research

Cooperation between farmers

(Indicators of multifunctional agriculture 14-16, table 2). Cooperation with neighbouring farmers is very common among the respondents but differ in character and degree. Many have some cooperation with others sharing, borrowing or renting expensive machinery. Several also help each other out during peak seasons, e.g. with the harvest. Leasing land from neighbours is also quite common but some have a deepened collaboration in this regard. A case in point is Arja (F1) who has 65 milking cows plus 75 heifers and calves but only owns 88 ha of land herself which is not enough to be self-sufficient and which also means her cows give more manure than she can sustainably use on her own fields. This is solved through collaboration with neighbours who own land which they do not currently farm themselves.[5] Bjarne in Denmark (F19) tells, like several others, how the conventional neighbours were in the beginning of his conversion to organic agriculture very sceptical but how their perception has changed as they see their organic neighbours succeed both in terms of farm land management and in economic returns. A certain curiosity may even be aroused for machinery and techniques used in organic production. One of Bjarne's conventional neighbours is now receiving his help with mechanical weeding so the neighbour can reduce the spraying to once per season. None of the interviewees said they have negative relationships to their conventional neighbours but many told they are closer to the organic ones. Here sharing of knowledge and supporting each other are important, both in informal meetings as well as meetings arranged through local and national associations for organic farmers.

Producer cooperatives for marketing

Cooperation for marketing purposes is also common. For example Jaan (F3) sells some of his products through Estonia's largest organic marketing cooperative with more than 100 members which is now celebrating its ten years' anniversary. Staffan and Carina in Sweden (F23) are part of a smaller marketing cooperative which coordinates internet and market sales of 7 farms and two small-scale processors. They have weekly phone meetings and about once a month they get together at one of the farms. These social gatherings, and the friendship in the cooperative, is very valuable to them. The cooperative also jointly own a large freezer and a truck for cold transports.

Another positive example of producers finding a practicable way to market their products together comes from Dmitri and Halina's dairy goat farm in Belarus (F10):

> Only a couple of years ago the farm owners had a problem marketing the produced milk and a large part of the time was spent managing direct sales and deliveries at the regional market. However in the last year a close cooperation was started with two web-shops (…) [selling] organic homemade and traditional local food stuffs focusing on organic and sustainably produced food. (…) Today the products from the "DAK" farm are greatly demanded on the market, both because of their unique character and for the engagement of the farmers. All the farm products are sold on the local market in Minsk (Koker and Stein-Bachinger 2013: 9).

Affiliation with associations and other networks

For many organic farmers' associations have been and are important as a place to meet others and learn from each other through study visits etc. Generally the farms which score high in multifunctionality according to table 2 are part of a large number of associations and networks. In fact, some point out that networking is important for them but it is also something that takes up a lot of time.

Research and local authorities

The larger farms in particular are engaged in on-going farm research. Many of the interviewees who currently do not have or never have been part of a research project expressed an interest in closer cooperation with researchers on particular topics of importance to them. Some of the mentioned research areas (both ongoing and wished for) were: soil fertility, crop rotation, soil compaction, green manure, catch crops, weed control, maize and soy cultivation, pig and cattle breeding, on farm slaughter, the farm as an integrated system including processing and direct sales.

A few say they have good relations to their local authorities, mostly through personal contacts with someone at the municipality. Almost all emphasize that they are not and would not like to be dependent on them. To the contrary, several give examples of how they assist with e.g. towing.

For most of the farmers the interaction with local authorities is limited to its controlling agencies, which many regard as burdensome and over bureaucratic. Some also complain that there is a lack of knowledge among the conventionally oriented controllers for issues particular to organic farming or animal welfare in general. Generally this attitude toward local authorities seems similar in all countries in this study.

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5 For more details, see CASE Peltomäki farm in this report.

Sustainable Food Societies Information Centers

Of the ten farmers acting as SFS information centres in this study (F9-F13, F15-F19) interviews were conducted with seven, one third of the total number of SFS. Most of these farmers emphasized their role as exponents and informers of the ERA system and their farms as meeting points for farmers and others wanting to learn more about sustainable agricultural practices. Several spoke of the importance of spreading information about the state of the Baltic Sea and the impact of ERA and their keen interest in being part of that. Expectations have not been met in some instances where the farmer had anticipated more visitors and an enlarged local customer base as a consequence of becoming a SFS. In most cases however the expectation was not that being an SFS information centre would lead to a change in food chain integration, at least not in the short term. Actual such local integration was in almost all cases not associated with SFS membership.

Speaking of benefits of networks some SFS farmers and ERA farmers alike were enthusiastic about the prospects of exchange and learning between themselves and other ERA farmers. In actualising such interchange lack of time was considered a major constraint. Some also expressed a saturation with networks and associations as membership in a number of them is already taking up too much time. Expectations on BERAS' role towards them was otherwise mostly oriented around research and possible collaboration in this regard. This interest had two main lines: addressing some questions of pressing importance for the farmers or further exploring and substantiating ERA principles to gain more scientifically based evidence for organic agricultural practices.

Summary: opportunities and challenges in relation to forming SFS

As evident from table 1 and 2 the case study farms represent a rather broad range in terms of types of farms and degree of integration with local food chains. This diversity brings, on one hand, different opportunities and challenges, and, on the other, is itself strongly influenced by political history, farm history, downstream market opportunities, etc.

Most similarity between the farms in the region as a whole is found in the commitment to environmentally sustainable agricultural practices, of which adherence to ERA is a principal example. Many also engage in environmental issues beyond direct farming measures. For example the main reason for being part of the BERAS project is in several instances to support the environmental objectives of decreasing eutrophication and the thriving of other species.

Independence from upstream markets is high in an ERA system of farming due to the self-sufficiency standard in feed and fertiliser. Dependence on fossil fuels, however, continues to be a major challenge both in economic and environmental terms. While several farmers, notably the biodynamic ones, emphasize principles of the farm as an organism with its different parts acting together in an ecosystemic fashion, others, notably in countries where organic agriculture is not so strong yet, emphasize the impossibility or costliness of purchasing e.g. organic fodder. Only a few farmers overtly criticized the control of upstream and downstream markets by large corporations. Two of these are themselves almost exclusively depending on large retail companies, albeit organic, for the marketing of their meats. Effectively, most of the others have created or are in the process of developing alternative, more local markets, or are selling through diverse channels.

Some of the farms resemble in themselves the concept of Sustainable Food Societies. They have within the farm everything from primary production through processing to marketing of a large number of products. They also have strong networks with other producers, processors and retailers as well as other activities connected to the farm. The most established such examples are in Germany and a similar one is being created in Poland. In Denmark and Sweden there are farms with similar characteristics though in somewhat smaller scale and some under development. This is a sphere where differences between the farms as enterprises are stark and clearly related to several factors of which access to local markets for organic products stands out as a primary one.

There are examples in the case study of farmers in Finland (F1) and Sweden (F21) who are not opting for this kind of broad production diversity and connection with local markets. The general tendency for ERA farmers in Germany, Denmark, Sweden (and perhaps Finland, though not visible in this study), however, is to try to retain more of the value by engaging in several steps of the food chain. These strategies are certainly present also at the farms in the post-socialist countries, but generally the farmers have fewer opportunities but to either market their produce as conventional or send it for export. Major challenges to increased integration between farmers and their local communities are economic capacity and willingness among consumers to pay extra for organic products, according to the interviewed farmers. In some instances it is actually lack of organic processors which stands in the way. Some solve this by, wholly or partly, creating alternatives in the form of own on farm processing or through direct marketing.

The amount of cooperation with neighbours and affiliation with associations and other networks is also correlated with the degree of diversification of the farms. Expensive machinery is made more affordable through sharing. Tasks requiring special competence or seasonally intensive jobs such as harvesting are made more manageable through labour collaboration. Cooperation with other producers, processors and retailers may ease access to and increase competitive advantage in the organic market. Membership in associations increase with the number of activities engaged in, and networking seems to gain in importance as well.

Several of the interviewed farmers expressed thoughts around the future of their farms and potential new social structures in the countryside. Such thoughts are partly connected to the need of making farming more attractive and economically feasible for younger generations, where shared ownership or tasks now performed by one family could be divided between different people. Another part is finding ways to connect more people to the farm with the purposes of spreading knowledge about agriculture and increasing consumption of the farm's produce. Farm 15 stands out as an example where both collaboration within the farm organisation is emphasised and the relationship to customers is given a lot of attention. As some farmers pointed out these are areas which could be expected to increase in importance in the future. These social aspects are also put forward by the SFS concept and would merit more scientific inquiry.

Other ways in which the forming of SFS could support farmers and implications from this study for the forming of SFS are listed below.

Implications for developing Sustainable Food Societies

Drawing on the results of the empirical study this section presents some general observations on how establishing SFS may develop in directions useful to ERA farmers.

- There is a potential in strengthening the local SFS as knowledge centres by and for farmers, organising for example field walks held by ERA farmers and professional advisers, organising courses and training for students, the general public etc. Such activities are already successfully implemented in several of the SFS information centres.
- A SFS network can thus be a meeting place and a channel for spreading information which contributes knowledge and facilitates knowledge exchange between ERA farmers and between farmers and other actors. Many farmers point out how important the contact and exchange of information and experience is, particularly during the conversion period.
- A SFS network can facilitate the establishment of cooperation between farmers and between farmers and other actors. E.g. through the forming of larger entities for deliveries new customers can be sourced. A SFS may also act as vehicle for connections to people with competence which could support a farm in adding a new field of production (e.g. horticulture), developing small-scale processing or get started with direct marketing without draining resources from animal husbandry, crop production and leisure time.
- A SFS network can also support public institutions in finding farmers which can deliver the bulk required, possibly through producer cooperatives, thus enlarging the market for organic and ERA produce.
- Local SFS can help consumers and farmers find each other to establish relationships through e.g. community supported agriculture (CSA).

- A SFS network may support farmers and other actors in solving problems through research, negotiation and contact with relevant expertise.

- A SFS network could act as a bridge to local authorities. Time is a serious constraint for the interviewed farmers. It could be beneficial if local groups could act on local political issues informed by farmers' views and needs but not necessarily requiring their full participation.

- SFS can indirectly support farmers by informing and campaigning for greater awareness among customers, private and public. Establishing or enlarging the customer base is in many of the cases the most pressing issue.

- SFS can communicate good examples of successful conversion to ERA to more farmers and other actors. None of the interviewed farmers seemed to fear competition, on the opposite, most seemed to think they would benefit if there were more actors in their sector.

- By realising fully integrated SFS work load of individual farmers and other actors could be better distributed through deepened cooperation between actors and closer connection between chains in the food system. The status and conditions for farm work could also benefit from better social integration and more cultural elements.

References

Darnhofer, I., Bellon, S., Dedieu, B. & Milestad, R. 2011. 'Adaptiveness to Enhance the Sustainability of Farming Systems' in *Sustainable Agriculture Volume 2*. Eds: Lichtfouse, E., Hamelin, M., Navarrete, M. & Debaeke, P. Springer.

Granstedt, A. 2012. *Farming for the future.* COMREC Studies in Environment and Development no. 6.

Granstedt, A., Schneider, T., Seuri, P. and Thomsson, O. 2008. 'Ecological Recycling Agriculture to Reduce Nutrient Pollution to the Baltic Sea'. *Journal Biological Agriculture and Horticulture,* 26(3) 279-307.

Jones, A., Pimbert, M. and Jiggins, J. 2011. *Virtuous Circles: Values, Systems, Sustainability.* IIED and IUCN CEESP, London.

Koker, W. and Stein-Bachinger, K. (eds). 2013. 'Farm Examples', Vol. 4, in: *Ecological Recycling Agriculture - Guidelines for farmers and advisors.* Eds. Stein-Bachinger, K., Reckling, M., Hufnagel, J. and Granstedt, A. Vol. 1-4. Järna, Sweden. Downloadable through www.beras.eu.

Larsson, M. 2012. 'Environmental Entrepreneurship in Organic Agriculture in Järna, Sweden'. *Journal of Sustainable Agriculture,* 36: 153 – 179.

Marsden, T. & Sonnino, R. 2008. 'Rural development and the regional state: Denying multifunctional agriculture in the UK'. *Journal of Rural Studies,* 24: 422 – 431.

Micha, M. 2013. 'Everything is connected: Challenges and opportunities of multifunctional organic farms in the Baltic Sea region'. Master thesis at Dept. of Human Geography, Stockholm University.

Milestad, R., Ahnström, J. & Björklund, J. 2011. 'Essential multiple functions of farms in rural communities and landscapes'. *Renewable Agriculture and Food Systems,* 26(2); 137–148.

Noe, E., Fjelsted Alroe, H., and Langvad, A.M.S. 2008. 'A polyocular framework for research on multifunctional farming and rural development'. *Sociologia Ruralis,* 48:1–15.

Renting, H., Rossing, W.A.H., Groot, J.C.J., Van der Ploeg, J.D., Laurent, C., Perraud, D., Stobbelaar, D.J. & Van Ittersum, M.K. 2009. 'Exploring multifunctional agriculture. A review of conceptual approaches and prospects for an integrative transitional framework'. *Journal of Environmental Management,* 90: 112–123.

Van der Ploeg, J.D. 2008. *The New Peasantries: Struggles for autonomy and sustainability in an era of empire and globalization.* London: Earthscan.

4. Impacts of ERA farming

Van der Ploeg, J.D. 2010. 'The peasantries of the twenty-first century: the commoditisation debate revisited'. *The Journal of Peasant Studies,* 37:1, 1-30

Van Huylenbroeck, G., Vandermeulen, V., Mettepenningen, E. and Verspecht, A. 'Multifunctionality of Agriculture: A Review of Definitions, Evidence and Instruments', *Living Rev. Landscape Res.,* 1, (2007), 3. [Online Article]: cited 2013.05.06, http://www.livingreviews.org/lrlr-2007-3

Wilson, G. A. 2007. *Multifunctional Agriculture: A Transition Theory Perspective.* Wallingford, Oxon, GBR: CABI Publishing.

Wilson, G. A. 2008. 'From 'weak' to 'strong' multifunctionality: Conceptualising farm-level multifunctional transitional pathways'. *Journal of Rural Studies,* 24: 367–383.

Wilson, G. A. 2010. 'Multifunctional 'quality' and rural community resilience'. *Trans Inst Br Geogr,* NS 35: 364–381

Wiskerke, J. S.C. 2009. 'On Places Lost and Places Regained: Reflections on the Alternative Food Geography and Sustainable Regional Development'. *International Planning Studies,* 14:4, 369-387.

4.5.2 CASE Peltomäki farm

Working with neighbors to reach self-sufficiency in fodder

Maria Kämäri, Jukka Kivelä

Facts about the farm

Arable land
61 ha + 28 ha of rented fields in conversion
Pasture
12 ha
Animal stock
64 Ayshire and Holstein cows (2012) + heifers and calves, total 110 animals
Housing
loose-housing barn (2009) for the cows, calves in group stalls and igloo's
Milking system
1 milk robot (Lely)
Milk production
9,300-9,500 kg ECM /cow
Roughage system
three horizontal bunker silos (6,000 m3) complemented with round bales

Peltomäki farm has started a conversion to organic farming in 2008, soon after Arja Peltomäki took over the farm from her parents. In 2011 farm animals started the conversion.

Reasons for starting the co-operation

Arable land of Peltomäki farm, about 89 ha when counting in the rented fields, is insufficient to meet the demand of fodder. Since there are over 80 animal units at the loose-housing barn and over 100 animal units on the farm, reasonable animal density (0,5 AU/ha) would require over 200 ha of fields and pastures. Relatively high milk production sets demands for the quality of fodder and especially for the protein content of the fodder.

In addition huge investments have been done on the farm recently (loose-housing barn was built in 2009) and the farm capital is not allowing Arja to buy more fields or machines. Arjas' husband is working outside the farm, but there is a part-time employee helping with the cattle. The cattle is keeping both the employee and Arja already so busy, that there is very little time working on the fields and harvesting forage during the summer. Thus, Arja doesn't have the area nor the time needed to produce high quality fodder for the cattle. To reach self-sufficiency in fodder under temporally and economically wise conditions, Arja Peltomäki has made co-operation contracts with neighboring farms.

Co-operation with neighboring farms

Arja has made two different kinds of contracts with four different farms. From two farms she buys grain fodder, such as oat, wheat, peas or broad bean. Fodder is usually dried before arriving to Peltomäki farm, but Arja also has the potential to dry the fodder in case there are some problems on the neighboring farm. The markets for organic grain and fodder are relatively variable and farmers don't always have certainty of getting fodder when needed. The harsh weather conditions in the winter and slippery roads might also limit the truck transportations of the feed industry to the Peltomäki farm. With the co-operation Arja has managed to minimize risks and ensure the supply of grain fodder trough out the year.

With two other farms Arja has arranged a deal which involves the right to use the fields of these farms for silage production and for grazing. These farms are specialized on organic crop production. Since there haven't been any grazing animals on the fields for twenty years, fields are free of pathogen and Arja is very pleased with the extra grazing area. In return Arja is giving out litter, which is a huge benefit for a crop husbandry. Via this contract farms are gaining a true win-win –situation.
Arja is also buying the seed mixtures for the fields, taking care of the planting and paying for the mowing, harvesting and transportation of the silage - done by a contractor. Silage is moved to Peltomäki, where there are three horizontal bunkers silos. In case the distances from the fields are long (>10 km), silage is being packed in round bales.

Conditions for good co-operation

Since there is a lot of organic farmers on the area, finding good companions wasn't too hard. Still, co-operation demands ability for teamwork, openness and reasonable distances. For example, when Arja is using the fields of the farms for grazing, people on the neighboring farm will look over the cattle, supply water and electricity on a daily basis. In addition co-operation wouldn't be too wise if the transportation cost rise too high due to the long distances.

When taking into consideration the price of the arable land on the area, co-operation is economically wise option. Due to the high prices buying of land is out of reach for many farmers. Thus co-operation offers good solutions for organic crop husbandry farms to accomplish diverse crop rotations, receive organic manure and to make the crop rotations even more effective with years of grazing and ley.

General problems in co-operation

When working on a neighboring field, the conditions might not meet the demands of the production. For example, on a crop farm field might not always be as smooth as needed for the mowing and harvesting of the silage. In some cases ditches don't work properly. Under these conditions the

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Beef farm		legume (d.m. kg/ha)	non-legume (d.m kg/ha)	N-legume (%)	N-nonleg (%)	N-harvested (N kg/ha)	N-fix (N kg/ha)	N-FYM (N kg/ha)	N-fix factor (N%)
1. barley (undersown)	barley + clover-grass	2000	2300	3,5	1,75	110,3	120	0	5,0
2. ley	red clover-grass	1600	2000	3,5	1,5	86,0	80	0	5,0
3. ley	red clover-grass	1400	2000	3,5	1,5	79,0	70	0	5,0
4. winter wheat	wheat	0	1400	0	2	28,0	20	0	5,0
5. oats	oats	0	1300	0	2	26,0	0	**164,6**	5,0
	fodder (average/yr)	**1000,0**	**1800,0**	**2800,0**		**65,9**			
0,5	manure							32,9	
TOTAL			**2800,0**	**2800,0**	**2,4**	**65,9**	**58,0**	**32,9**	
	deposit N						5		
Primary N-balance (YIELD/ Primary N)		1,14							
Primary N-balance incl. Deposit		1,05							
circulation factor (p+m)/p		1,52							
surface balance		0,69							

			1/x
N-fixation:	C= harvested biomass of legumes/total biomass of legumes	0,5	2
	B = proportion of fixed nitrogen in legumes	0,7	
	A = average total content of N in legumes	3,5	
	N-fixation factor: A*B*C	4,9	
	"spill over"	0,1	
	FINAL N-fixation factor (N % in harvested legume yield)	5,00	

co-operation might get problematic, if the owner of the field is not too keen on fixing the defects. In general co-operation should also be done at operational level in order to accomplish long-lasting, local and sustainable way to implement organic farming. Problems can still be avoided by planning the contracts carefully taking in to consideration all the issues related to distribution of work and costs.

Visions for the future

In the future Arja is keen to create a working farm unit of four farms with one crop rotation. Now there are several crop rotations being implemented at the same time, which can make the controlling of the co-operation rather difficult now and then. The production of the fodder may vary between the years. There is also a risk that the contractor is too busy harvesting the silage if the hectares of ley expand occasionally on the area. By combining the crop-rotations the shared use of machinery and labor would allow farmers to harvest forage too in a cost-efficient way. Above all, by making a one farm unit, the crop rotations could be designed more precisely and functionally for the local demand of fodder and food. By gathering the knowhow, knowledge, machinery, networks etc. of the four farms, risks could be minimized, costs could be lower and marketing and branding of the products would be easier among other benefits.

Arja would also like to widen the co-operation by working with other entrepreneurs than farmers. She is hoping to find a chef, who will create a unique product or a line of products and perhaps - start processing milk on the farm. Arja has a great respect for people expertise's and she sees that the success lies in teamwork of different professionals. Even though Arja is quite happy delivering milk for the market leading dairy, she would like to develop the production and upgrading of the farm milk by localizing the processing and getting closer to the customers.

4.5.3 Nutrient Efficiency in Fodder for Dairy Cows - in an Ecological Recycling Agriculture context

Moa Larsson Sundgren

Feed efficiency and nitrogen utilization in the modern dairy industry has been evaluated by several researches. Today's dairy production is not built on resource or nutrient efficiency. Maximization of profit has implied a negative impact on both environmental and animal health (Sundgren 1990). Under current practice, to obtain high productivity, cows, who are ruminants, are given proteins from crops that could be used as human food. Balance of nutrition with a high proportion of concentrates has a negative impact on the health and wellbeing of cows. It also affects milk quality negatively. The capacity to use the protein nutrient in concentrates is low (Bertilsson 2001), which contributes to high nutrient losses from the farm and implies low feed efficiency.

The potential of environmentally damaging high nutrient leakage occurs both directly where the concentrates are produced and when digested, as all nutrients that cannot be used for milk production and cow sustenance is lost to the environment. The high level of cereals in cattle's balance of nutrition impacts on the environment and land usage. Today about 80 % of the arable land is used to produce animal feed. The cultivation of clover-rich ley improves soil fertility and structure and the usage of clover-rich ley in crop rotation is crucial to increasing humus content (Granstedt and Kellenberg 2011). Grass and clover ley, when used as a feed for ruminants, not only improves the humus content during cultivation, but also gives back nutrients in the form of manure to the soil and therefore the combination of fodder production of clover-rich ley and milk production can be well suited on a Ecological Recycling Agriculture (ERA) farm.

When calculated from energy intake, energy use, and milk production, an optimum of concentrates in dairy cow feeds is obtained when the balance of nutrition consists of 40-50 % concentrates

(Lund 1998, from Oddmund Saue, 1983). Use of resources and the environmental impact are not considered. The absolute minimum recommendation of roughage is 35 % of dry matter (DM) in the balance of nutrition for cows (Bertilsson & Burstedt 1985). Balance of nutrition in conventional milk production normally consists of only 35-40 % roughage (silage, pasture and hay). In organic production the minimum allowed level of roughage is 50 % of Dry Matter (DM) during the fist three month of lactation and 60 % on a daily rations (EC No.889/2008). It is regulated in organic agriculture as ruminants have a digestive system suited to process roughage (Lund 1998). This is still a high proportion concentrate, often mainly cereals and peas, to digest for a ruminant. While cows have the ability to converting feed sources such as grass and clover from ley into high quality protein for humans, cows are inefficient in converting dietary nitrogen (N) into milk nitrogen (N) compared to simple stomached animals where dietary N is used for growth (Rius et. al. 2010).

Hellstrand (2006) has shown that there has been a dramatic change in fodder strategies in Swedish milk production 1991-1999 when the use of protein in fodder, such as soya, increased with a factor of 2,7 %. The milk production level at the time was constant. Feed efficiency was thus affected negatively and farm economy, as cost per input, increased. According to Hellstrand (2006) farm income decreased with 840 million SEK and the ammonium emission increased by 15% in Sweden. The high quality protein that was used for fodder could have supplied the total protein requirement for 6.6 million people. Changes in fodder strategies in Sweden are now like Denmark, Netherlands and USA (Hellstrand 2008). Swedish milk production corresponds to the average within OECD for similar production levels (Hellstrand 2012). Using the current Swedish N accounting methodology, the above changes in fodder strategies will result in increasing nutrient losses to the Baltic Sea. Hellstrand (2008) estimates that the nitrogen lost to the sea is 6 million kg N. Hellstrand et. al. (2008) recognized that the fodder strategy is an important tool to manage the eutrophication of the Baltic Sea. A change in fodder also has a social impact on a global level which opens up for dairy production in regions, for example in the woodland in the Northern part of Sweden, where conditions are difficult for such production (Hellstrand and Yan 2009). The recommendation for balance of nutrition in conventional dairy production in Sweden (Swedish Milk 2003) is 26 kg N higher per cow than the recommendation for organic dairy production (Andreson).

Olesen et. al. (2006) has shown that the emission of green house gases from cattle production is correlated to the nutrient surplus in the agricultural system. N surplus is thus a possible indicator of losses of green house gases. Where the N efficiency is high the green house gases are lower per production unit. Animals selected solely for milk production also gave higher per unit greenhouse gases combined milk and meat production (O´Brien et. al. 2011). Lighter meat breeds have to an increasing extent been used for meat production which decreases nutrient leakage and increases biodiversity in grasslands. Scenarios described by Kumm (2003) and Hessle and Kumm (2011) have shown that grazing meadows can be a production alternative that can be economically sustainable.

Animals differ in production result in spite of having the same balance of nutrition. Breeding efficient animals decreases input needs and reduces impact on the environment. One of the most important factors to increase productivity and to decrease the negative impacts on the environment is effective feed conversion efficiency. This is achieved through animal health, good genotypes, reproduction ability and a long life (Waghorn and Hegarty 2011). Native breeds are promoted for organic farming since those breeds are locally adapted. One such breed in Sweden, the Swedish Mountain, Fjällko, produces around 5000-6000 kg milk a year. They are known for high lifetime production and good ability to produce milk on roughage (Hallander 1989). Normal dairy cows are selected and raised to obtain high milk yield per year. Intensive milk breeds, such as the Holstein, is a result of such intensive selection. The top bulls are selected from cows that perform high milk production, often in conventional systems, using a high amount of protein fodder. The cows that produce 10 000 kg milk a year are fed a high proportion of concentrates which has environmental issues as noted above. Not only is milk yield per year important, but also lifetime production is an important factor for breeding. This, and the recruitment rate on the farm, is also crucial to achieve a good farm economy. In breeding, it is important to note that a bull´s selective ranking, based on the milk production result of its offsprings, differs if the offspring cows are used in conventional or organic systems. The animals selected for breeding, the top bulls in conventional systems, were not the top bulls in organic systems (Nauta et. al. 2006).

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4.5.3 Nutrient Efficiency in Fodder for Dairy Cows

Milk production on a balance of nutrition based on roughage

As described in chapter 2 high milk production in ERA farming is dependent on the quality of roughage. There are good examples of high milk production among the ERA farms in the project. However lower production levels, to about 6500 ECM, was the average production level of the ERA dairy farms accounted from data collected in the nutrient balances preformed in the project. A milk production level of 6000 ECM was achieved at Tingvall research farm when cows produced milk on roughage only. Many cows in the study produced about 7000 ECM. In a time period of three years 10 Swedish Holstein cows where given roughage; silage, hay and pasture. A control group at the same farm was given an organic based balance of nutrition. The cows given roughage produced in-between 4516-8630 ECM during the three years and in average 5700, 5800 and 6350 ECM. The control group given organic balance of nutrition produced 8550, 8000 and 9500 during the same time period. In the study the cows gave birth in fall. A calving period in spring time would most likely have given a better lactation production. Health and fertility were better for the cows given roughage only. For the cows given roughage the time in-between calving was slightly longer 12,7 month and for the cows given organic balance of nutrition it was 12,2 month. The cow's physical nutrition balance was affected and, especially cows in first lactation cows was affected negatively. The cows got thin during the stable period but recovered and were healthy and fertile (Johansson and Sundås 2002). In one experiment by Steinshamn and Thuen (1999) cows preformed a yearly production of 3767 and 5133 kg ECM on concentrate additions of 5% respectively 25% of total energy intake. The low milk yield in both treatments was, beside the low amount of concentrate levels, partly explained as a result of high proportion of cows in first lactation. Other studies have also shown a milk production about 5000-6000 on very restricted concentrated fodder additions. Milk production level has been lower when concentrate is restricted but on the other hand no health problems were found at research farms (Eriksson 2010).

Those studies are interesting in an ERA context as the opportunity to produce milk on roughage is of importance, both from a resource and a farm sustainability perspective. The clover rich lay is crucial to ERA farming as it builds up the Soil Organic Biomass (SOM) soil fertility and structure. From a resource point of view it is not sustainable to give up to 50% DM cereals and concentrates to cows that can use grass for production. It is, as mentioned in chapter 2, more difficult to compensate a low nutrition harvest of ley in an ERA system. The timing of harvest is of importance for the quality. Different kinds of grass and legume species can be grown to ease the strain on harvest period and weather conditions.

The fodder for dairy cows has different functions and nutrition values. Legumes consist of more protein and minerals while grass consists of more fibre and sugar. The legumes in ley are rapidly digested while grass takes double the time to be digested in the rumen. Cows consume more legumes than grass if they can choose but too much protein can give high levels of urea and have negative impact on fertility. The cow's ability to consume feeds is one limiting factor for high milk production. Ley fodder is rich in easily digested protein and to avoid disturbing the micro organisms in the rumen easily digested carbohydrates are needed. If the ley is harvested in a late stage the cow will not consume as much fodder, but fibre is important for the stomach. If the fibre content in the fodder is too low the fat in the milk is negatively affected. The crude protein is easily digested both in ley, peas and cereals. The type of protein that is slowly digested is difficult to supply in organic dairy production. That is fodder with high AAT (amino acids absorbed from the small intestine) values, commonly found in soy, corn and rape products (Källander 2005). However cows have the ability to build up all amino acids they need by microbes. In a study by Virtanen (1966) showed that cows given urea and ammoniac as only nitrogen sources continued to produce milk, but the milk production was low, 4200 kg ECM. For a cow producing 30 kg milk the microbe protein responded for 35-66% of the AAT (Clark et. al. 1992) and to

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sustain high producing cow fodder that passes undigested to the small intestine, AAT is needed. To build microbe protein energy from fermented carbon hydrates is necessary. With low energy supply a large part of the energy is used to supply the small instance and the usage for milk protein synthesis in the udder is negatively affected. In contrast a good higher energy concentration in the fodder did improve the AAT uptake (Rius et. al. 2010). In this way higher energy concentration in the fodder could partly displace protein (Eriksson 2010). According to Clark et. al. (1992) the energy and N are the nutritional factors that most often limits microbal growth and milk production

A study of organic milk production has shown no negative impact on milk production or on the protein and fat content in milk when the AAT per MJ decreased from 8 to 7,6 AAT per MJ. The level of urea was higher with higher protein concentration in the fodder. The cows in the study had a yearly production of 6500 kg milk per year. Higher levels such as 9000 kg ECM a year is however difficult to achieve without concentrates (Källander 2005). Amino acids are needed to build up the protein in milk and to sustain the cow's body function and most of those necessary amino acids are absorbed from the small intestine. The AAT has mainly two sources, the fodder protein that has not been digested in the rumen, and microbe protein that is created in the rumen out of digested protein. However, if there is too much digested protein in the rumen the level of urea increases in the blood and later in milk and urine. A higher protein level in fodder is therefore visible as urea and as nitrate levels in the urine (Eriksson 2010). Milk urea nitrogen (MUN) was found to be a useful indicator of the efficiency of N utilization and thus N emissions to the environment. The best predictor of MUN was the dietary CP concentration (Nousiainen et. al. 2004).

The nutrient content in roughage to achieve high milk production in an organic dairy farm should be 10,5 to 11 MJ. Increase from 10,5 to 11 MJ then the milk production increases with 5,5 litre of milk (Källander 2005). Roughage also gives a more even lactation curve. The nutrient value in Tingvall was for silage 10,3 and 10,8, for hay it was 9,7 MJ/kg DM. In the Guidelines manual (BERAS Implementation), good quality silage consists of 11 MJ kg/ DM and a crude protein amount of 150-200 g/kg DM and 400-500 g Neutral Determent Fibre (NDF) /kg DM are recommended. In the example the clover content was 30-50%. Arable land to supply one dairy cow (including recruitment) was calculated to be 1.45 to 2.10 ha when elderly heifer stock grazed on natural pastures.

Nitrogen efficiency as measured by conversion from fodder protein to milk and meat production cannot be 100%. The ability to digest protein, an evaluation of 200 northern Europe fodder trials, has shown that the percentage of through digestibility would be 91% (Huhtanen et. al. 2008). In a calculation of theoretical minimum of N losses from a cow producing 25 kg milk 3.5 % protein a day example by Van Vuuren and Meijs (1987) but with a digestibility of 91 % the necessary crude protein would be 2060 per day. This means 12% crude protein. In a balance of nutrition calculation 12 % crude protein would be needed to sustain a cow producing 25 kg milk and energy need of 17 kg ts and 11,5 MJ metabolizable energy (ME) (Eriksson 2010). In a balance of nutrition with 12,1 % crude protein the production decreased from 31 to 27 kg ECM /d from the crude protein level of 16,7% (Weisbjerg et. al. 2010).

In the first BERAS project (Granstedt et. al. 2008) it was concluded that the high level of specialization both on farm and on regional levels lead to high nutrient leakage. This is due to high nutrient input, from fodder on the animal farms and as a result of limited possibilities to recycle all of the nutrient from manure on the farm. The Peltomäki farm is one example of an ERA farm evaluated in the second BERAS project (BERAS-Implementation) that achieves a high milk production on high quality fodder produced on the farm. In this way the Peltomäki farm can keep the nutrient input low to the extended farm system. The milk production is high to be an ERA farm, 9200 kg milk per cow. For the Peltomäki farm the Fababean (Vicia faba) is an important crop to keep the milk production high. The success at Peltomäki farm is explained by healthy cows and a high lifetime production level.

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Conclusions

Improving the ley quality is crucial at an ERA farm, both for dairy production and for crop production as it improves humus content and structure in the soil. The timing and weather conditions is, however, more critical when ley is harvested for feed in dairy production. Cereals and peas that cannot be sold as human feed can compensate a low quality of hay or silage. A good alternative to keep a high production level, as shown in the example of Peltomäki farm, can be to cultivate the Fababean. There is a possibility to compensate a low quality ley, at least to some extent with cereals or concentrates. In some studies the high roughage level has been 70-80% of the DM in balance of nutrition. In the Tinvall study, where high productive cows were given 100% roughage they did get thin and such a balance of nutrition might not be realistic. As the example of Peltomäki shows it is possible to keep a high milk production level in ERA farming. However, it is more realistic to accept a lower level of milk production. Seen from a resource perspective it seems reasonable to grow cereals or vegetables for direct consumption by humans than to use such products as fodder for dairy cows. Single stomach animal uses the N better for growth than dairy cows uses the N for milk, it can still be questionable to give cows all residues from crop production. If dairy cows are looked at as both milk and meat producers the picture might be different. From an economic point of view dairy production can be combined with meat production thus allowing the use of lower quality roughage. As shown from the Peltomäki farm, lack of arable land can be a impediment for dairy farmers that want to convert to ERA. The example of cooperation, explained further in the chapter Case Peltomäki farm, can be an inspiration to think in new ways.

High lifetime production is important from an economic point of view as the cost for recruitment is rather high in conventional milk production systems. The costs of raising a heifer and sorting new good dairy cows should be related to how many lactation periods the cows perform. An average lifetime for dairy cows is about five years, which means three lactation periods. Low recruitment rate means that the cows are held in production for longer time. This gives a high lifetime production and low recruitment rate. The cost for raising cows is to be divided by the years the cow is in production.

When it comes to meat production light meat breeds are more suitable for grazing of meadows and it might not be suitable for ERA farming to hold high productive dairy cow breeds, selected to produce on a high amount of concentrates. That's said, there are within breeds, animal differences on production from roughage. Local breeds or certain breed program focusing on high milk production on roughage could therefore be interesting in ERA farming.

We might need to accept a lower yearly production level on ERA farms as indicated by the average production level found in the ERA farm data. However the milk production level differs between the countries and correlated to higher milk production in respective country. A lower level of production can be compensated economically by a high lifetime productivity and lower recruitment rate. What ERA recommendation would be in percentage of roughage in a balance of nutrition for dairy cows is something that future BERAS projects could look into, striving to find an environmental and economically reasonable and resource effective balance of nutrition.

References

Andresen, N. Utfodringsrekommendationer i ekologisk mjölkproduktion. Hushållningssällskapet i Kristianstad.

Bertilsson J. & Burstedt E. 1985. Utfodringsåtgärder. Vallfoder eller spannmål till korna? Aktuellt från lantbruksuniversitetet 411, Husdjur.

Bertilsson J. 2001. Konferensrapport Ekologiskt lantbruk Ultuna 13-15 november. CUL.
Clark J.H., Klusmeyer T.H., Cameron M.R. 1992. Microbal Protein Synthesis and Flows of Commission Regulation (EC) No 889/2008 Laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 http://eur-lex.europa.eu/LexUriServ.do?uri=CONSLEG:2008R0889:20130701:EN:HTML 2013-08-31
Nitrogen Fractions to Duodenum of Dairy Cows. Journal of Dairy Science 75: 2304-2323, August 1992

Granstedt, A., Schneider, T., Seuri, P and Thomsson, O. 2008. Ecological recycling agriculture to reduce nutrient pollution to the Baltic Sea. Biological Agriculture and Horticulture 26: 279-307.

Granstedt, A. Kellenberg K. 2011. Skilleby long term field trial 1991-2010 final report June 2011, Biodynamic Research Institute http://www.jdb.se/files/Skilleby-long%20term_field_reial_1991_2010.pdf (2013-08-24)

Hallander H. 1989, Svenska Lantraser. Bokförlaget Blå Ankan AB Veberöd
Hellstrand, S. 2006 A multi-Criteria Analysis of Sustainable Effects of Increasing Concentrate Intensity in Swedish Milk production 1989-1999. Environmental, Development and Sustainability, Kluwer Academic Publisher 8: 351-373

Hellstrand, S., Sumelius J. and Bäckman S. 2008. Ekonomiska och miljöeffekter for olika åtgärder att begränsa Östersjöns övergödning- kan den gröna marknadskraften bidra? Discussion paper n:o 23, Department of Economics and Management, 39p. http://www.helsinki.fi/taloutiede/abs/DP23.pdf (2011-02-25)

Hellstrand S. 2008. Ekonomisk och miljömässig optimering av svensk mjölkproduktion, rapport för Svenska Naturskyddsföreningen

Hellstrand S. and Yan J. 2009. The potential to increase sustainable global green energy production through increased efficiency in milk and cattle production: a Swedish case. First International Conference on Applied Energy, January 5-7, 2009 Hong Kong

Hellstrand S. 2012. Animal production in sustainable agriculture. Manuscript

Hessle A. and Kumm K-I. 2011 Use of breed steer for profitable management of biological valuble semi-natural pastures in Sweden. Journal for Nature Conservation 19: 131-136.

Huhtanen P. Nousiainen J.I Rinne M. Kytölä K. Khalili H. 2008. Utalization and Partition of Dietary Nitrogen in Dairy Cows Fed Grass Silage-Based Diets Jorunal of Dairy Science 91: 3589-3599

Johansson B. and Sundås S. 2002. Mjölkproduktion med endast grovfoder på Tingvalls försöksgård. Fakta Jordbruk 18

Kumm K-I. 2003. Sustainable management of Swedish semi-natural pastures with high species diversity. Journal of nature Conservation 11: 117-125.

Källander I. 2005. Ekologiskt Lantbruk odling och djurhållning. Bokförlaget Natur och Kultur

Eriksson T. 2010. Hur lite protein behöver kon? Djurhälo-& utfodringskonferens 2010 Svensk Mjölk

Nauta WJ, Veerkamp RF, Brascamp EW, Bovenhuis H. 2006. Genotyp by Environment interactions for milk production trails between organic and conventional dairy cattle production in Netherlands. Journal of Dairy Science 89: 2729-2737.

Nousiainen J. Shinhfield K. J. and Huhtanen P. 2004. Evaluation of Milk Urea Nitrogen as a Diagnostic of Protein Feeding Journal of Dariy Science 87: 386-398

O´Brien D., Shalloo, L., Buckely, F., Horan, B., Grainger, C.. Wallace, M. 2011. The effect of methodology on estimates of greenhouse gas emission from grass-based dairy systems Journal of Science Agriculture Ecosystems & Environment 141: 39-48

Olesen J. E., Schelde, K., Weiske, A., Weisbjerg M.R., Asman W.A.H., Djurhuus, J. 2006-Modelling greenhouse gas emission from European conventional and organic dairy farms. Agriculture Ecosystems & Environment 112: 207-220

Lund V. 1998 Mjölkproduktion. In: Granstedt A., Bovin H., Brorsson, K-Å., Rölin Å. 1998. Ekologiskt Lantbruk. Bokförlaget Natur och Kultur/LTs förlag

Rius A.G., McGilliard M.L., Umberger C.A., Hanigan M.D. 2010. Interactions of energy and predicted metabolizable protein in determining nitrogen efficiency in lactating dairy cow. Journal of Dairy Science may; 93(5):2034-43.

Steinshamn H. and Thuen E. 1999. Effects of concentrate level in organic milk production In: Ecological Animal Husbandry in The Nordic Countries Proceedings from NJF-seminar No. 303 September 1999. http://orgprints.org/3057/1/dar_2.pdf (2013-08-24)

Sundgren P-E. 1990. Alternativ Husdjursavel. Seminarium HFÄ

4. Impacts of ERA farming
4.5.3 Nutrient Efficiency in Fodder for Dairy Cows

Svensk mjölk. 2003. Kvalitetssäkrad mjölkproduktion: Kvalitetssäkrad utfodring av Mjölkkor. Eskiltuna

Virtanen A. I. 1966. Milk production of Cows on Protein-Free Feed. Sceince 153: 1603-1614

Waghorn G. C., Hegarty R. S. 2011. Lowering ruminant methane emission through improved feed conversion efficiency. Animal feed Science and Technology 166-167 (2011) 291-301

Weisbjerg M.R., Kristensen N. B., Hvelplund , T., Lund, P., Lovendhal, p. 2010. Malkekoens production ved reduceret kvaelstoftildelning I. Malkekoens biologiske potential for reduceret udskillelse af fosfor, kvaelstoftildelning og metan. Intern rapport. Husdyrburg nr 22 Det jordbruksvidenskapligr fakultet. Aarhus Universitet.

5. Conversion to Ecological Recycling Agriculture (ERA) in the Baltic Area – proposed action in the framework of the BERAS Implementation Project

Per Wramner

Introduction

The purpose of this paper is to summarize and analyze, from a policy perspective, the most important preconditions for a Conversion to ERA[1] that have been identified during the execution of the BERAS[2] Implementation Project (2010-2013). Focus is on obstacles to and limitations for conversion to ERA and ways to overcome them. Priority has been given to measures that can be applied by all or most Baltic countries at their national level. The general measures proposed in the paper will be supplemented by country-specific measures which are tailor-made for each country by the BERAS Implementation partners as a part of their commitment within the framework of the Project´s Work Package 4 (WP 4). The paper is intended to be a common basis for the elaboration of such specific measures.

1 *Ecological Recycling Agriculture*

2 *Baltic Ecological Recycling Agriculture and Society*

This paper is also intended to constitute a basis for measures by international organizations, governments, governmental agencies, NGOs, farmers etc. to promote conversion to ERA or promote measures to reduce negative environmental impacts of conventional agricultural methods by applying individual components of the ERA concept. It should be underlined that such individual components of the ERA system, e.g. crop rotation, biological nitrogen fixation and reduction of animal density, can also be used in conventional agricultural systems to reduce their negative impacts on the environment.

The BERAS concepts have been developed through two transnational projects part-financed by the European Union and Norway (the Baltic Sea Region Programme), BERAS (2003 – 2006) and BERAS Implementation (2010 – 2013). The projects are the result of common efforts by the partnership from nine countries around the

Baltic Sea (Sweden, Denmark, Germany, Poland, Belarus, Lithuania, Latvia, Estonia and Finland) as well as Russia and Norway. They include national and local authorities, universities and research institutes, advisory services, ecological and environmental NGOs, farmers' organizations, food chain actors and finance institutions.

The BERAS projects have developed and implemented practical examples where research, innovation and entrepreneurship from a multi sectorial engagement flow into realistic fully integrated ecological alternatives for the whole food chain from farmer to consumer.

This report has been prepared by the BERAS Implementation Policy Group (chaired by Per Wramner, Sweden). It is mainly based on available literature, official documents and inputs from BERAS Implementation Partners (in particular from Leif Bach Jørgensen, Denmark). Drafts prepared by the BERAS Implementation Secretariat have continuously been discussed in the Policy Group. Policy issues were also discussed at the BERAS Implementation Conferences in Järna 2011, Riga 2012, Tallinn 2013 and Gdansk 2013.

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Background

The Baltic Sea – international environmental agreements

The environmental situation of the Baltic Sea, not least the eutrophication, is worrying and causing growing concern among the riparian countries. An extensive international cooperation to address the situation has gradually begun. The BERAS Implementation is basically an agricultural project but has its roots in, and aims ultimately at a reduction of, the eutrophication of the Baltic Sea.

The key international fora for Baltic environmental issues are EU and HELCOM.[3] Both stand behind policy documents of great importance in this context.

EU

The EU Strategy for the Baltic Sea Region (EUSBRS) is an important starting point for the member countries as regards environmental conservation in the Baltic Sea. "Save the Sea" is the first of its three objectives and aims at achieving good environmental status by 2020, as required in the EU Marine Strategy Framework Directive, and favorable conservation status as required in the EU Habitat Directive and the EU Biodiversity Strategy. In addition, coastal waters have to be in good status and emissions of nitrogen limited according to the EU Water Framework Directive and the EU Nitrate Directive respectively.

The Baltic Sea Action Plan

Another starting point that is more of a policy nature is the HELCOM Baltic Sea Action Plan (BSAP).[4] It points out eutrophication as a major environmental problem of the Baltic Sea and provides for far-reaching measures to reduce the loads of nutrients.

BSAP is a political document of great importance to the BERAS Implementation Project. One of its overarching objectives is a sea unaffected by eutrophication. All governments around the Baltic Sea have

3 HELCOM (the Helsinki Commission) is the governing body of the "Convention on the Protection of the Marine Environment of the Baltic Sea Area" (the Helsinki Convention).

4 The Helsinki Commission 2007: The Baltic Sea Action Plan.

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committed themselves to take action to, inter alia, accomplish country-specific reductions of their N and P flows to the Baltic. BSAP has established the following ecological objectives specifying its eutrophication goal:

- Concentrations of nutrients close to natural levels
- Clear water
- Natural level of algal blooms
- Natural distribution and occurrence of plants and animals
- Natural oxygen levels

According to the BSAP, the following reductions in N and P flows are required to achieve its eutrophication goal:

- N should be reduced from 737 000 to 600 000 tonnes/year.
- P should be reduced from 36 000 to 21 000 tonnes/year.

However, more far-reaching reductions will probably be needed. Research has made progress since the BSAP was decided upon in 2007. The water flow in rivers falling into the Baltic Sea has increased due to climatic changes. The oxygen situation in the Baltic still shows a negative trend. According to official Swedish sources, the extreme oxygen conditions in the Baltic Proper continue. Both the areal extent and the volume of hypoxia and anoxia area elevated to levels never seen before.[5]
The following general conclusion regarding agriculture and the eutrophication goal of the BSAP can be made:[6 7 8]

- The Baltic Sea suffers from heavy eutrophication which constitutes a serious envi-ronmental problem.
- Nitrogen (N) and phosphorous (P) are main agents behind the eutrophication of the Baltic Sea.
- Agriculture is the source of about half of the anthropogenic N and P flows to the Bal-tic Sea.
- Measures to improve the environmental situation in the Baltic Sea have to include substantial reductions of N and P flows from agriculture.
- A business-as-usual scenario for agriculture during the next decades will mean a sub-stantial increase of these flows.

5 Hansson, M. et al. 2013: Oxygen Survey in the Baltic Sea 2012 – Extent of Anoxia and Hypoxia, 1960-2012. SMHI Report Oceanography No. 46, 2013.
6 Granstedt, A. 2012: Farming for the Future – with a focus on the Baltic Sea Region. BERAS Implementation Reports No. 2.
7 Havsmiljöinstitutet 2012: Havet 2012. Om miljötillståndet i svenska havsområden.
8 HELCOM 2005: The Fourth Baltic Sea Pollution Load Compilation (PLC-4). Baltic Deal Environment Proceedings. No. 93.

- It will probably not be possible to achieve the goal within the framework of the pre-sent, highly specialized agricultural system. Therefore, more far-reaching measures, probably implying a system change, including from linear to more closed recirculating systems, will be required.

General development of agriculture in the Baltic area

The modernization of agriculture in Northern Europe during the last 100-150 years increased yields immensely. At the same time, it led to a uniform, biologically depleted agricultural landscape and a number of other negative impacts. Most serious of these impacts are reduced biodiversity, water pollution, spread of toxic substances in the environment, climate-changing emissions and the loss of cultural capital.

Most of the environmental impacts of farming relate to land use and the intensity of that use. Generally speaking, the greater the intensity, large-scaleness and specialization, the greater the negative impacts. Yesterday´s agriculture, with its close coupling of crops and animal production, reliance on local resources, small scale and variety, was environment-friendly and depleted very little of our planet's basic natural resources. It was conducted in – and it created – an agricultural landscape that produced important natural and cultural assets. Among these assets were pastures and meadows with their rich biodiversity.[9 10]

Of particular importance in this context, is that the modernization, broadly speaking, implied a change from more or less closed cycles of nutrients to linear systems with a continuous supply of nutrients from outside. Nutrient recirculation is replaced by nutrient efficiency. Supply of nutrients is mainly guided by what is profitable. In this respect, agriculture differs significantly from most other sectors of society that strive for closed cycles and apply various tools to this end. There is no way back to the agriculture of the past, but older practices have left us a heritage that we can learn from, make use of and develop through further research. In the interests of nature conservation, efforts are being made to preserve the remnants of the traditional agricultural landscape, particularly through environmental payment systems financed by Rural Development Programmes of the EU.

Beyond that, there are aspects of older farming practices that may be adapted and applied to improve present and future farming practices. In particular, they can help to reduce the negative environmental

9 Wramner, P. och Nygård, O. 2013: Småskalig livsmedelsproduktion som ett instrument för att främja naturvården i odlingslandskapet. COMREC Studies in Environment and Development 7.
10 Kumm, K.-I. 2011: Den svenska kött- och mjölkproduktionens inverkan på biologisk mångfald och klimat – skillnader mellan betesbaserade och kraftfoderbaserade system. Jordbruksverket Rapport 2011:21.

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impacts of larger scale and increased specialization on either crop or animal production. Specialization has increased the need for synthetic fertilizers and imported fodder.

The imbalance on larger animal farms between fodder production and the scale of animal production have serious and far-reaching consequences. It leads to surpluses of manure and urine which leak plant nutrients to surrounding streams and bodies of water. The load of nitrogen and phosphorus originating in agriculture is a major cause of eutrophication of the Baltic Sea. A lot has been done – and is being done – to reduce the pollution of the sea from agriculture. However, measures taken up to now do not go beyond the framework of current agricultural policies.

It is evident, that we must do far more than is being done today. A substantial reduction of the load of nutrients emitted from agriculture to the sea requires much more than continued trimming of conventional agricultural practices. New farming and food systems that affect the root causes instead of symptoms and thereby drastically reduce the negative environmental impacts are urgently needed. Conversion to ERA is one way to achieve such a comprehensive system reform.

Need for research and development according to the Standing Committee on Agricultural Research (SCAR) of the European Commission

SCAR – an official body with high authority and credibility – published in 2011 an overview of the need for agricultural research and development (R&D) in the European Union.[11] R&D has been a key component in the BERAS Implementation Project and should be included in all future efforts to promote conversion to ERA. The SCAR report begins with a list of current or future problems that have to be solved:

- The increasing scarcity of natural resources and destabilization of environmental systems represents a real threat not only to future food supplies but also to global stability and prosperity.
- Many of today´s food production systems compromise the capacity of Earth to produce food in the future.
- Our current food system relies on the provision without cost of a variety of ecosystem services. The food system may negatively affect the environment and hence harm the ecosystem services upon which not only the food sector itself but also other sectors rely.
- The current specialized, large-scale, high-tech and high-yield agriculture does not represent modernity and the future. It is not even profitable if the environmental costs are included and/or the Polluter Pays Principle is applied.

11 SCAR 2011: Sustainable food consumption and production in a resource-constrained world. EC-SCAR 3rd Foresight Exercise.

- Our average diet with high intakes of meat, fat and sugar is a risk for human health, social systems and the environmental life support systems.

Two ways forward are described:

- **Building on existing technologies and knowledge systems**. This first approach expands and intensifies ongoing research and development on productivity and sustainability.
- **Developing radically new farming systems.** This second approach has as a starting point that agriculture is a vital component in the management of natural resources. It emphasizes the importance of a holistic and systems-based approach to production and sharing of knowledge. One example of its application is ERA.

The second approach is strongly recommended by SCAR as the only realistic one in the long run. The following general policy in the fields of agriculture, food etc. is proposed in the SCAR report:

- Coherence between food, energy, health and environmental policies, across all levels of governance, are prerequisites for a timely transition to sustainable and equitable food systems.
- A radical change in food consumption and production is unavoidable to meet the challenges of scarcities and to make the European agro-food system more resilient.
- Incorporating the true costs – or benefits – of different productions systems on eco-system services is a powerful way to incentivize sustainability.

As regards R&D, SCAR proposes the following guidelines:

- R&D and agricultural knowledge systems must be fundamentally reorganized – a paradigm shift is required.
- A transition to sustainable food production and consumption requires comprehensive, cross-disciplinary research, linking together agri-cultural, environmental, social and health concerns under the principle of sustainability.
- This means, e.g., that research on lifestyles, diets, consumption, food provision systems etc. should apply the criteria of sustainability.

R&D in line with the SCAR report has been a lodestar for the BERAS Implementation Project and is strongly recommended to play a similar role in all future following-up activities. ERA offers solutions to the basic policy insuffiencies and problems highlighted by EC-SCAR.

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Ecological Recycling Agriculture (ERA) and Nutrient Management

ERA

ERA is organic agriculture using local resources and integrating animal and crop production (on each farm or cooperating farms in close proximity). ERA is based on three fundamental ecological principles: utilization of renewable resources, recycling and biodiversity conservation. The number of animals is balanced with what the available land of the farm can produce in fodder (0.5 – 1.0 animal livestock units/hectare). The manure is used as fertilizer. This means that a large part of the nutrient uptake in the fodder production is effectively recycled. Surpluses of N and P are largely avoided. Combined with the cultivation of leguminous grassland (e.g. clover), as part of crop rotation, the farm can reach a high degree of self-sufficiency in fodder and manure. The norm is at least 80 % self-sufficiency.

As in other organic agricultural systems, no chemical fertilizers and pesticides are used in ERA.

The concept of ERA was developed by BERAS (2003-2006), an EU-supported project that involved farms in all EU Member States around the Baltic Sea, and refined by the BERAS Implementation Project. It represented a broad, holistic approach to the use of ERA methods to reduce leaching of nutrients from agriculture to the aquatic environment and lighten the negative environmental impacts of farming more generally.

The following conclusions can be drawn from the BERAS Project:[12 13]

- ERA is an efficient way to substantially reduce the N and P flow from agriculture. This is achieved by applying the principles of recycling trough integration of crop and animal production on farms (or farms in close cooperation) with an animal density adapted to the own fodder production in combination with best known agricultural technique to reduce losses of plant nutrients. Focus is on wise management of plant nutrients, characterized by balance between different components of the farming system, efficiency and circulation.

- Scenarios based on ERA farms show that a complete conversion to ERA will result in a far-reaching reduction of flows from agriculture trough reduced surplus of plant nutrients.

- For N, the reduction will be 47 %. For P, the reduction substantially eliminates the surplus.

- The soil organic matter is increased, thereby enhancing fertility, increasing water holding capacity, preserving soil biodiversity and removing carbon from the atmosphere.

- The energy-consuming and polluting production and transport of fodder and fertilizers are reduced.

- Biodiversity is also conserved trough diverse crop rotation and management practises that imply no use of pesticides.

- ERA represents a farming system that is fundamentally different from traditional agriculture. From the perspective of flows from agriculture of N and P, ERA addresses the root causes while protection measures within the framework of traditional agriculture mainly address the symptoms. This is the basic advantage of ERA as regards pollution compared to traditional agricultural systems.

- In comparison to conventional agriculture, ERA produces a high number of added values, including ecosystem services and other public goods. Still, the yield is only slightly lower than in conventional agriculture.

In summary, ERA is an efficient tool to provide farming systems that are more environmentally friendly and sustainable than conventional farming systems, not least as regards the N and P flow from agriculture. Thus, ERA has a potential to contribute significantly towards sustainable development of rural areas.

The results of the BERAS Project were encouraging and it was a natural step to follow it up in a new EU project, BERAS Implementation (2010-2013).

Nutrient management in general

Improved nutrient management in a wide sense is the backbone of the ERA concept and the key to the reduction of the N and P flow from agriculture. However, it should be underlined that a number of measures, in addition to a conversion to ERA, can be taken to reduce that flow, even if ERA, thanks to its focus on root causes (not symptoms) and changes of the whole agricultural system, is very efficient compared to other measures, also in combination. Some general nutrient management measures can also be important tools to facilitate conversion to ERA and constitute important steps in such conversion.[14]

12 Granstedt, A., Schneider, T. and Thomsson, O. 2008: Ecological Recycling Agriculture to Reduce Nutrient Pollution to the Baltic Sea. Biological Agriculture and Horticulture, Vol. 26: 279-307.

13 Larsson, M., Granstedt, A. and Thomsson, O. 2011: Sustainable food systems – targeting production methods, distribution and food basket content? Organic Food and Agriculture, Book 1. ISBN 979-953-307-117-5.

14 Granstedt, A. 2012: Farming for the Future – with a focus on the Baltic Sea Region. BERAS Implementation Reports No. 2.

A basic measure is to reduce the inputs of nutrients, to change today´s dominating norm of economically optimal application, i.e. to fertilize up to the level where the fertilizer costs more than it yields. Because of the diminishing marginal returns, this means that great reductions are possible at low costs. The last 20-30 % of inputs make little difference as regards yields.[15]

Nutrient management is already well established as a tool to reduce N and P flows from agriculture, albeit at a completely inadequate level to achieve sufficient reduction of these flows. The tool includes EU legislation (Nitrate Directive), national legislation, extension, financial support (environmental payment) etc. However, its focus has been more on symptoms than causes. Its scope and level have been insufficient. It has focused on manure while artificial fertilizers have been largely unregulated.

To become a more effective tool, nutrient management has to change focus. The total nutrient flows have to be considered and a system perspective applied. One interesting step in this direction was taken by Denmark when a system of nutrient bookkeeping was introduced. The result was that the loss of N was halved. The production level was not significantly affected. The system was not affected by any policy restrictions as more stringent protective measures are allowed in the EU environmental legislation.

15 *Sutton, M.A. et al. 2011: The European Nitrogen Assessment. Cambridge University Press.*

There are several ways to reduce the flow of N and P from agriculture. They usually complement each other but may also be mutually exclusive. A selection of relevant ways could be as follows:[16]

- **Advice to farmers.** This way has been applied in several countries with limited success. It is evident that extension alone has not enough impact to significantly reduce the flow of N and P from agriculture. At the same time, extension has to be an important component of all other methods. For example, improved advice on crop rotation could easily contribute to the reduction of N and P flows.

- **Bookkeeping at the farm level.** The experiences of this system, e.g. in Denmark, are quite positive. The system is general, exact and easy to adjust once in place. But it is also complex, costly and probably not feasible everywhere. In Denmark, it is mainly surpluses that have been affected. Further steps to reduce flows have to include change of agricultural systems and/or targeted measures with a specific focus on problem areas.

- **Financial support for reduction.** This method has been applied in several countries (e.g. Finland and Estonia).

16 *Einarsson, P. 2012: Policy interventions for ecological recycling agriculture. Available options for governments in the Baltic Sea Region. BERAS Implementation Reports No. 1.*

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It is inexact, unless combined with bookkeeping, and not very cost-effective.

- **Permanent extensification.** This is a cost-effective and efficient measure, particularly for vulnerable areas, that can be accomplished in various ways (e.g. choice of farming method or crop). Conversion to perennial pastures is one key component. Permanent economic compensation will probably be needed. This measure should be used selectively and to a limited extent to avoid significant production cuts and resulting import from countries with less stringent environmental standards.

- **Reduction of legal stocking rates**. Stricter regulation of animal density on farm level is urgently needed. Stepwise reduction should be included in all policies, including farm investment support schemes, particularly when it comes to larger livestock holdings. The required legislation is largely in place already. There is just a need to adjust figures. A positive effect is the impact on the whole agricultural system, for example reduced regional specialization. This means a step towards ERA. A problem is the large investments in the current structure which presuppose incentive schemes to facilitate conversion to ERA.

- **Fees on nutrient surpluses.** This method was previously applied in Sweden and Finland in the form of a tax on chemical fertilizers but has unfortunately now been abandoned, despite relatively good experiences. The method should consider the total nutrient flows but primarily include artificial fertilizers and commercial feedstuffs . Focus should be on nutrient efficiency related to the final output. This requires bookkeeping. The fees have to be high enough to significantly affect the use of artificial fertilizers and commercial feedstuffs but can – and should – be recycled to the agricultural sector in a way that is neutral from a production perspective. The level can vary according to the amount of negative impacts caused by various types of agriculture in various geographical environments. It is important that such fees are designed so that they contribute to more efficient management of plant nutrients without causing significant reduction of production.

- **Ecological agriculture.** This agricultural system usually implies a substantial reduction of N and P flows compared to conventional systems. It also means a great step towards ERA. There is a need for economic and other support for conversion as well as information to the whole food chain. Support for depreciation of loans for investments in large-scale, specialized animal or crop production will be of specific importance. All actors, from producers to consumers, should be included in the conversion process.

When discussing the described measures, attention should also be paid to the pronounced spatial variation regarding some key factors that is commonly found. Such factors are the natural environment and its vulnerability (geology, climatology, hydrology, ecology etc.), land use (historical and present), water regulations, type and intensity of agriculture, existing environmental conservation programmes etc. More targeted approaches to address environmental problems caused by agriculture are urgently needed. For example, it is important to identify hot spots that should be prioritized in the work to reduce negative environmental impacts of agriculture.

Geographically focused measures could include mandatory improvements of larger livestock holdings (e.g. > 75 animal units), mandatory use of best available technology (e.g. GPS) to increase management efficiency, establishment of water plans according to the EU Water Framework Directive, promotion of low input farming (a concept that may be environmentally effective and a step towards ERA but is rather vague) etc. It is necessary to have similar environmental standards in all EU countries to avoid movement of environmentally harmful agricultural activities (e.g. large pig factories) from one EU country to another.

Most of the described measures to reduce N and P flows from agriculture imply both improvements from an environmental perspective and steps towards a conversion to ERA. Therefore, all such measures should be promoted as far as possible. It should be underlined that the environment in the short run will benefit more from small such steps within the framework of conventional agriculture, that are generally applied, than from the full conversion of a limited number of conventional farms.

Three levels or steps in the increased environmental friendliness of agriculture and in the transition from conventional agriculture to ERA can be discerned. They are all addressed by the BERAS Implementation Project. The *first level* is conventional agriculture that has taken measures to reduce the negative impact on the environment (in particular as regards loss of plant nutrients) in addition to today´s norm. The *second level* is ecological (organic) agriculture without a far-reaching circulation of plant nutrients. The *third level* is ERA which in this context can be named an organic plus agricultural system.

The BERAS Implementation Project

The objective of the BERAS Implementation Project is to facilitate and promote the establishment of ERA farms in the Baltic Sea catchment area, particularly in intensive agricultural areas, and thereby contribute to reduced inputs of nutrients and pesticides to the Baltic Sea. The Project shall also contribute to the development of integrated Sustainable Food Societies (SFS) and to other environmental benefits linked to ERA.

The Project focuses on the actual transition from conventional practices to ERA with a view to identifying measures that can facilitate the transition. The Project covers (1) agricultural aspects of conversion, (2) the role of food preferences and patterns of consumption, (3) policy issues and (4) education and information.

Achievements

Agriculture

A number of measures to promote and facilitate conversion to ERA have been taken. These include:

- A comprehensive textbook on ERA has been published.[17]
- Guidelines on conversion to ERA for farms with different types of production, including sections on practical agriculture, economic and market aspects, have been compiled.[18]
- Advisory services to farmers who wish to convert to ERA have been given.
- Research and development on ERA methods, including studies of model farms and continued field trials, have been carried out. To a large extent they are continuations of earlier BERAS studies. The model farms represent different production types, e.g. specialized animal or crop production.
- Networks of ERA farms in different countries have been established for exchange of experiences of conversion.

17 Granstedt, A. 2012: Farming for the Future – with a focus on the Baltic Sea Region. BERAS Implementation Reports No. 2.

18 Stein-Bachinger, K., Reckling, M., Hufnagel, J. & Granstedt, A. (eds.) 2013: Ecological Recycling Agriculture - Guidelines for farmers and advisors. Vol. 1-4

Food
Several measures to link ERA and consumption of organic food to the mutual benefit have been taken. These include:

- **Sustainable Food Societies** (SFS) consist of different actors in the food chain (farmers, processors, distributors, consumers etc.) which are connected to each other in local market clusters or networks. Such societies have been – or are being – established in all participating countries (altogether about 20 Societies). The goal is to establish new and closer relationships between all actors based on increasing consumption of ERA products, thereby strengthening the position of ERA farmers. The Societies will also function as centres for learning and knowledge exchange and inspire similar initiatives. SFS have a potential to promote both conversion to ERA and a general economic and social sustainability in rural areas that is beneficial for continuous ERA. In particular the role of SFS to contribute to the development of compelling alternatives to intensive, large-scale agriculture should be underlined. The SFS could thereby counteract the clear trend in all EU countries towards intensification and size rationalization. Smallholdings are increasingly abandoned, not least in eastern countries. The current CAP and foreign investments in agricultural land contribute to this development.[19]

- **Diet for a Clean Baltic** is one of the key concepts developed by the BERAS Implementation Project. It is basically an activity aiming at clarifying, drawing attention to and creating understanding among consumers for the close link between the food consumption patterns and the environment of the Baltic Sea as well as in the agricultural landscape in general. Such a diet should be characterized by (1) tasty and healthy food, (2) food with a high proportion of organically grown raw products, (3) locally produced food, (4) food according to season, (5) reasonable amounts of meat (< 20 %) and (6) minimization of food waste. All links in the food chain have been involved in the development of the concept. The endeavor was to make the concept as far as possible decentralized and market driven. A key role in its development was played by the Municipality of Södertälje where it also was successfully implemented.

- **Market strategies** for organic food products, local food processing etc. have been developed. They will constitute valuable guidelines on conversion to ERA for different actors in the food chain.

19 According to Landbrugsavisen (Paper from the Danish Farmers´ Organization) 7 June 2013, only Danish companies have bought nearly 500.000 hectares for more than 3 billion Euros and started, inter alia, large-scale, higly polluting plants for pig production (9 in Poland, 8 in Latvia, 4 in Lithuania and 2 in Estonia).

Policy
To facilitate and promote conversion to ERA, the Project both developed various ideas and concepts and supported practical implementation. The conversion is partly consumer-driven up to and including the level of organic farming. However, the step from organic farming to ERA has up to now hardly been affected by consumer demands. ERA products have not meant an added value for the farmer. Therefore, there will be a need to examine available opportunities to take measures within current institutional frameworks and, if so required, work for changes of these frameworks. Policy aspects are often interdisciplinary and have been integrated in most other parts of the Project. The so called Triple Helix Model for the coordination and cooperation between the three sectors politics/society, research/education and business/industry has been a lodestar for much of the policy work.[20]

A number of specific measures to examine relevant policy issues have been taken. These include:

- A Policy Group with members from most participating countries was established to implement and coordinate the policy work. This report is one of the results of its work.

- A consultant was contracted to carry out a study on available options for governments to promote conversion to ERA. The main conclusion was that several opportunities to promote the conversion to and continued application of ERA do exist within the framework of the CAP.[21 22]

- Studies of rules for procurement of food within the framework of Diet for a Clean Baltic showed that municipalities and other official bodies have ample opportunities to specifically purchase organic products.

- Meetings with ministries of agriculture, parliaments etc. have been – or will be – conducted in most countries to inform about and discuss ERA and the BERAS Implementation Project.

- Policy issues were discussed at most conferences arranged by the BERAS Implementation Project 2010-2013.

- A scientific seminar was arranged in 2012 together with the Stockholm Resilience Centre of Stockholm University.

The reform process of the CAP for the period 2014-2020 has been going on throughout the project period. It has therefore been an important task to follow the process and seek to influence it at all levels available. Some partners have followed the process through the NGO umbrella organization European Environmental Bureau (EEB). A delegation from the BERAS Implementation Secretariat visited the European Parliament in Brussels in 2011 to present the Project. Several partners have influenced nationally, e.g. by discussions with politicians and governmental officials, farmer's organizations, researchers, NGOs etc. and at the European level through participation in international conferences and other contacts.

Education and information
Various activities in the field of education and information were carried out. These include:

- A comprehensive textbook on ERA has been published (see footnote 14).

- A five weeks long (7,5 ECTS) academic summer course for university students was arranged in Järna 2012. The theme was

20 Wramner, P. 2012: Forskningens bidrag till omställningsarbetet. Presentation at the Conference "Mänsklig samverkan kring jorden, maten, havet och klimatet. Lokal utveckling för global hållbarhet." Järna 19-20 April 2012.
21 Einarsson, P. 2012: Policy interventions for ecological recycling agriculture. Available options for governments in the Baltic Sea Region. BERAS Implementation Reports No. 1.
22 Einarsson, P. 2013: Policy interventions for ecological recycling agriculture – Governments have the policy tools. Presentation at the Conference "Farming for the Future - Ecological Recycling Agriculture to Save the Baltic Sea" in Tallinn 27 February 2013.

Sustainable Food Societies for a Clean Baltic.

- During the project time a number of comprehensive conferences with different themes have been arranged. These include Helsinki 2010 – Start up; Järna 2011 – Sustainable Food Societies; Copenhagen 2011 – Diet for a Clean Baltic; Riga 2012 – Investments and Marketing; Kaunas 2012 – Education; Tallinn 2013 – Farming for the Future and Gdansk 2013 – Conclusions.

- BERAS Implementation Centres (BICs) have been established in most partner countries. BICs are good examples of the application of ERA that constitute demonstration and learning centres. They promote ERA in their region by various information activities addressing farmers, consumers, decision makers etc.

- Educational programmes and materials (including an education toolbox) have been developed for lifelong learning within a broad range of ERA-related issues, from basic school to university level, for farmers, advisers teachers etc.

- A wide range of measures to raise awareness among farmers, other actors in the food chain, politicians, scientists, teachers, governmental and municipal officials, NGO representatives etc. has been carried out.

- A pool of experts representing different specialities, levels etc. who are ready to provide information on ERA has been established.

Overall assessment of the achievements of the BERAS Implementation Project

The Project has largely carried out the tasks in its work plan and achieved its objectives. The huge potential of the ERA concept (including complementary concepts as Sustainable Food Societies and Diet for a Clean Baltic) has been confirmed and underlined. Knowledge, awareness and understanding of ERA have increased significantly. Several ERA-related activities have started in all countries. This is particularly true for the grassroots level, not least when it comes to consumers.

An important component of the project has been networking across borders in the Baltic region. It should be underlined that it will continue, both as a unified network and in the form of collaboration between individual partners. The Project will end in September 2013, but the work to promote ERA will continue, both nationally and internationally. Many partners and other involved institutions will in the future be involved in concrete R&D activities, information, lobbying etc.

The Project has identified a number of obstacles to or limitations for a conversion to ERA on a broad scale and devoted considerable attention to measures aiming at overcoming them.

Nevertheless, there are still a number of significant such impediments to conversion. Many of them are more or less explicitly of a policy nature and will be discussed more in details in the following parts of this chapter.

The Policy Framework for ERA

World Trade Organization (WTO) Agreement on Agriculture

WTO is an intergovernmental organization that deals with the global rules of trade between nations. Its main function is to ensure that trade flows are as smoothly, predictably and freely as possible. The Agreement on Agriculture implies limitations of subsidies and protection that in practice constitute policy restrictions at the national level. However, domestic subsidies, that do not significantly affect trade negatively, e.g. for environmental conservation, are allowed within the framework of the "Green Box". This means that there is considerable scope within the regulatory framework of WTO for different kinds of support to ERA conversion.

EU – and the individual Member States – are members of WTO. Therefore, the CAP – and its application in individual Member States has to be in line with the requirements of its Agreement on Agriculture.[23]

EU´s Common Agricultural Policy (CAP) – the current design

The Common Agricultural Policy stipulates the overall framework for the agricultural policies in Europe. It determines general requirements to be met by all member states, but it also leaves options for individual states to legislate and subsidize according to individual needs. This section describes the aspects of the current and future European political framework, as identified by the Policy Group, that are most relevant for ERA.

The CAP is often seen as a barrier to the conversion to and continuous application of ERA. This is certainly true. The current CAP involves a number of obstacles to and limitations for ERA. These impediments include:

- The main focus of the CAP does not favor ERA.

- Instead, the CAP generally promotes agricultural production which is large-scale, specialized, intensive, mechanized, chemicalized etc. It is specialized on either crop or animal production and causes eutrophication of water and degradation of biodiversity.

- A fundamental reform of the CAP would be needed to introduce ERA on a broad scale.

- It will apparently not be possible to implement such a reform in connection with the ongoing review of the CAP for the period 2014-2020. The present unsatisfactory political deal on the new

23 *Swinbank, A. 2013: The EU's Common Agricultural Policy, 1973–2013: A policy reformed, or just more of the same. Presentation at the International Symposium: Global Outlook — International Competition for Land, Stockholm 29–30 January 2013, Royal Swedish Academy of Forestry and Agriculture.*

CAP is fixed in most of its features. Only minor improvements of it can at best be achieved at this stage.

However, the current CAP also offers a lot of flexibility that member countries can use to change their national agricultural policy to promote conversion to ERA. This applies to legislation (few restrictions exist even if EU should be notified), taxes (national policy, no restrictions), financial support within the Green Box etc. Much more could thus be done within the framework of the current CAP than has been done up to know. This also applies to the revised CAP for the period 2014-2020, even if it risks becoming worse from an ERA perspective than the current one. See the next section below.

Detailed presentations of policy aspects on ERA in relation to CAP have been given in reports of the BERAS Implementation Project.[24 25] It is shown that a number of opportunities to promote the conversion to and continued application of ERA do exist within the framework of the current CAP. These opportunities include a considerable national flexibility in terms of legislation, taxation and economic support to facilitate conversion. A number of measures to achieve this – including different kinds of direct economic support – can be taken both at national and EU levels. However, few such steps have been taken in the Baltic Sea Region. What is required is political will, something that up to now has been lacking in all countries in the Region. The cases from different Baltic states will show more in detail to what extent the individual Member States have exploited these opportunities.

Regarding technical aspects – legal, administrative, economic etc. – on promotion of ERA within the framework of the CAP, reference is made to the above mentioned two reports. The current paper will focus on the political aspects, mainly the political will to make use of existing opportunities within the CAP to promote conversion to ERA and how to affect it in a positive way. This is a factor of decisive importance which has been addressed in the BERAS Implementation Project.

The revised CAP for the period 2014-2020

The reform process

A new CAP to cover the period 2014-2020 was negotiated through the years 2011 to 2013. Just before the deadline for the work on this report,[26] a political deal on the CAP was reached, while the Multiannual Financial Framework (MFF) was not finally concluded. This means that there is still some uncertainty about the final outcome, first and foremost the flexibility to transfer funds between direct payments and rural development and the rates of co-financing for rural development schemes. This weakens the basis for providing information on the exact financial framework for the national implementation and the specific recommendations. At the same time it emphasizes the need to maintain focus on the final political negotiations on the MFF and to exploit the opportunities to influence policy in favor of ERA.

24 Einarsson, P. 2012: Policy interventions for ecological recycling agriculture. Available options for governments in the Baltic Sea Region. BERAS Implementation Reports No. 1.

25 Einarsson, P. 2013: Policy interventions for ecological recycling agriculture – Governments have the policy tools. Presentation at the Conference "Farming for the Future - Ecological Recycling Agriculture to Save the Baltic Sea" in Tallinn 27 February 2013.

26 July 15th, 2013.

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The European Commission issued its proposal for a reform of the CAP in October 2011.[27] For 1½ year both the European Parliament and the Council have negotiated the proposal to arrive at their individual positions. These positions became clear in March 2013, after the agreement on the overall budget in the MFF by the Council (Heads of State) in February.

After that, trialogue negotiations went on, aiming at compromises between the different positions of the Parliament and the Council, with the Commission as a facilitator. The Irish Presidency succeeded in reaching a political deal at the end of June. By the deadline of this report the plenary vote in the Parliament is still pending. The final endorsement is expected to take place in the autumn of 2013 and the regulation will take effect from January 2015.

Based on the overall framework agreed, individual Member State will formulate a national Rural Development Programme (RDP) including national regulations. Most likely this process has already been initiated in many Member States.

From a general environmental and ERA perspective, the prospects for the new CAP are not very encouraging. The original proposal was aiming at a paradigm shift, based on the mantra: "Public money for public goods". The ambition was a further step along the trajectory set by former reforms towards more money for the environment and less market orientation. However, the contents became more and more vague and half-hearted during the negotiations and thus jeopardized the intention of the proposal from the Commission. As a whole, the political deal is worse from an ERA and general environmental perspective than the current CAP.[28 29 30 31 32]

The overall structure of the CAP remains unchanged, with the Pillar 1 budget for direct payment and the Pillar 2 budget for rural development. The following provides a description of the content of the new CAP and an assessment of the potential effects of the reform on the environment and the options for conversion to ERA.

Pillar 1

The decoupling of direct payments to specific crops, which was introduced by the latest regulation of CAP in 2005, has been a driver for ERA development. Particularly the option to obtain EU support for other crops than cereals and oil-seeds has had a positive impact. The support for beets and grassland (in rotation and permanent) is especially essential for ERA farming.

The question is to what extent the new requirements for greening financed by direct payments will help to promote ERA. The new regulation implies that 30 % of the direct

27 http://ec.europa.eu/agriculture/cap-post-2013/communication/index_en.htm

28 German Federal Environment Agency 2012: The Legislative Proposals for the Reform of the CAP. Good initiatives but not good enough for the environment. German Federal Environment Agency, Press Office, August 2012.

29 European Environment Bureau 2012: Greening the CAP. http:/www.bfn.de/0313_veroe.html

30 Institut fur Agrarökologie und Biodiversitet et al. 2012: Common Agricultural Policy from 2014 – Perspectives for more Biodiversity and Environmental Benefits of Farming? Policy recommendations from the project "Reform of the Common Agricultural Policy (CAP) 2013 and achievement of the biodiversity and environment goals".

31 EEB 2013: First analysis of the final CAP deal and its impacts on the environment. Working Paper 25 June.

32 Matthews, A. 2013: A triumph for the Irish Presidency – a damp squib for CAP reform. http://capreform.eu/

payments are earmarked to farmers, who meet specific greening requirements. This means that farmers not meeting these will obtain only 70 % of the direct payments they would otherwise have received.

The requirements are related to
- crop diversification,
- protection of permanent grassland and
- establishment of Ecological Focus Areas (EFAs).

Environmental representatives stressed the urgent need to change the requirement proposed by the Commission regarding crop diversity to crop rotation. Such a change would indeed favor the environment and ERA. These attempts, however, failed. The proposal was even watered down in the political deal. Only farms with more than 30 hectares must meet the requirement of three crops which exempts 46 % of the utilized agricultural area or 94 % of all holdings in Europe.

EFAs were meant to be the most effective greening measure. However, the proposal of the Commission for EFAs to constitute 7 % of the farm area ended up with 5 % and a decision that the Commission should evaluate an increase to 7 % in 2017. This is indeed a negative result, particularly as there are assessments claiming that EFAs to become effective should cover 10 % of the area. In addition, the content of the measure has been weakened by including nitrogen fixing crops and wood energy crops in the EFAs and introducing a 15 ha threshold.

However, the greening requirements may also offer opportunities in support of a step-wise development towards ERA. For instance, it seems to be an option to meet the EFA requirement by growing pulses. This option counteracts the original intent of the EFAs, but has been introduced due to the opinion of the Council that EFAs should not compromise the income of the farmer.

In addition, the concept of equivalence mechanisms has been introduced. This means that a list of farming practices will be considered equivalent to the greening. In this way organic farmers seem to become recognized as ‘green by definition’. This may stimulate more farmers to become organic – but would also imply that ecological farmers get no incentive to improve their environmental performance which could counteract the development of ERA.

It was a goal in the reform process to simplify the CAP and make it less bureaucratic. Therefore, the Commission focused on finding requirements which are simple and easy to control. However, the equivalence mechanism is likely to lead to an increased level of complexity and bureaucracy.

When evaluating the impact of the new greening measures, it is also important to keep in mind the great variation between Member States in terms of receiving direct payment support. The political deal on greening requirements allows individual member states some flexibility for meeting the requirements. Flexibility may provide a good opportunity for governments with environmental ambitions to ensure that the greening efforts under Pillar 1 are efficient. In countries like Denmark, where the original greening requirements will have only limited environmental effects, flexibility may be an advantage. Flexibility may also be an opportunity for specifying greening requirements which are more favorable to ERA than the current ones. However, it is important to bear in mind that flexibility is also an option for countries, less focused on

the environment, to weaken the greening requirements. This will likely be the case in some countries around the Baltic Sea as well.

A summarizing conclusion could be that there is an obvious risk that the new greening requirements largely will be of a cosmetic nature.

In addition to the new greening requirements, there is still the need for the individual farmer to meet the cross-compliance requirements in order to avoid cuts in the direct payments. The new CAP keeps many of the existing cross-compliance requirements but some have been removed. It was proposed to include the Water Framework Directive and Sustainable Use of Pesticides Directive requirements in the cross-compliance scheme. Such measures would certainly promote ERA. But these requirements are not included in the final agreement. The same applies to a proposal to include protection of wetlands and carbon rich soils in the cross-compliance scheme. The EEB[33] concludes as a consequence that the agreement is a step backwards from previous CAP reforms.

Pillar 2

The economic support from the Pillar 2 budget remains earmarked for voluntary efforts beyond the base line. This means that although some direct payments are related to greening, there is still a clear distinction between Pillar 1 and 2. Pillar 1 activities are a matter of compliance and comprehend all farmers, whereas pillar 2 activities are a matter of specific projects carried out by specific farmers, in specific areas and under specific conditions. Pillar 1 activities determine the baseline for the environmental actions, whereas Pillar 2 projects allow improved environmental performance or provide solutions to specific problems. The general consequence of the greening of Pillar 1 should be a change of the baseline to become more ambitious. However, the greening effect is limited and the introduction of equivalence measures provides a risk of blurring the baseline for requirements and payments in Pillar 2. Dialogue with policy makers nationally about greening requirements and a new baseline might help the implementation of ERA. But the main potential for a boost of ERA is clearly in the design of specific measures under Pillar 2.

As mentioned before, the Multiannual Financial Framework (MFF) has not been finally concluded. This means that there remain some outstanding issues which could not be settled in the CAP deal because they are covered in the parallel MFF negotiations. These issues include the flexibility to transfer funds between direct payments and rural development, the allocation of national envelopes for direct payments (external convergence) and rural development, rates of co-financing in Pillar 2 rural development schemes, the question of capping and degressivity and possibly the crisis reserve.[34] Nevertheless, the positions of the Council and Parliament and the negotiations provide good indications for the outcome. The following is based on the expected outcome at the time for the deadline of this report.

Generally speaking, the major changes in relation to rural development programmes are financial. Funding of these programmes is likely to become a problem in many member states. The budget deal in February

33 EEB 2013: First analysis of the final CAP deal and its impacts on the environment. Working Paper 25 June.

34 Matthews, A. 2013: A triumph for the Irish Presidency – a damp squib for CAP reform. http://capreform.eu/

2013 resulted in an overall cut of the funding for agriculture, higher for Pillar 2 than for Pillar 1. This means the end of a 25-year policy of gradual shifts of funds from Pillar 1 to Pillar 2. There will be options to transfer money from Pillar 1 to Pillar 2 (modulation) – up to 15 %. Transfer from Pillar 1 to Pillar 2 will not require national co-financing. This could encourage countries to use more money within the targeted approach in Pillar 2. However, it will also be possible to transfer money from Pillar 2 to Pillar 1 (inverse modulation) – up to 25 % for those countries where direct payments are less than 90 % of the EU average. This option for increased inverse modulation may have an impact on the willingness to transfer money to Pillar 2. There is a risk that the financial crisis will push economic strapped nations to reduce the current share of Pillar 2 in order to save the national co-financing.

The agreement on making it possible to transfer money from Pillar 2 to Pillar 1 will most likely affect the actual transfer from Pillar 1 to Pillar 2. Farmers´ organizations will certainly claim that moving money between the pillars will result in an unfair distortion of competition between countries, making it pretty hard for politicians to decide on modulation.

Funding for environmental activities in many countries will most of all depend on the willingness of governments to transfer money from Pillar 1 to Pillar 2 (modulation) or, the other way , to remove funding from environmental activities to direct and not targeted support to farmers in Pillar 1. The risk is imminent that some governments use their authority to further reduce the environmental consideration.

As in the present CAP, each Member State will have to prepare a Rural Development Programme (RDP), to be approved by the Commission. The basic concept, describing the national targets and priorities, remains the same. However, instead of dealing with four axes, the new RDP is to address the following six Union priorities for rural development:

1. Fostering knowledge transfer in agriculture, forestry and rural areas
2. Enhancing the competitiveness of all types of agriculture and enhancing farm viability
3. Promoting food chain organization and risk management in agriculture
4. Restoring, preserving and enhancing ecosystems dependent on agriculture and forestry
5. Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in the agriculture, food and forestry sectors
6. Promoting social inclusion, poverty reduction and economic development in rural areas.

These priorities define the points of emphasis with respect to the needs identified at the Union level. Each priority can be broken down to ‘focus areas’ to better structure attribution of measures and planned interventions.[35]

In the current CAP there is a 25 % minimum spending for the environmental measures in Axis 2 under Pillar 2. Currently, 44 % of the Rural Development budget goes to the environment.[36] Although the final deal is expected to include a higher and compulsory 30 % minimum spending, it does not limit it to environmental measures. Included in the 30 % minimum spending are investment measures that risk eating up the total amount without bringing any environmental benefits to rural areas. Also new measures according to risk management are added to Pillar 2. This, together with the smaller overall budget, means that the environment most likely will be worse off, particularly in member states that choose the inverse modulation model. The only chance to avoid this is if member states voluntarily move money from the direct payments to environmental issues. Only few countries are likely to use this opportunity – Denmark, Netherlands and Great Britain are the most probable. An effective implementation of ERA will in all Member States require RDP support. Therefore, it becomes crucial to influence policy makers to include ERA implementation or effective policies pointing in the direction of ERA in the RDPs and to ensure proper funding for this effort.

35 Example of focus areas under priority 5: Efficiency in water use, Efficiency in energy use, Supply and use of renewable energy, Reducing nitrous oxide and methane emissions, Carbon sequestration.
36 EEB 2013: First analysis of the final CAP deal and its impacts on the environment. Working Paper 25 June.

There is a risk that member states avoid environmental payments to farmers by choosing greening and RDP environment measures which have already been realized. This was truly the case in the current CAP.

Finally, it should be mentioned that Sustainable Food Societies (SFS), a core outcome of the BERAS Implementation Project, are in line with the goals of Rural Development Programmes: competitiveness in the food sector, creation of jobs and making attractive living conditions in rural areas.[37] In Denmark there is already a wide range of instruments in the current Programme, which could – despite some bureaucratic hurdles – be effective to promote SFS: support for cooperation and advice on establishment and innovation in farms and small businesses, marketing support and promotion etc. It is of greatest importance to develop a compelling alternative to intensive, large-scale agriculture. Therefore, dialogue with policy makers nationally about the content of RDPs is of crucial importance.

37 Danish Ministry of Food: Mål for landdistriktsprogrammet. http://www.landdistriktsprogram.dk/maal_for programmet.aspx?id=35782

Summary and recommended action

As a whole, the new reform is worse from an ERA and general environmental perspective than the current CAP, particularly in its final form.[38 39 40 41]

There are still opportunities to influence details of the new CAP in the "right" direction as regards specific provisions that support the implementation and development of ERA. In all countries continued pressure should be put on politicians in the negotiations on the MFF, primarily regarding the flexibility to transfer funds between direct payments and rural development, and rates of co-financing in Rural Development schemes in Pillar 2. Steps to facilitate conversion to ERA can be taken when the new CAP is applied at the national level, e.g. by shifting funds from the first to the second Pillar and by defining effective and efficient environmental measures within the RDP. It is an issue of

38 German Federal Environment Agency 2012: The Legislative Proposals for the Reform of the CAP. Good initiatives but not good enough for the environment. German Federal Environment Agency, Press Office, August 2012.
39 European Environment Bureau 2012: Greening the CAP. http:/www.bfn.de/0313_veroe.html
40 Institut fur Agrarökologie und Biodiversitet et al. 2012: Common Agricultural Policy from 2014 – Perspectives for more Biodiversity and Environmental Benefits of Farming? Policy recommendations from the project "Reform of the Common Agricultural Policy (CAP) 2013 and achievement of the biodiversity and environment goals".
41 EEB 2013: First analysis of the final CAP deal and its impacts on the environment. Working Paper 25 June.

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utmost importance that advantage is taken of these opportunities, both within and outside the BERAS Implementation Project. It is therefore highly recommended that all partners of the Project immediately do their best to exert strongest possible influence on their national governments to make them acting in this direction.

The following summarizing remarks and recommendations should be highlighted:

- Almost half of the EU budget is still transferred to agriculture. The deal ended up with a CAP where the bulk part of the money will continue being spent on direct payments to farmers with no obvious rationale.

- No paradigm shift towards "public money for public goods" was reached. The opportunity of creating more legitimacy to the CAP was lost. Cutting of Pillar 1 and using more money targeted to environmental issues instead of greening of Pillar 1 remain the way to go. The new deal interrupted the trajectory of former reforms and health checks towards more sustainability

- The allocation of funds is too strongly weighted in favor of Pillar 1. The budget is cut more for Pillar 2 than for Pillar 1. From an ERA perspective this is a serious drawback. Pillar 2 is the most important source of funds to support conversion to ERA.

- There is a need to shift at least 15 % of the Pillar 1 budget to Pillar 2, earmarked for environmental support and an adequate management support of Ecological Focus Areas (EFAs), Natura 2000 sites and High Value Farmland (funded with 100 % EU support, thus giving an incentive to Member States to implement adequate programmes).

- The greening component could have been a step towards a wide scale anchoring of ecological benefits through the CAP. However, the benefits are limited or absent in the new deal. In order for greening to result in real improvements, the requirements should have been mandatory for all farmers and the baseline for mandatory environmental consideration should have been at a level that implies a general improvement of the natural environment in agricultural areas. Stronger and more precise wording that underlines the importance of the environment would also have been desirable.

- The important issue of N and P flows from agriculture is mostly dealt with in broad and general terms. There are no criteria for defining excess nitrogen inputs or stocking rates. This issue needs to be addressed in national implementation and design of RDP.

- The requirements on crop diversification should have been a demand for crop rotation to be efficient.

- The establishment of EFAs could have been a very important and environmentally positive component of the CAP. However, the outcome is insufficient in both quantitative and qualitative terms. The extent of EFAs should have covered at least 10 % of the usable agricultural land and specific maintenance and management measures for each area should have been included.

- Coupled support and support for areas with natural constraints should be more strongly instrumentalized and focused in order to promote environmental conservation.

- Environmental conservation is surprisingly and regrettably not given clear priority in Pillar 2. Additionally, obstacles in terms of co-financing and administration jeopardize its effectiveness.

- The development of national RDPs is a key step from an ERA perspective in the implementation of the new CAP. It is of utmost importance that attention to ERA aspects be paid during the whole process (setting of targets, prioritization, selection of measures to be supported, monitoring, evaluation etc.).

European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-A)

Another change in relation to funding of Pillar 2 activities is the introduction of the EIP-A[42] concept. It is an EU-sponsored mechanism for the promotion of agricultural innovations that seeks to achieve its aims by
a) creating added value by better linking research and farming practice and encouraging the wider use of available innovation measures;
b) promoting the faster and wider transposition of innovative solutions into practice; and
c) informing the scientific community about the research needs of farming practice.

The EIP-A focuses on the strengthening of implementation of new concepts and on collaboration and better practice sharing. It also holds the ambition to make innovation address actual needs of the farmers. The EIP-A is meant as a bottom up activity with cross functional Operational Groups (OGs) consisting of farmers, scientists, NGOs and policy administrators acting as the driving force.

These aims are very much in line with what is needed for the further development and implementation of the ERA concept. Even if EIP-A is not a funding or policy instrument of its own, it offers a potential opportunity for various kinds of support to activities aiming at the further development and implementation of the ERA concept, both at national and regional levels.

The EIP-A is still not fully matured, but it is judged that the ERA would have a good chance for getting support from this initiative. Funding of EIP activities come from RDP and Life, a fund for research and development. This opportunity of EIP-A to contribute to the promotion of ERA should be utilized as much as possible by all BERAS Implementation partners.

42 *http:/ec.europa.eu/agriculture/eip/index_en.htm*

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Obstacles to and limitations for conversion to ERA at national levels – and ways to overcome them

In addition to the obstacles and limitations at the EU level, which were discussed in the previous section, a number of impediments at the national levels have been identified. In this section, these impediments and ways to overcome them are addressed. That task, in particular pointing out opportunities, has been given highest priority by the BERAS Implementation Project. It should be underlined that the shift from conventional agriculture to ERA implies a change of the whole agricultural system. To bring about such a change, a considerable number of impediments have to be overcome.

Specific, concrete work to overcome the obstacles and limitations was also included in the task. However, due to the short duration (three years) of the Project, limited time was remaining for that work once the impediments and ways to overcome them were identified, even if it was given high priority.

Underlying impediments and ways to overcome them

A great number of underlying factors that constitute impediments for the conversion to ERA were identified by the BERAS Implementation Project. These include lack of:

- Scientific consensus on the advantages and potential of ERA, both from production and from environmental perspectives
- General awareness of the role of agriculture for the eutrophication of the Baltic Sea
- General awareness of the potential of ERA
- Interest in ERA among farmers and farmers' organizations
- Knowledge of ERA production methods among farmers, extension officers, agricultural officials etc.
- Consumer demand for ERA products
- Public pressure to promote ERA
- Political will to promote ERA

Even though all these factors were successfully addressed by the Project, they still constitute significant impediments to the conversion to ERA. This applies in varying degrees to each of the underlying factors – but particularly to all of them together. Therefore, continuous efforts to address these impediments should be a major component in all future efforts to promote conversion to ERA.

A number of measures that could be taken to overcome underlying obstacles for and limitations to conversion to ERA have been identified. These include:

- Improvement of the scientific basis for ERA – more research and international peer reviewed publishing – in line with the proposals of the SCAR
- General information on the role of agriculture for the eutrophication of the Baltic Sea in cooperation with Coalition Clean Baltic, Baltic COMPASS, Baltic DEAL, Baltic Manure etc.
- General information on the potential of ERA to solve eutrophication problems caused by agriculture
- Advocacy aiming at increased knowledge, awareness and acceptance of ERA, addressing both decision makers, other key persons etc. and the general public
- Consumer information about ERA products and their environmental benefits through, inter alia, Diet for a Clean Baltic
- Networking with the civil society – NGOs in the fields of organic farming, environmental conservation (including the cultural heritage), consumer interests, sustainable food concepts, local and traditional food production, rural development etc.
- Specific information on ERA to politicians responsible for agriculture, food, environmental conservation, rural development etc.

Impediments in national agricultural and environmental policies and ways to overcome them

The above mentioned underlying obstacles and limitations are evident also in national agricultural and environmental policies. The BERAS Implementation Project identified and addressed a number of specific, national policy issues precluding conversion to ERA. However, they still constitute significant impediments to conversion.

National agricultural policies have to be a part of the CAP. However, instead of making use of available opportunities to promote ERA within the framework of the

CAP, national policies in all countries in the Baltic Sea Region to a large extent hamper conversion and contribute to the resistance to ERA in the agricultural establishment, especially by lack of action. Examples of such lack of action include:

- Policy tools to address nutrient surpluses do not consider root causes and the systemic nature of the eutrophication problem.
- ERA is not seen as a solution to the eutrophication problem.
- Available opportunities to reward farmers for recycling practices from CAP funds are not used.
- Little attention is paid to ERA in agricultural research.
- Little attention is paid to ERA in agricultural education at all levels.
- Little attention is paid to ERA in agricultural extension services. In those cases where ERA is at all dealt with, the attitude is often negative.

The Project identified and addressed a number of specific policy measures to overcome obstacles and limitations in national agricultural and environmental policies. However, most measures remain to be implemented and still constitute significant impediments to conversion.

The key measures to address obstacles and limitations at the national level should be (1) specific and well-designed economic and other support for the conversion to ERA (e.g. to reduce or get rid of debts from investments in large-scale, specialized animal or crop production) as well as (2) information and direct lobbying. Main target groups for information should be agricultural politicians, agencies, organizations etc. but also the general public. The message should include:

- Root causes of the eutrophication problem
- The potential of ERA
- The need for specific measures to promote conversion
- Availability of such measures within the framework of the current and the new CAP
- The need for increased attention to ERA in agricultural extension services

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Even though a number of measures to promote ERA could be implemented at national levels, it would be strategic for the countries in the Baltic Region to agree on joint actions to this end. Thereby, a strong platform to affect future CAP reforms would also be created.

Impediments at the individual farm level and ways to overcome them

The above mentioned underlying and policy-related obstacles and limitations are evident also at the individual farm level. In addition, a number of impediments for conversion to ERA that directly faces the individual farmer were identified by the BERAS Implementation Project. These include:

- Lack of awareness and knowledge of the elements and potentials of ERA, both among individual farmers and in farming communities
- Lack of economic support to conversion costs, e.g. for depreciation of loans for investments in large-scale, specialized animal or crop production
- Lack of specific distribution channels for ERA products
- Difficulties in achieving continuous profitability
- Lack of agricultural extension support
- Attitude of colleagues, farmers' organizations etc.

The Project identified and addressed a number of specific policy measures to overcome obstacles and limitations at the individual farm level.The key measure is direct information to farmers and farmers' organizations on the elements and potentials of ERA. Networks of ERA farms and BICs can serve as good examples and bases for knowledge exchange on how to overcome obstacles to conversion and achieve continuous profitability. In addition, a number of measures that have already been mentioned under "national policies" should also be applied at this level.

A key issue for the individual farmer which has also been dealt with in this report is how to get a better prize for ERA products than for ordinary organic products. ERA represents an organic plus farming system whose products probably could be sold at a higher prize if consumers were aware of their quality and environmental advantages. It should be a major task for the future work to promote ERA to develop ways to convey such information to consumers, e.g. by a certification system.

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Organic Farming as a Step in the Conversion to ERA

The organic agricultural system generally implies a substantial reduction of N and P flows compared to conventional systems, even if its advantage in certain cases is limited. Key factors are cultivations techniques, handling of manure and natural conditions. Conversion from conventional to organic farming also means a great step towards ERA. This applies to all kinds of organic farming. From an ERA perspective, there is therefore a need for economic and other support not only for conversion to ERA but also for conversion from conventional to organic farming.[43] During the current period of CAP, various kinds of support to organic agriculture have in practice been the most important way to promote conversion to ERA.

ERA differs from organic farming by applying stricter requirements concerning animal feed, balance between crop and livestock production, level of self-sufficiency, standards of animal density and nutrient balance. For example, ERA requirement concerning the proportion of homemade fodder far exceeds the 50% posed by certified organic farming (while conventional farming is not subject to any requirement at all).
It should be noted that certified organic agriculture consists of different production models. Grazing of permanent grassland dominates in some places, crop production in others. Several organic farms have a higher level of self-sufficiency than required in ERA. Although ERA standards of animal density and nutrient balance are still rare, a significant number of organic farms are relatively close to these standards. On the other hand, organic farming is in many places becoming more and more intensive and large-scale, a similar development as seen in conventional farming.

The EU has recently proposed to increase the requirement regarding the proportion of homemade fodder for organic agriculture from 50 to 70%. Gradual increase in the requirements of the organic sector is a well-known method of operation since the appearance of the European certification scheme, but there is also a negative aspect. The threshold becomes higher and this may reduce the number of conventional farmers who are willing or able to convert to organic farming. Over time, this may also reduce the number of farmers who continue to convert to ERA.

Therefore, a way to avoid this risk and achieve the same result could be to keep the current threshold and instead use voluntary top up measures linked to different support levels and other benefits. Such a system could create new organic plus models, e.g. organic farming with focus on reducing loss of nutrients. ERA could of course be a very progressive top up farming method in this context.

It is also important to keep in mind that the development of organic farming needs to be driven by the market. It is not enough to support organic farming – there should also be a market for organic products. Marketing is as essential as transformation of the farming sector. There is a need for support to develop processing and increase sales of organic products. For example, support schemes could focus on strengthening the organic brand, supporting a wider availability of organic products in supermarkets or making the public food consumption a driver for the whole organic market.[44]

43 Granstedt, A. 2012: *Farming for the Future – with a focus on the Baltic Sea Region. BERAS Implementation Reports No. 2.*

44 *In Denmark a new national grant scheme "Promoting the production and marketing of organic foods" is implemented to support such activities as "Green cities" where a number of municipalities have a goal of 75% of government spending should be organic. Estonia, Germany and Sweden also have national action plans to this end.*

Final Words

This chapter will also be published in a separate report from the BERAS Implementation Project. The general descriptions and analyses of the chapter will be supplemented by data on specific conditions in the countries of the Baltic Region and case studies from individual countries.

The chapter focuses on the general aspects of the CAP, e.g. which tools are available to support conversion to ERA or which impediments to conversion are most important and how can they be overcome.

Large parts of the CAP, in particular Pillar 1, are of a general character, while Pillar 2 and the RDPs address national conditions and local problems.

The separate report will, in addition to the general aspects, address specific national conditions and needs/prerequisites for specific national measures to promote conversion to ERA. Important background factors are natural conditions, historical background, present situation (both successes and problems), present policy, future challenges etc.

Final conclusions and recommendations

Artur Granstedt

Ecological Recycling Agriculture and Society is a strategy to reduce the nutrient load to the sea and the emissions of greenhouse gases, enrich the landscape and biological diversity and develop a long-term sustainable economy.

On 15 November 2007 the Baltic Sea Action Plan (BSAP) was signed at an EU ministerial meeting in Krakow. The goal is to save the environment in the Baltic Sea, the Sound and the Kattegat through the reduction of nutrient leaching and hazardous substances and the protection of biodiversity, including fish stocks. The total annual nitrogen load from the countries around the Baltic Sea is to be reduced by 135 000 tones (a decrease of 20%) and the phosphorus load by 15 000 tonnes (a decrease of about 40%) by 2021. This was the expression of an important and necessary goal.

The difficulties in achieving these environmental goals for the marine environment are in part due to the fact that the actions taken have not addressed the main cause of eutrophication - the ongoing and increasing specialization in agriculture.

Climate change is one of the most serious threats to the environment and to securing food and other necessities required for long-term survival for a growing world population. A hundred years ago agriculture was self sufficient in both plant nutrients and energy and was able to contribute food, fibre and fuel to the rest of society. Today conventional industrial agriculture in countries around the Baltic is dependent on external resources and contributes to global warming. Fossil fuels are used in agriculture traction and in the production of artificial fertilizers, pesticides and imported feed, etc. The entire food chain currently accounts for nearly half of the global warming when the impact of agriculture on global deforestation and degradation of soil organic matter is taken into account.

Agriculture production needs to be organized so that, as far as possible, the current linear flows of nutrients are replaced by an effective recycling of nutrients within the agriculture system and the whole food sector. Due attention to food security and food safety issues with no contamination by hazardous and unnatural substances must be given.

Most of the plant nutrients removed with the harvest from our agricultural fields (70 - 90%) is feed to animals and excreted in the form of nutrient rich manure. This should come back to the soil to provide all the essential elements (potassium, sulphur, nitrogen and phosphorus) and micro-nutrients that are required for nutritious food. This ideal scenario is very far from today's reality. Most of the products harvested on the crop specialized farms go to specialized livestock farms in the animal dense regions in the countries around the Baltic and the nutrient surpluses on these farms are leached to the environment. The specialized animal-free cereal farms producing the animal feed compensate nutrient losses by applying artificial fertilizers. This is unsustainable in the long-term.

Ecological Recycling Agriculture (ERA) in the BERAS projects is defined as an organic (ecological) agriculture system based on local and renewable resources with an integration of animal and crop production (on each farm or farms in close proximity). Thereby, a large part of the nutrient uptake in the fodder production, including also trace elements, is effectively recycled. This in effect means that each farm strives to be self-sufficient in fodder production which in turn limits animal density and ensures a more even distribution of animals to most farms. No chemical pesticides or artificial mineral fertilizers are used. Maximum recycling of nutrients ensures that the net export of minerals is kept to a minimum. The net removal of nitrogen and minerals that does occur through losses to the environment and sale of products is mainly compensated for through biological nitrogen fixation and soil weathering processes (Granstedt et al 2008, www.beras.eu).

The comparative studies of type-farms in the Baltic Sea countries show that excess nitrogen is lower on the ERA farms than in the average conventional agriculture and significantly lower when compared with conventional livestock farms with intensive livestock production based on purchased feed. The input/output ratio is lower compared to conventional agriculture. This means that organic farming is less wasteful of external resources and results in lower nutrient losses to the surrounding environment.

Less use of fossil energy to produce artificial fertilizers and other inputs and to transport external resources and the significantly higher proportion of grassland with legumes means that ERA has the capacity to decrease the negative climate impacts from agriculture and support a more sustainable society. According to several studies the humus proportion and thus carbon storage capacity in soil also increases on organic farms. No use of chemicals and variable crop rotation promote biodiversity, landscape diversity and reduce the amount and number of hazard chemicals in the environment.

In the BERAS and subsequent BERAS Implementation projects the conversion process was studied. This included the whole food chain, including food consumption. A concept for both private and public consumption including schools called Diet for a Clean Baltic was introduced and established. This includes a lower consumption of meat special from no ruminant animals. A restructuring of agriculture in the Baltic region to ERA would, according to BERAS project findings, contribute to realising the goals of the Baltic Sea Action Plan by reducing the nutrient load to the Baltic Sea. A recycling-based agriculture, with more forage-based feed and reduced use of external resources, also significantly lowers the negative impact of food production on the climate.

Recommendations supported by the BERAS Implementation project:

- Improve the overall use and recycling of nutrients within the agriculture system and reduce the losses to the atmosphere and water. This implies a more intensive recycling of nutrients between livestock and crop production on farms.

- Refocus nutrient management legislation to cover total N and P flows in agriculture.

- Reduce external N and P inputs and increase recycling within the system. This can be done by taxing nutrient inputs and by legislated nutrient bookkeeping systems – in combination with professional advice and training.

- Reduce maximum legal stocking rates to match on-farm feed production, combined with economic support for reorganization of farms.

- Prioritize measures in advisory systems, environmental legislation and agro-environment support which improve nutrient recycling rather than passive mitigation measures.

- Promote/prescribe better crop rotations that include nitrogen-fixing legumes and grassland to protect soil degradation.

- Promote organic farming more systematically. Although the current organic baseline is below the Ecological Recycling Agriculture (ERA) standard of recycling, it is far ahead of conventional agriculture, especially in pesticide reduction. Provide support to organic farming in a way that rewards steps toward ERA.

- Stimulate the empowerment of farming communities to take action in their own watershed through improved knowledge towards sustainable resource management and support to establish water protection actions.

- Acknowledge and support existing multifunctional ecological farms that already produce food, provide employment opportunities and reduce the negative impact of agriculture on the environment and climate.

- Promote and support innovative solutions to achieve higher energy efficiency, better nutrient management that lower emissions and leaching, biogas production etc.

BERAS: www.beras.eu

BERAS Implementation Pool of Expertise

Conversion to ERA and SFS					
Category	Field of expertise	Name	Surname	Organisation	Country
1	Animal husbandry	Ragnar	Leming	Estonian University of Life Sciences	Estonia
1	Crop production, plant protection	Anne	Luik	Estonian University of Life Sciences	Estonia
3	Food quality, processing	Darja	Matt	Estonian University of Life Sciences	Estonia
3,8	Distribution, marketing, cooperation	Elen	Peetsmann	Estonian University of Life Sciences	Estonia
3,6,7	Processing, distribution, marketing, organic catering	Merit	Mikk	Estonian Organic Farming Foundation	Estonia
3,9	Processing, regulation, policy, promotion	Airi	Vetemaa	Estonian Organic Farming Foundation	Estonia
9	Environmental aspects	Sirli	Pehme	Estonian University of Life Sciences	Estonia
6,7	Organic catering	Margot	Pomerants	Ministry of Agriculture	Estonia
1	Organic farming	Anzelika	Raskauskiene	Aleksandras Stulginskis University	Lithuania
1	Organic farming	Arūnas	Svitojus	Baltic Foundation	Lithuania
6	Diet for a Clean Baltic	Zydra	Narbutiene	Kaunas Region Municipality Administration	Lithuania
1	Organic farming	Anzelika	Raskauskiene	Aleksandras Stulginskis University	Lithuania
1	Organic farming	Arūnas	Svitojus	Baltic Foundation	Lithuania
1,2	Crop and animal production, business plans for organic farming	Aleksander	Banasik	Pomorski Ośrodek Doradztwa Rolniczego w Gdańsku	Poland
2	Business plans for organic farming	Katarzyna	Jasińska	Pomorski Ośrodek Doradztwa Rolniczego w Gdańsku	Poland
3	Business plans for organic farming	Katarzyna	Kotewicz	Pomorski Ośrodek Doradztwa Rolniczego w Gdańsku	Poland
4	Investment building/machines, technologies	Małgorzata	Huzior	Pomorski Ośrodek Doradztwa Rolniczego w Gdańsku	Poland
5, 9	Financing, other	Katarzyna	Radtke	Pomorski Ośrodek Doradztwa Rolniczego w Gdańsku	Poland
1, 3	Crop and animal production, processing, distribution, marketing	Jacek	Plotta	Private Farm	Poland
1, 3, 4	Organic farming rules and regulations, converting into organic, crop and animal production, grain processing plant	Janusz	Sliczny	Educational organic farm "EKOSTYL" (Beras Implementation Center)	Poland
1, 3, 8	Organic farming rules and regulations, converting into organic, crop and animal production, grain processing plant, ecotourism farms, distribution	Iwona	Sliczna	Educational organic farm "EKOSTYL" (Beras Implementation Center)	Poland
2, 3, 8, 9	Organic farming rules and regulations, converting into organic, ecotourism farms, distribution of organic food, ecological education and research	Malgorzata	Sliczna	Educational organic farm "EKOSTYL" (Beras Implementation Center)	Poland
2,3,6,8	Field of expertise: eco-tourism, ecological food network, Diet for a Clean Baltic, links between farmers and consumers	Maria	Staniszewska	Polish Ecological Club	Poland
2,3,6,9	Field of expertise: eco-tourism, ecological food network, Diet for a Clean Baltic, links between farmers and consumers	Aleksandra	Józewicz	Polish Ecological Club	Poland
9	Other (CAP - Policy) knowledge about agricultural and environmental policy in Denmark; European Common Agricultural Policy - reform and outcome	Leif Bach	Jørgensen	Danish Ecological Council (NGO)	Denmark
1	Crop and animal production advisor and teacher in agriculture	Wijnand	Koker	Associera Lantbruksrådgivning/ Agriculture advisors	Sweden
1,6	Trained and experienced in biodynamic/organic gardening/ horticulture and pedagogy in relation to school gardens	Aurora	Unge		Sweden
2	Develop the farm as a whole	Hans	von Essen	Associera Lantbruksrådgivning/ Agriculture advisors	Sweden
1,3	Gardening, vegetables, biodynamics	Daniel	Hörberg	Skillebyholm	Sweden
5,6,3,9	Diet for a clean Baltic, school lunch transformation, locally produced food, international networking, project planning	Helena	Nordlund	Södertälje municipality and the Association SOFIA	Sweden
7	Food, processing	Johan	Andersson	Järna kafe	Sweden
1,6,8	Ecology, environmental conservation and agricultural policy	Per	Wramner	Södertörn University	Sweden
1,9	Environmental effects of agricultural systems and policies to deal with those	Peter	Einarsson	Kvarnåkern AB	Sweden

Conversion to ERA and SFS					
Category	Field of expertise	Name	Surname	Organisation	Country
8,9	Networking, culinary heritage	Riina	Noodapera	Hushållningssällskapet Gotland, Gotland Rural Economy and Agricultural society	Sweden
1,3	Advisor for organic agriculture. Growing fieldcrops, ley, vegetable, animal feed production, helping convert farms with milk, lamp, crop production	Hermann	Leggedör	Hushållningssällskapet Rådgivning Agri AB	Sweden
1, 3, 6	Research on organic food quality and taste	Lars	Kjellenberg	Biodynamic Research Institute	Sweden
9	How to explain in an easy way the connections between agriculture history/methods - too much fertilizers - biological/ ecological consequences, and which decisions everyone can make in their everyday life to make the life for us and our nature better. I am pedagogic and inspiring as a group leader. Target group: 6-99 years	Linda	Wirén		Sweden
7	Restaurant - procurement, cooking with organic/biodynamic ingredients	Robert	Westerdahl	Ytterjärna Restaurang AB	Sweden
7	Restaurant - procurement, cooking with organic/biodynamic ingredients	Putte	Arnberg	Ytterjärna Restaurang AB	Sweden
1, 9	Ecological crop and animal production; Research and adviser service - research on organic recycling plant nutrients, nature resource conservation, soil, water and climate consequences of farming systems	Artur	Granstedt	Biodynamic Research Institute	Sweden
1	Crop and animal production: adviser in plant production of organic farms. Extensive experience from different type of organic plant production	Per	Ståhl	Hushållningssällskapet Rådgivning Agri AB	Sweden
8	Tourism	Thomas	Hjelm	AB Utposten and Gröna Kusten ekon. Förening	Sweden
1, 9	Organic growing of vegetables, potatoes, berries, fruit and greenhouse	Marie-Louise	Albertson Juhlin	Swedish Rural Economy and Agricultural Societies	Sweden
1	Crop production	Madeleine	Wiström	Swedish Rural Economy and Agricultural Societies	Sweden
1, 2	Crop and (animal) production - counselling for organic crop production, practical experiance of organic crop and animal production, international experiance in organic farming; business plans for organic.	Christoph	Hochmuth	Swedish Rural Economy and Agricultural Societies	Sweden
3, 8	Marketing, tourism	Ann	Telehagen	Swedish Rural Economy and Agricultural Societies - Kalmar-Kronoberg-Blekinge	Sweden
1	Crop production	Kerstin	Andersson	HIR Malmöhus AB	Sweden
1	Crop and animal production. Research projects: organic ley seed production (red clover, white clover, timothy), intercropping of forage maize and faba bean for silage in organic production. Research areas: crops and micronutrition, plant physiology, red clover sustainability, legumes	Eva	Stoltz	Hushållningssällskapet/HS Konsult AB - The Rural Economy and Agricultural Society	Sweden
1, 3, 6, 7, 8	Food consulting, EU-legislation, food safety, quality systems, planning food premises (buildings, different kind of food processes), drinking water, agriculture legislation, communication (between authorities and companies), training and education in the areas above	Per	Nilsson	Profox Company	Sweden
9	Attorney at law with special competence in agriculture and food systems	Jostein	Hertwig	Biodynamic Research Institute	Sweden/ Norway
5	Ecological economics/circulation economics	Ove Daniel	Jakobsen	Centre for ecological economics and ethics, Body Graduate School of Business, University of Nordland	Norway
6,7	Competence and experience to support and provide guidance to cooks and people who work in restaurants, and institutional kitchens about their food choices and menu. Can provide courses for cooks and canteen staff who need guidance and expertise in restructing period for a more sustainable menu. Knowledge about organic farming, agricultural and bureaucratic structures in Norway. One of the initiators of the Nordic network BINGEN, a network of consumers and new organic and biodynamic farmers of the future	Elisabeth von Hanno	Brockfield	Country Governor in Oslo and Akershus	Norway
1, 9	Organic farming (general), climate change, nutrient cycling, policy	Jon Magne	Holten	Oikos - Organic Norway, www. oikos.no	Norway

Conversion to ERA and SFS

Category	Field of expertise	Name	Surname	Organisation	Country
3, 6	Organic product market in Latvia, public/institutional ecofood	Agnese	Radžele-Šulce	Latvian Rural Advisory and Training Centre	Latvia
1	Crop production	Laura	Ludevika	Latvian Rural Advisory and Training Centre	Latvia
1, 4, 6	Animal production, investments, building/machines, technologies, public/institutional ecofood	Jānis	Kažotnieks	Latvian Rural Advisory and Training Centre	Latvia
3	Processing, distribution - packaging materials for organic products; bio packaging materials	Sandra	Muižniece-Brasava	Latvia University of Agriculture	Latvia
1, 6	Crop production, public/institutional ecofood	Dzidra	Kreismane	Latvia University of Agriculture	Latvia
1, 3, 7	Animal production, processing, distribution, marketing, restaurants, cafés	Elita	Aplociņa	Latvia University of Agriculture	Latvia
3	Distribution, marketing - direct buying, community supported agriculture	Zane	Ruģēna-Bojāre	Friends of the Earth, direct buying activist	Latvia
3, 9	Marketing – retail of organic products	Liene	Brizga-Kalnina	Owner of Eco shop	Latvia
1,2,4	Advising in organic production and assistance in organic certification	Dzmitry	Lutayeu	IPAAB "East-West"	Belarus
1,2,6	Advising in organic production and public nutrition	Lana	Semenas	Organisation "Ecohome"	Belarus
6,9	Public food, contacts with authorities and ecological education of consumers	Natalia	Parechina	Organisation "CER"	Belarus
3,6,7	Food processing, national traditions in food procession and consumption, consumers attitude	Nadzeja	Sakalouskaja	"Ecaeja" Ltd	Belarus
3,7	Food processing according to national traditions, mainly - bakery	Ales	Prishivalka	"Zhorny" private enterprize	Belarus
8	"Stay on a farm" and agroecological tourism generally on the national level	Natalia	Barisenka	Organisation "Country Escape"	Belarus
1	Development and modelling of cropping systems for organic farming	Dr. Johann	Bachinger	Leibniz-Centre for Agricultural Landscape Research (ZALF)	Germany
1	Agronomy, bio energy crops, organic certification, cropping systems, climate change and agriculture	Johannes	Hufnagel	Leibniz-Centre for Agricultural Landscape Research (ZALF)	Germany
1	Crop production, nutrient management; nature conservation on farm level; environmental effects of agricultural systems	Dr. Karin	Stein-Bachinger	Leibniz-Centre for Agricultural Landscape Research (ZALF)	Germany
1	Agronomy, legumes, crop rotations, software tools (ROTOR), agronomic evaluation of cropping systems	Moritz	Reckling	Leibniz-Centre for Agricultural Landscape Research (ZALF)	Germany
2, 3, 4, 5	Advisor for economics and financing of organic farming, business plans for organic farms and conversion, including on farm processing and marketing	Hubert	Redelberger	Hubert Redelberger - Unternehmensberatung für den ökologischen Landbau	Germany
1	Entomologist, development of concepts for plant protection in organic farming, beneficial insects and insect pest interactions	Prof. Dr. Stefan	Kühne	Julius-Kühn-Institut (JKI)	Germany
1	Organic crop production advisor	Gustav	Alvermann	Ökoring - Versuchs- und Beratungsring Ökologischer Landbau Schleswig-Holstein e.V.	Germany
1, 3, 4, 5	Crop and animal production, processing, direct marketing (box scheme), distribution, financing	Ludolf	von Maltzan	Ökodorf Brodowin	Germany
1, 4	Crop production, investments, machines	Alfons	Wiesler-Trapp	Domäne Fredeburg	Germany
3, 7	Processing, distribution, marketing, cafés	Susanne	Trapp	Domäne Fredeburg	Germany
2, 3, 5, 7	Business plans, processing, distribution, marketing, financing, restaurants	Rolf	Haug	LandWert Hof	Germany
1	Crop production, field experiments with cereals, legumes, potatoes etc.	Dr. Harriet	Gruber	Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern (LFA)	Germany

Categories

1 Crop and animal production
2 Business plans for organic farming
3 Processing, distribution, marketing
4 Investments building/machines, technologies
5 Financing
6 Public/institutional ecofood
7 Restaurants, cafés
8 Tourism
9 Other

Education

Category	Field of expertise	Name	Surname	Organisation	Country
2	Education on university level	Eve	Veromann	Estonian University of Life Sciences	Estonia
3	Adult education in organic farming	Airi	Vetemaa	Estonian Organic Farming Foundation	Estonia
1	Education in basic schools	Sirli	Pehme	Estonian University of Life Sciences	Estonia
1,2,3	Education in organic farming	Anne	Luik	Estonian University of Life Sciences	Estonia
1,2,3	Adult education in organic farming	Margot	Pomerants	Ministry of Agriculture	Estonia
2	Water quality	Laima	Cesoniene	ASU	Lithuania
2	Food quality	Daiva	Sileikiene	ASU	Lithuania
1	Diet for a Clean Baltic	Edita	Zaromskiene	Kaunas Region Educational Centre	Lithuania
1	Diet for a Clean Baltic	Laima	Ruzgiene	Kaunas Region Educational Centre	Lithuania
1	Education	Onute	Gerviene	Kaunas Region Slienava Basic School	Lithuania
1	Education	Janina	Stanaitiene	Mastaičiai Basic School	Lithuania
2	Water quality	Laima	Cesoniene	Aleksandras Stulginskis University	Lithuania
2	Food quality	Daiva	Sileikiene	Aleksandras Stulginskis University	Lithuania
1	Diet for a Clean Baltic	Edita	Žaromskienė	Kaunas Region Educational Centre	Lithuania
1	Diet for a Clean Baltic	Laima	Ruzgienė	Kaunas Region Educational Centre	Lithuania
1	Education	Onutė	Gervienė	Kaunas Region Educational Centre	Lithuania
1	Education	Janina	Stanaitienė	Mastaičiai Basic School	Lithuania
3	Diet for a Clean Baltic - Food technology	Žydra	Narbutienė	Kaunas Region Municipality Administration	Lithuania
3	Education	Janusz	Sliczny	Educational organic farm "EKOSTYL" (Beras Implementation Center)	Poland
3	Education	Iwona	Sliczna	Educational organic farm "EKOSTYL" (Beras Implementation Center)	Poland
3	Education	Malgorzata	Sliczna	Educational organic farm "EKOSTYL" (Beras Implementation Center)	Poland
1	Education, basic school and high school	Ann	Telehagen	Swedish Rural Economy and Agricultural Societies - Kalmar-Kronoberg-Blekinge	Sweden
2	Research and education: conceptualizing and implementing sustainable food societies, food culture, transition processes	Sofi	Gerber	Biodynamic Research Institute	Sweden
1,3	Crop and animal production advisor and teacher in agriculture	Wijnand	Koker	Associera Lantbruksrådgivning/Agriculture advisors	Sweden
1,3	Strategy and development	Hans	von Essen	Associera Lantbruksrådgivning/Agriculture advisors	Sweden
1,2,3	Teacher experience in biology, chemistry, ecology, school gardening from pupils aged 10 to students on university level and farmers	Lars	Kjellenberg	Biodynamic Research Institute	Sweden
1	Development of eco basic school	Kristīne	Liberta	Ikskile Free School	Latvia
3	Training courses for organic farmers	Laura	Ludevika	Latvian Rural Advisory and Training Centre	Latvia
3	Training courses for consultants and organic farmers	Kaspars	Zurins	Latvian Rural Advisory and Training Centre	Latvia
2	Education on university level	Dzidra	Kreismane	Latvia University of Agriculture	Latvia
2, 3	Development and modelling of cropping systems for organic farming	Johann	Bachinger	Leibniz-Centre for Agricultural Landscape Research (ZALF)	Germany
2	Entomologist, development of concepts for plant protection in organic farming, beneficial insects and insect pest interactions	Stefan	Kühne	Julius-Kühn-Institut (JKI)	Germany
2, 3	Crop production, nutrient management, nature conservation on farm level, environmental effects of agricultural systems	Karin	Stein-Bachinger	Leibniz-Centre for Agricultural Landscape Research (ZALF)	Germany

Categories

1 Basic schools
2 Universities
3 Other adult education

BERAS Partners

SWEDEN
Södertörn University
www.sh.se

Biodynamic Research Institute, www.jdb.se/sbfi

Södertälje municipality,
www.sodertalje.se

Swedish Rural Network,
www.landsbygdsnatverket.se

Swedish Rural Economy
and Agricultural societies,
Gotland: www.hush.se/i
Kalmar: www.hush.se/h

FINLAND
MTT Agrifood Research
www.mtt.fi

Centre for Economic Development, Transport and
the Environment
for Uusimaa, www.ely-keskus.fi/uusimaa

Finnish Environment Institute,
www.environment.fi/syke

University of Helsinki, Department of Agricultural
Sciences,
www.helsinki.fi

ESTONIA
Estonian University of Life
Sciences,
www.emu.ee

Estonian Organic Farming
Foundation (EOFF),
www.maheklubi.ee

LATVIA
Latvian Rural Advisory and
Training Centre, www.llkc.lv

LITHUANIA
Aleksandras Stulginskis University
www.lzuu.lt/pradzia/lt

Baltic Foundation HPI,
www.heifer.lt;
www.heifer.org

Kaunas District Municipality,
www.krs.lt

POLAND
Institute of Soil Science
and Plant Cultivation –
National Research Institute,
www.iung.pulawy.pl

Kujawsko-Pomorski
Agricultural Advisory Centre in
Minikowo, www.kpodr.pl

Polish Ecological Club
in Krakow, City of
Gliwice Chapter,
www.pkegliwice.pl

Independent Autonomous Association of Individual Farmers
'Solidarity',
www.solidarnoscri.pl

Pomeranian Agricultural
Advisory Center in Gdańsk,
www.podr.pl

GERMANY
Leibniz-Centre for Agricultural
Landscape Research, www.zalf.de

DENMARK
The Danish Ecological Council,
www.ecocouncil.dk

BELARUS
International Public
Association of Animal
Breeders "East-West"

www.beras.eu

The Baltic Sea is threatened by eutrophication and agriculture is responsible for about 50 % of the nitrogen and phosphorus load to the sea. BERAS Implementation addresses these challenges through a systemic shift to Ecological Recycling Agriculture (ERA) in association with the whole food chain, from farmer to consumer. Through increased recirculation of resources and the application of best practises the nutrient leakage, caused by the highly specialised agricultural system, can be significantly curbed.

This report gathers the scientific results of the environmental, economic and sociological assessments and scenarios within the BERAS Implementation project. It includes theoretical frameworks, production models and evaluations of the conversion process based on a number of ERA case studies. Environmental impacts of farming systems, economic perspectives on conversion as well as policy recommendations for supporting a shift to ERA are presented.

BERAS Implementation (2010-2013) is a transnational project part-funded by EU (Baltic Sea Region Programme 2007-2013). The project has a scientific basis and a partnership and supporting network with competence within the whole food chain. Among these are 24 project partners from 9 countries around the Baltic Sea and 35 associated organisations with representatives also from Russia and Norway.

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