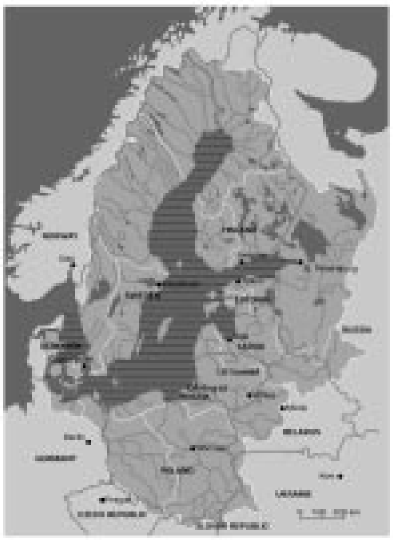
Ekologiskt lantbruk nr 43 • OCTOBER 2005

POSSIBILITIES FOR AND ECONOMIC CONSEQUENCES OF SWITCHING TO LOCAL ECOLOGICAL RECYCLING AGRICULTURE

John Sumelius (ed.)



Baltic Ecological Recycling Agriculture and Society (BERAS) Nr. 3

Baltic Sea Region INTERREG III B

Centrum för uthålligt lantbruk

Ekologiskt lantbruk – 43
Possibilities for and Economic Consequences of Switching to Local Ecological Recycling Agriculture

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Ecological Agriculture – 43
Possibilities for and Economic Consequences of Switching to Local Ecological Recycling Agriculture

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Authors are responsible for the factual contents of the report.

ISSN 1102-6758
ISRN SLU-EKBL-EL--29--SE
ISBN: 91-576-6857-4
Antal sidor: 68
Ämnesord/*Key words: Organic farming, Organic food, Local food, Sustainability, Resource management, Food systems, Rural development, Costs, Farm management*

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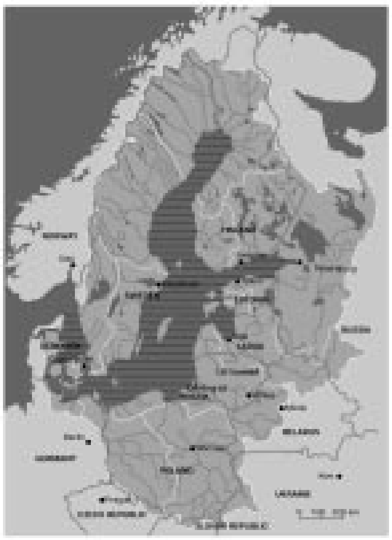

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CONTENTS

BALTIC ECOLOGICAL RECYCLING AGRICULTURE AND SOCIETY (BERAS)

Artur Granstedt

The serious environmental situation in the Baltic Sea is a consequence of agricultural specialisation, pollution from industries, incorrect waste management and the unsustainable lifestyle prevailing in the countries around the Baltic Sea (i.e. in its drainage basin). Reduced use of non-renewable energy and other resources and the elimination of pesticides would result in less pollution of air, water and soil. Increased recycling of nutrients within the agricultural systems through integration of plants and animals in the farming system would reduce leaching from fields. There is a need to analyse environmental and socio-economic consequences as well as the opportunities and obstacles facing the various actors in the food system, i.e. producers, processors, traders and consumers. It is necessary to develop knowledge and skills in this area and to better understand the potential for and consequences of a larger-scale changeover to such systems throughout the region.

A knowledge base that can be used to reduce the negative environmental impacts of production, distribution, processing and consumption of food in the Baltic Sea drainage area will be developed. This will be based on case studies, complemented with scenarios and consequence analyses, of ongoing practical, local ecological initiatives to promote local food supply cooperation between consumers and ecological producers in rural villages in the eight EU and EU-candidate countries around the Baltic Sea. The aim is to learn about and promote more sustainable food systems. The project is an EU-funded INTERREG III B project.

Methodologically the project is based on studies of 50 selected ecological recycling farms representing different farming conditions and 10 examples of more or less local and/or regional food systems located in the eight partner countries. The first work package, WP 1, builds on activities and cooperation with representatives from already established local ecological food initiatives and recycling farms in each country. It includes evaluation, promotion and exchange of experiences with other initiatives in and among the project countries.

The second work package, WP 2, will study and quantify the environmental benefits that can be achieved through local ecological consumption, processing and ecological, integrated, recycling farming, in comparison with conventional food systems. The results will feed into the evaluation process and be made available to the actors. The third and fourth work packages, WP 3 and WP 4, will evaluate the economic and social consequences at the societal level including rural development and job opportunities. The final work programme, WP 5, will produce recommendations for implementation and disseminate this to concerned actors, including policy and decision makers.

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INTRODUCTION

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As a concept, ecological recycling agriculture is close to organic farming. Farmers, consumers and society at large are increasingly supporting this type of agriculture for a number of reasons. For all three groups the most notable reason for supporting localised organic production systems is likely to be the reduction of nitrogen and phosphorus loads into the waterways and into the Baltic Sea. The environmental effects of recycling agriculture have been described in another BERAS report and need not be repeated here (Granstedt, Seuri and Thomsson, 2004). This research report takes another perspective. It begins by analysing the economic consequences of switching to local production in combination with ecological methods. This entails not only focus on either organic agriculture or localised production but on a combination of these two requirements. The outcomes depend on which actor one analyses: the farmer, the consumer, the local community or municipality or society at large. Furthermore, the reduction of the aggregated emissions to the Baltic Sea is a matter which needs to be addressed on an international level. The aim is here to cover aspects of all these levels, although we do not try to solve all problems. The aim is rather to illustrate the panorama of views and possibilities based in part on case studies of farms, households and communities.

The report starts out at the production level with an analysis by Reeder (in this volume) of the costs of production of organic milk on a dairy farm in the community of Järna in Sweden. From the farmer's point of view, the production of organic milk is connected with higher costs per unit of milk produced. The environmentally friendly mode of production is likely to lead to lower environmental costs to society at large through lower amounts of nutrient emissions. Yet, on the farm level, the requirements of self-sufficiency in feed, local inputs and recycling may lead to fewer attractive alternatives and therefore to higher costs. While it may not be advisable to draw far-reaching conclusions from one in-depth study, Reeder's results are quite clear. Total production costs are in the range of 0.055-0.066 Euro/kg milk (0.50-0.60 SEK/kg milk) higher than for conventional production. Particularly the fixed costs seem to be much higher for this farm. The higher production costs and the lower milk yield are offset by a 0.055 Euro/kg milk (0.50 SEK/kg milk) higher milk price and a livestock premium of 187 Euro (SEK 1700) per cow.

A production cost survey can give an idea of the costs incurred by individual farmers. However, it does not tell much about the possibilities of changes in the production mix or about the effects of institutional constraints. These issues can be investigated using linear programming models. Bäckman and Křůmalová (in this volume) modelled three organic farms in the municipality of Juva in south-eastern Finland. The main production lines on these farms are dairy, forage and beef production respectively. The results of the scenarios show the ecological production options that are available to each farmer in order to improve gross margins. The analyses include the opportunity cost (incomes lost) owing to institutional and environmental constraints, for instance the requirement of self-sufficiency in feed. Bäckman and Křůmalová also point out that trade between farmers is an important feature of local markets and generally improves the economy of the farmers. The article raises some important questions concerning the effects of the CAP reform, which will come into effect 2006.

From society's point of view the effects of nutrient emissions lead to eutrophication of waterways and the Baltic Sea and are therefore a social cost (Larsson, in this volume). The argument in favour of rapid action is that prevention is less expensive than cleaning up after environmental degradation has already taken place. Larsson cites two studies by Gren (1997, 2001) according to which the cost of a 50% reduction of total nitrogen emissions to the Baltic Sea is estimated to be 1.32 billion Euros (SEK 12 billion) per year if the most efficient solutions are applied. This estimate requires countries to cooperate since cleaning costs may be less expensive in one country than in another. Citing Söderqvist, Larsson reports that the combined willingness-to-pay of the population around the Baltic Sea has been estimated to be 3.4 billion Euros (SEK 31 billion) per year. Larsson proposes some economic and administrative instruments for achieving sustainable agriculture, and he suggests some dietary options for consumers.

From the local community's point of view, an increase in demand for local foodstuffs is likely to have a positive effect on the regional economy in terms of increased employment and increased tax returns. Decreased transports may lead to a decrease in energy consumption. Vihma (2004) has estimated these effects the so-called ReGae input–output model. This model was used to estimate the effects of a 5% exogenous increase in demand for local foodstuffs in the province of southern Savolax, a region in south-eastern Finland with a rather important food sector. The increased demand would lead to a 0.34% increase in employment in the regional economy of at least 200 persons. The increase would be the strongest in the food sector with an increase of 7.45% in employment. Output would grow by 0.31 % and imports would decrease by 0.52%.

The consumers buy partly conventional and partly organic food. Thomsson (in this volume) followed the food expenditures of 15 environmentally conscious households in Järna, Sweden. He then compared these food expenditures with the average expenditures for Swedish households. While the environmentally conscious household had substantially higher food expenditures, the variation within households was large. Households consuming large amounts of animal products usually had higher expenditure than those consuming large amounts of plant products.

Citing Statistics Finland, Hannula (in this volume, results are preliminary) notes that the average Finnish household spends 1580 Euro/person/year on food. She studied ten household in the municipality of Juva in south-eastern Finland and found per capita expenditures in the same range as the Finnish average. However, individual differences between households were large.

Taken as a whole, the publication sheds additional light on the possibilities, constraints and strengths of local organic agriculture.

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PRODUCTION COST OF ORGANIC MILK
A case study of a dairy farm in Sweden

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Keywords
Organic farming, Production cost, Organic dairy farm

Abstract

Organic milk often has a higher consumer price than conventional milk because of higher production costs. The objective of this case study was to account for the production cost of organic milk on one farm participating in the Baltic Ecological Recycling Agriculture and Society Project (BERAS). The farm supplied milk to a local dairy which delivered it to local food shops. The objective was also to compare the results with the production costs of conventional milk. Data from the case farm were collected for three years and processed in the Bonnkalk computer program. The results were compiled as a mean for three years and compared to two modelling scenarios for conventional milk. The variable production cost for the case farm was 3.45 SEK (Swedish kronor) and total fixed costs 1.01 SEK per kg milk. It is not worthwhile to draw far-reaching conclusions from one in-depth study because of its limited statistical significance, but such a study can serve as an example and indicate trends. When the results from the case farm were compared to those for conventional milk, the production cost of organic milk was higher. The reasons for this are several. Organic farming is a system of complementary components which are highly dependant on each other and not easily substituted, while conventional farming can freely choose an enterprise mix and inputs which are financially the most favourable. Organic milk is produced within a set of regulations which restrict farm management, land use and production methods. Overall, organic farming endeavours to use local resources, recycle waste products and enhance the services of the ecosystem. Production costs tend to increase when environmentally friendly methods are used. Organic and conventional farming have different sets of prerequisites which must be considered when comparisons are made. It is therefore not appropriate to compare a single enterprise outside its farm context and focus on isolated figures. The exact figures can thus be argued about – because of this incomparability – but the results of the case study indicate that the difference between conventional and organic milk is in the range of 0.50 - 0.60 SEK/kg milk.

Exchange rate: 1 Euro = approx. 9 SEK.

Acknowledgements

Many thanks to the farm family at the case farm for giving me their time and attention and so generously making all the farm records available.

Introduction

This case study is part of WP 3 of the Baltic Ecological Recycling Agriculture and Society Project (BERAS). The objective of the study was to account for the production cost of organic milk on one of the Swedish farms participating in the project. The study encompassed three years: 2001, 2002 and 2003. The objective was also to compare the production cost of organic milk with that of conventional milk. Due to limited time and resources, the study focused on the variable production costs of organic milk on one organic dairy farm.

Organic production is defined by the European Commission as follows: "Organic farming differs from other farming systems in a number of ways. It favours renewable resources and recycling, returning to the soil the nutrients found in waste products. Where livestock is concerned, meat and poultry production is regulated with particular concern for animal welfare and by using natural foodstuffs. Organic farming respects the environment's own systems for controlling pests and disease in raising crops and livestock and avoids the use of synthetic pesticides, herbicides, chemical fertilisers, growth hormones, antibiotics or gene manipulation. Instead, organic farmers use the range of techniques that help sustain ecosystems and reduce pollution."

The family cultivating the case farm had a biodynamic approach to farming. At www.biodynamics.com, the webpage of the Biodynamic Farming and Gardening Association, biodynamic farming is defined as follows: "Biodynamics is a science of life-forces, a recognition of the basic principles at work in nature, and an approach to agriculture which takes these principles into account to bring about balance and healing. In a very real way, then, Biodynamics is an ongoing path of knowledge rather than an assemblage of methods and techniques."

A new Demeter regulation came into force in May 2002 that called for 100 per cent organic feed. At that time there was no concentrate on the market that satisfied this regulation so the farm excluded it from the feed plan.

Data

Farm data were collected for three years from 2001 through 2003. The main sources were the bookkeeping, the annual reports and various farm records such as the Swedish recording and AI programme, the Individ RAM (programme for analysing dairy economics), the CDB (Central Database of Bovine registration) and feeding plans. Another important source of information was the farmer's recollections of the actual production and management.

Farm background

The farm was situated in the district of Järna some 35 km south of Stockholm. It had been run according to organic and biodynamic principles since the late sixties. In 1972 the farm's land and livestock were certified according to Demeter regulations. Demeter is the organisation that certifies biodynamic production. Production was also certified according to the regulations of KRAV, the Swedish organisation certifying organic production.

The farm was owned by one foundation and run by another, which meant that one foundation rented the land, farm buildings and housing from the other.

The farm acted on the local market as much as possible. Cereals were delivered to a local mill, Saltå Kvarn, from where fodder grain was bought. Milk was partly delivered to Arla Foods and partly to a local diary, Järna Mejeri. The livestock was slaughtered in a nearby slaughterhouse and the meat distributed on the local market.

During the years 2001-2003 many changes took place on the farm. In 2001 the herd of milking cows was enlarged by merging two farms, many old cows were replaced and a new herd was established. The replacement was done with heifers raised on the farm. At the end of 2002 a stable for young stock was finished. The farm wanted to keep all the livestock together in the same yard. At the end of 2003 a tower for silage was raised.

The farmer and his wife looked upon farming as a way of living. They intended to continue being farmers as long as farming would bring them satisfaction, enjoyment and a reasonable income. The land and the livestock were seen as a strong unity, each dependent on the other. The driving force was to cultivate the land in harmony with the eco-system and strive for the well-being of the livestock heard

Their vision for the near future was that the area's farmers should cooperate to develop the local dairy as well as invest in a local slaughter house. That would strengthen their presence on the local market and also make it possible to start delivering milk and meat directly to the Stockholm market. This, in turn, would bring the producer closer to the consumer, benefiting the farm economy as well as the environment by reducing transportation.

Acting on the local market with locally produced food would promote another vision the farm family had: to increase the community's understanding of agriculture and make the inherent values of farming visible to people. The family's experience was that very few people to-day understand the conditions of farming and what it means to be a farmer.

How is this gap abridged? And how can the interest of young people in farming be increased? These were essential questions for the family as they felt that the gap between the city and the countryside was widening, and that the absence of the younger generation on farms was a genuine problem.

Farm Resources

The farm cultivated 120 hectares of arable land and 30 hectares of pastureland. The land was plain and soil was mainly of clay loam type. Drainage was satisfactory and the farm's land was situated mainly around the farm's hub.

Table 1 shows the land use in 2001-2003. According to EU regulations certified production allows for the grazing or harvesting of set-aside land.

The dairy production building was a conventional stanchion barn with tied up system. The stalls had been lengthened in 2001. Movable equipment was used for milking. The barn had a system for handling solid manure, which was composted on a concrete floor and processed in an experimental biogas plant. Calves were kept in the barn up to approximately three months of age. Fodder, straw and hay were also kept in the barn. Silage was stored in horizontal silos, as well as in round bales mainly fed to young stock. In 2003 a silage tower was under construction. Young stock were kept in a separate building on a neighbouring farm up to the end of 2002, when the new loose house for young stock was completed next to the barn.

There was a machinery shed, but not big enough to house all the agricultural machinery and equipment.

Part of the machinery had been bought from the neighbouring farm when the two farms were merged. In recent years investments had been made in new machinery in order to modernise. On average, the farm machinery was some eight to ten years old. The latest investments were a Valtra X120 tractor, John Deere forage chopper and Gregorie Besson reversible plough.

An experimental biogas plant processed the manure. It began operating in 2003.

The farm had about 50 dairy cows of Swedish Red and White breed. The young heifers and bulls were kept in a loose house where two or three suckling cows kept them company.

The daily farm work was done by the family and two young trainees. The family had come to the farm in 1993. Total yearly man-hours were approximately 5400, of which 3300 were related to animal husbandry. The farm had cooperated with neighbouring farms but at the time of the study was operating more on its own.

Table 1. Land use in 2001-2003, ha.

	Ley and grassland	Whole grain	Winter wheat	Oats	Set-aside	Natural Pastureland	Woodland pasture
2001	87.05	5.4	14.06	20.2	8.45	34.03	23.9
2002	75.84	9.52	20.54	14.06	15.5	27.7	4.23
2003	76.73	9.0	25.33	11.54	12.48	27.7	4.23

Activities

The farm cultivated ley for hay and silage, and oats and winter wheat for sale. The crop sequence was of five years: Ley I, Ley II, Ley III, winter wheat and oat with re-seed of ley.

The farm had about 50 dairy cows, recruitment was 30 per cent. In 2001 and 2002 the bull calves were sold to another breeder but in 2003 they were kept on the farm and raised for beef.

The feeding plans were based on silage and hay ad lib, fodder grain and mineral feed. The silage was distributed from an automatic silage carriage that passed the feed table 3 times every 24 hours. The fodder grain was fed according to lactation phase and was distributed from an automatic grain carriage that passed the feed table 4 times every 24 hours. In April 2002 the farm stopped using concentrate because of a new Demeter regulation that called for 100 per cent organic feed. In 2001 and part of 2002 the feeding plans also included a secondary product from sugar processing.

The farm was participating in Individ RAM, a programme for analysing dairy economics. The level of production for 2001-2003 is shown in Table 2.

From April 2002 the concentrate was excluded from the feeding plan. The yield of ley is calculated on the basis of what was actually consumed according to feeding plans. The figures therefore also reflect the loss from harvest to feeding table.

Every year the farm applied for EU subsidies available under the CAP programme (2001-2005). Organic producers receive an extra premium for livestock and crops. The yearly subsidies are shown in Table 3.

The farm supplied milk to Arla Foods and to Järna Mejeri, the local dairy. On average, Järna Mejeri paid approximately 0.50 SEK more per kg than Arla Foods; see Table 4.

Arla Foods regularly paid 0.50 SEK/kg as a premium for organic milk. Delivery to the local dairy grew steadily during the period and represented 45% of total production in 2003.

Table 2. Level of production, 2001-2003.

	2001	2002	2003
Number of cows	53.8	48.4	49.3
Yield, kg/cow/year	7702	7487	6745
Cereals, ha	34.26	34.6	36.87
Whole grain silage, ha	5.4	9.52	9.0
Oats, yield kg/ha	?[1)]	3597	2762
Winter Wheat, yield kg/ha	3629	2914	2287
Ley and pastureland, ha	87.05	75.84	76.73
Ley yield, kg dry matter/ha[2]	4000	8700	6400
Natural pastureland, ha	38.26	31.93	31.93

[1)] No reliable data available

[2)] The yield is calculated on the basis of amount consumed according to feeding plan

Table 3. EU subsidy payments for 2001-2003, SEK.

	2001	2002	2003
Direct area payments	208 691	262 039	204 610
Direct area payments organic production	97 859	95 276	96 392
Slaughter premium	10 695	13 683	17 503
Livestock premium organic production	130 220	121 278	135 014
Natural pastureland premium for biodiversity	92 354	92 354	92 354
Total	539 819	584 630	545 873

Table 4. Producer prices for milk, 2001-2003, SEK/kg.

	2001	2002	2003	Average
Arla Foods	3.37	3.46	3.50	3.44
Järna Mejeri	3.85	3.95	4.05	3.95
Average	3.49	3.61	3.75	3.62

Method

The data were processed in the Bonnkalk computer program, developed by a farm business adviser at The Rural Economy and Agricultural Society (Hushållningssällskapet), in the Region of Västernorrland. It is used by the advisory service for calculating the production costs of milk, meat and cereals. Based on Excel, the program is composed of several modules. It can be run in a simpler version, intended for the farmers themselves, and an advanced version which is more elaborate and requires a more detailed input of data.

Critical issues concerning method

Not all facts and figures from the past were easy to obtain. Although many were on records, many others such as for yields, working hours, tractor hours, harvesting conditions, feeding plans and strategies were not. Figures for these are estimates by the farmer based on recollection.

The exchange of services, seeds and other inputs between the local farms was common. These activities were not always recorded in the bookkeeping. Another critical issue was the time spent on different field operations and transportations which not only had an effect on total working hours but also on the capital costs of the machinery. Arbitrary decisions were sometimes made in order to manage this. Evaluating the machinery was also difficult since part of it had been in joint ownership with another farm.

Feeding plans were in place for the dairy cows but not for the young stock. They were more or less fed ad lib with roughage. Their consumption was calculated according to recommended feeding plans with regard to age and expected daily weight gain.

Results

Variable costs

Variable costs are expenditures related directly to output. If the output falls, these costs will fall also. In dairy production the variable costs are those for the heifers, feed, veterinary services, insemination and litter materials as well as other overhead such as advisory services, recording schemes and financial costs for working capital.

Labour costs

In this case study the cost of labour was a variable cost. The price per hour was 140 SEK in 2001, 150 SEK in 2002, and 160 SEK in 2003, regardless of the type of work. These figures were an average of the price per hour used in the gross margin calculations compiled by The Rural Economy and Agriculture Society and in the yearly dairy economics report from The Swedish Dairy Association.

Variable costs per cow and year

Table 5 shows the variable costs per cow and year and the average over three years.

Table 5. Variable costs, 2001-2003, SEK/cow.

Variable costs for	2001	2002	2003	Average
Heifer	2168	2733	2811	2571
Feed	11 721	11 141	10 288	11 050
Overhead	2564	2512	2517	2531
Labour	8400	9000	9600	9000
Total variable cost per cow and year	24 853	25 386	25 216	25 152

Total variable costs per cow differed by approximately 500 SEK between 2001 and 2002 and decreased by approximately 200 SEK between 2002 and 2003. The average value therefore seems to be representative. The variable heifer cost increased during the period mainly due to higher replacement. In 2003 the new loose house for young stock was built but the capital cost of this new building was not included in the heifer cost. Capital costs for production buildings are accounted for separately: see "Fixed costs" below.

Variable cost per kg milk produced

Table 6 shows the variable costs per kg milk produced per year and the average over three years.

The milk yield dropped in 2002 as concentrate was excluded from the feeding plan due to the new Demeter regulation. As the milk yield decreased the variable cost per kg milk produced increased, especially the labour cost. The cost of feed remained more or less the same over the three years.

At the time, organic producers of milk were receiving a livestock premium of 1700 SEK per diary cow (1 cow equals 1 animal unit) per hectare of ley. They were also receiving this premium per 1.66 animal units of young stock aged between 6-24 months per hectare of ley. This premium did not decrease the variable production cost of milk and was therefore not included in the calculations.

Table 6. Variable costs, 2001-2003, SEK/kg milk produced.

Variable costs for	2001	2002	2003	Average
Heifer	0.28	0.36	0.42	0.35
Feed	1.52	1.49	1.53	1.51
Overhead	0.34	0.34	0.37	0.35
Labour	1.09	1.20	1.42	1.24
Total variable cost/kg milk produced	3.23	3.39	3.74	3.45
Milk produced, kg	7702	7488	6745	7312

Milk price minus variable cost of feed

One key figure of profitability often used in dairy economics is producer price for milk minus the cost of feed. Table 7 shows the producer price for milk, the cost of feed, the key figure per year and the average for three years.

Table 7. Milk price minus cost of feed, 2001-2003, SEK.

	2001	2002	2003	Average
Producer price for milk, SEK/kg milk delivered	3.49	3.61	3.75	3.62
Cost of feed	1.52	1.49	1.53	1.51
Producer price for milk minus cost of feed, key figure	1.97	2.12	2.22	2.11

The cost of feed is one of the highest in a dairy farm's operations. The larger the key figure the better the profitability and the greater the surplus to cover other variable and fixed costs. A low cost of feed and a high producer price lifts the key figure.

Fixed costs

Fixed costs do not vary as output varies. Fixed costs include such items as land lease, insurance, administration, farm vehicle etc. Fixed costs also include the capital costs of farm machinery and production buildings.

In the case study capital costs for farm machinery included depreciation, interest and maintenance. A simple method was used to calculate the annual depreciation expense: an estimated residual value was deducted from the original cost of an asset and the balance was divided by the number of years of expected life. For example, if the original cost of a tractor is 500000 SEK and the estimated residual value is 100000 SEK, and it has an expected life of 10 years, the annual depreciation expense is 40000 SEK. Six per cent is used here as the rate of interest.

The capital costs for farm machinery were allocated to plant cultivation. Each crop was charged with its capital cost according to the machinery used and the amount of tractor hours used per hectare for cultivation (from ploughing to harvest). Services bought outside the farm were also allocated to the current crop.

Fixed costs were divided between dairy cows, young stock and plant cultivation while the capital costs of production buildings were divided between dairy cows and young stock. Table 8 shows the fixed cost per year and the average for the three years.

Table 8. Fixed costs, 2001-2003, SEK/kg milk.

	2001	**2002**	**2003**	**Average**
Fixed cost	0.51	0.56	0.77	0.61
Capital costs of production buildings	0.26	0.34	0.59	0.40
Total fixed costs per kg milk	0.77	0.90	1.36	1.01

The capital costs of farm buildings included depreciation, interest and maintenance. Calculation of these costs was difficult because of the mix between the ownership, the enterprise and the farming family. The farm was owned by one foundation. Another foundation rented the land and production buildings. The farming family rented their house from the second foundation.

Investments made in the production buildings were usually regulated by adjusting the lease. However, this was not the case for the latest investments in the loose house for young stock in 2003 and silage tower in 2003-2004. At the time of this study an agreement between the two foundations had not been reached but it was assumed that the tenant foundation would be charged a sum of money equalling the depreciation expense and the cost of interest for the loan. It was likely that future investments would also be treated in this way.

Due to the complexity of the situation, the capital costs of the production buildings were calculated in the following manner:

i) Capital costs except for maintenance of the cow barn were included in the farm lease. By looking at past figures, the yearly average cost for maintenance of the cow barn was estimated to be 65000 SEK.

ii) The capital costs for the new loose house for young stock were included in the calculations. Depreciation, interest and maintenance were allocated mainly to young stock.

Total production cost of milk

Table 9 shows the total production cost of milk per year and the average for three years.

Table 9. Total costs, 2001-2003, SEK/kg milk.

	2001	2002	2003	Average
Total variable cost	3.23	3.39	3.74	3.45
Total fixed cost	0.77	0.90	1.36	1.01
Total production cost	4.00	4.29	5.10	4.46

Total production costs increased during the period, especially in 2003. The main reason for this was decreased milk yield followed by increased costs for labour and increased capital costs due to the investment in the new loose house for young stock.

Other studies

The Swedish Institute for Food and Agricultural Economics (SLI)

The case farm results can be compared to other studies of production costs. A study published in 2003 by The Swedish Institute for Food and Agricultural Economics (SLI), includes a comparison of the production cost of conventional milk with that of organic milk, based on best possible agricultural practice and best possible results from the point of view of agricultural business.

The study was carried out in 2000-2001. The scenarios for the two production systems are modelled on the same conditions: 40 diary cows, milk yield 8500 kg in the conventional system and 7500 kg in the organic, farms situated in the south-west of Sweden, machinery costs equalling the cost of buying the service from a "machinery ring", cost of land and capital costs of production buildings excluded. Fixed overheads are 500 SEK/cow and 200 SEK/ha. The results are compared in Table 10.

Table 10. Production cost of conventional milk and organic milk from the modelling study compared with case farm production cost, SEK/kg milk.

	Modelling study		Case farm,
	Conventional milk	Organic milk	calculated average
Production costs	2.79	3.29	3.86

In Table 8 the average fixed cost for the case farm is 0.61 SEK/kg milk including land lease. If the land lease is excluded the average fixed cost is 0.41 SEK/kg milk and the comparable average production cost is 3.86 (3.45 + 0.41) SEK/kg milk.

The Swedish Dairy Association

The Swedish Dairy Association publishes annually a modelling scenario of economic performance in Swedish dairy production. The objective is to illuminate trends affecting the profitability of dairy production. The scenario is based on statistical data from a large number of dairy farms, and on the assumption that productivity is increasing every year. All producer prices and costs are updated yearly according to current price trends. The variable production costs are compared in Table 11.

Table 11. Variable production cost of conventional milk from the modelling scenario compared with case farm variable production cost, SEK/kg.

	Modelling study Conventional milk	Case farm, average
Variable production cost	2.89[1]	3.45

[1] Own adaptation

The variable production cost of the modelling refers to 2003. The study includes conventional as well as organic dairy farms, although there is no variable production cost for the organic farms separately. The average milk yield is 9170 kg for the conventional dairy cow and 7940 kg for the organic.

The study does not include fixed costs and the capital costs of production buildings. These costs, differing greatly between farms, are estimated by The Association of Swedish Forestry and Agricultural Employers (SLA) to be 4000-5000 SEK per cow and year. If the fixed costs are estimated at 4500 SEK per year they will be 0.49 SEK per kg conventional milk. Table 12 shows the variable production costs, fixed costs and total production costs.

Table 12. Production costs of conventional milk from the modelling study compared with case farm production cost, SEK/kg milk.

	Modelling study Conventional milk	Case farm, average
Variable production cost	2.89	3.45
Fixed costs	0.49	1.01
Total production cost	3.38	4.46

The fixed costs for the case farm are almost double compared to the SLA-estimated fixed costs. The total production cost for the case farm is higher by slightly more than 1 SEK.

Table 13 shows milk price minus cost of feed for the modelling study and for the case farm.

Table 13. Milk price minus variable cost of feed, SEK/kg.

	Modelling study		Case study, average
	Conventional milk	Organic milk	
Milk price minus cost of feed	2.11	1.83	2.27
Milk yield, kg	9104	7940	7312

In the modelling study the cost of feed was calculated with regard to the alternative value of forage and purchased fodder. The cost of feed for the case farm was the actual cost on the farm. In the modelling study the milk yield was corrected for the fat and protein content; this was not done with the milk yield on the case farm. The correction has no great significance in the comparison.

Analysis and discussion

The best factor for comparison between the two production systems is the variable production cost. On this level it does not matter if the land is owned or leased or how the capital is provided. The capital cost of production buildings and other fixed costs are also excluded.

The average variable production cost for the case farm was 3.45 (3.23-3.74) SEK per kg milk. The variable production cost for the modelling farm in the study by The Swedish Dairy Association is 2.89 SEK per kg conventional milk. The difference is 0.56 SEK per kg. If fixed costs are also included in this comparison the gap increases to 1.08 SEK per kg. Fixed costs are dependent on the farm enterprise mix.

In the study by the SLI the production cost was 2.79 SEK per kg conventional milk and 3.29 for organic milk. The corresponding production cost for the case farm was 3.86 SEK per kg milk. The difference is 1.07 SEK compared to conventional milk and 0.57 SEK compared to organic.

Milk price minus cost of feed is a key profitability factor often used in comparisons. It reflects the quality and the production cost of the roughage, as well as the quality of the milk delivered. In the modelling study by the Swedish Dairy Association milk minus feed was 1.82 SEK for conventional milk and 2.27 for organic. Milk minus feed for the case farm was 2.11 SEK with a range from 1.97 to 2.22 SEK, well in line with the modelling study.

Organic versus conventional production

It would, of course, be ill-advised to draw far-reaching conclusions from the present comparison between modelling scenarios and the in-depth study of one case farm even though the latter extends over three years. The obvious weaknesses are i) the studies are from different years, ii) there is great variation in the economic performance of dairy farms; one case farm does not reflect this variation and limits the statistical significance, iii) one of the referred scenarios is modelled on best possible practice, technique and husbandry, the other on statistics and assumptions, both of which minimise the impact of the farmer’s skills and ability; in the case study these characteristics have a heavy impact on the result, iv) the production systems for conventional milk and organic milk are themselves completely different and not really comparable since organic production is a system. This must be considered when a single organic enterprise, dairy production for instance, is compared outside its farm context.

However, the case study identifies an important trend which is also confirmed by the two modelling scenarios: the variable production cost is higher for organic milk. The size of the difference can be debated, but the results from the case farm indicate that it is in the range of 0.50-0.60 SEK per kg milk.

Milk price minus cost of feed was higher on the case farm because of a higher milk price, but also because of lower feed costs since the feeding plans were based on more roughage, fodder grain and no concentrate since the middle of 2002.

What is the reason for higher production costs?

The criteria for organic production systems (e.g. farm management, land use, animal husbandry, feed production and feeding strategies) are completely different from those for conventional production. Greater attention is given to soil fertility and crop sequences as well as renewable resources, recycling and self-sufficiency. One of the cornerstones of organic farming is a striving to prevent problems and to stimulate processes which assist pest and weed management. Another cornerstone is a holistic approach in which organic production is seen as a system of complementary components highly dependent on each other and not easily substituted. Certified organic production is also subject to a great many regulations which restrict production methods and alternatives. If production fails to fulfil these regulations it loses its organic status.

Conventional farming relies heavily on outside inputs such as synthetic fertilisers, pesticides and soybeans. The enterprise mix and inputs which are financially most rewarding is chosen; i.e. winter wheat is planted year after year in the same field without regard for crop rotation and ecosystem impact. Soybeans are frequently used in feeding plans disregarding the impact soybean production has on ecosystems in exporting countries. All agricultural activity has an impact on the environment. Conventional farming, however, has no price tag with respect to its impact on ecosystems. The production costs do not include environmental costs: these are externalised. Organic farming, on the other hand, is a system whose distinct objective is to assist ecosystems and minimise its own environmental footprint. The environmental costs are internalised in the production cost.

Conclusion and advice to farmer

The milk yield dropped in 2002 when concentrate was excluded from the feeding plan. When the milk yield decreased the production cost increased. Particularly labour costs and fixed costs per kg milk were high in proportion to the total production cost. If yield were to be increased the fixed costs would be allocated a larger quantity. The challenge was to raise milk yield with current feeding plans based on roughage and grain.

The farm's key profitability figure, milk price minus cost of feed, kept up with the one in the study by The Swedish Dairy Association: 2.11 to 2.27 SEK per kg milk. The greater the key figure the greater the amount left to cover remaining costs. The size of the key figure also reflected the milk quality and the quality of the roughage. In dairy production the cost of feed is a heavy item directly affecting profitability. Opting for good quality ley and hey is therefore always recommended. In 2003 the farm erected a silage tower to store the harvest of 2004. Hopefully the expectations of higher silage quality will be realised.

The cost of roughage was calculated from field to the feeding table which means that the loss is included in the cost. The acreage for roughage on organic farms is usually ample so as to avoid shortage. With reduced losses and more individual feed control the surplus acreage could be used for cash cereals.

The costs for veterinary services were extremely low, indicating good health status. During the case study I spent many hours in the farm office next to the rows of cows. The atmosphere in the stable was always very calm and peaceful.

All investments which save labour, time and expenses are strongly recommended. The investment in the loose house for young stock not only simplified the feeding routines but also reduced the time spent delivering the feed. Future investments in the farm's energy supply are encouraged. If the farm can provide for its own energy needs it will not be affected by increasing energy costs.

To realise the aspirations of the farm family, cooperation with other farmers as well as with the local diary is also encouraged. The presence of the area's farmers in the local market place will bridge the gap between consumer and producer, and promote local produce. Locally produced food will not only increase the transparency of food production but also consumer awareness of how organic milk is produced. This, in turn, would help bring about a higher consumer price and benefit the local dairy, as well as the farmers. In addition, less transport is needed the closer producers are to consumers, a vital aspect today when food transportation has become global with little regard for its environmental impact.

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LOCAL FOOD OPTIONS – a linear programming perspective on three organic farms in South Savolax, Finland

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Abstract

The options for three case farms to maintain and increase localized organic food production and circulation were analysed, and a standard linear programming method was used. Several scenarios were developed for each case farm; as a result, possibilities for co-operation between farmers through local markets could be analysed. Trade between farmers was observed to be a major component of local production and consumption. Several possibilities for increasing organic production were found. Making fuller use of the capacities of animal sheds, machinery, land and labour was possible by increased trade between farmers. The sensitivity of activities at the farms to price and support variations were studied indirectly by looking at validity ranges and sensitivities to changes. Numerous constraints were analysed, both institutional and environmental. The institutional constraints consisted of the markets and existing regulations; environmental constraints were based mainly on agronomics. The income foregone from different organic constraints was calculated.

Introduction

Localizing food systems has been proposed as a sound solution for improving the economy in remote rural areas and the recycling of nutrients at the local level. In this report we analyse farmers' options for localizing production within the framework of organic farming. The report originates from the BERAS project, where localized organic farming is assumed to decrease the externalized environmental effects through localizing the factor inputs and outputs.

There is growing interest in research, and a range of studies deals with local production and consumption issues in food systems. Many of the studies investigate environmental effects, e.g. Gilg and Battershill (2000) and Sundkvist et al. (2001), consumers' attitudes, e.g. Weatherell et al. (2003), and possible effects on local economies, e.g. Williams (1996). Primary enterprises (including farming) are traditionally considered a basic sector for local economy that creates external income. The role of net income has also been emphasized. The net income of an economy is determined by total external income, times a multiplier, minus total external spending (Williams 1996). In the area of farming, studies dealing with distribution channels and co-operations between farmers or farmers and consumers can be found. However, the studies look at the

Shortenings

LP	– Linear-programming
GM	– Gross margin
CAP	– Common Agriculture Policy of European Union
EC	– European Commission
UAA	– Utilized Agricultural Area
LU	– Livestock Units

possible advantages and disadvantages of the "initiative" rather than the economic effects at farm level.

The principles of organic farming give rise to several choices for reducing the burden on environment and livestock. One objective is to have a balance between animal production and land, such that nutrients are returned from animal production to the land and vice versa. This is strengthened, for instance, by not allowing nitrogen and phosphorous as mineral fertilizer but only allowing organic fertilizers. Both conventional and organic systems can be seen as recycling ones, but the conventional type might consume more energy. Several pesticides are also banned in organic farming such as all synthetic pesticides and herbicides. Organic farmers thus save part of the costs of fertilizers and pesticides. Economically, organic farming is facing more stringent constraints on the input side leading to lower production. But they have a less stringent output side with a possibility to sell products to a higher price through organic certification, which conventional farms cannot do.

What can farmers do to enhance local food systems? What would be the effects of this on the economy of the organic farmer? What are the possibilities for and constraints on organic farmers with respect to meeting the need for localizing production and consumption? What is the effect of not allowing any purchases of feed at the farm level? This last question is a strict interpretation of fundamental organic farming. These questions will be partly answered by utilizing a linear programming farm model. Three selected cases (real farms) were analysed in depth: a farm that produces forage, a dairy farm and a beef farm. The farms are located in the same municipality, Juva, in central eastern Finland.

The Juva region is 134 600 hectares in area of which 74% (87 000 ha) is forest and only 8% (9 000 ha) is agricultural land. Approximately 20 000 hectares is water. The Juva region is predominantly rural with a population density of only 6.8 inhabitants/km^2 (about 7 500 inhabitants in total). The area is categorized as a C1 support area (A being the most favourable farming area and C3 the least, see http://www.mmm.fi/english/agriculture/support.htm). Agricultural production is constrained by natural conditions such as a short growing season, little precipitation (but with high variability during the growing season) and small, scattered fields. Juva is on the border of wheat production area and therefore early varieties are preferred. The short growing season forms the soils and forest area is very dominating. Cereal production is mostly for fodder (90% of the cereal area, 2002). The area is favourable for animal husbandry and especially ruminants. Dairy farms comprise nearly 50% of the farms (410 farms, 2002). The farms have on average 19 hectares of agricultural land and 74 hectares of forest (2000).

Total agricultural land area in the municipality of Juva is 8 900 hectares, of which 1 334 hectares or about 15% is under organic management. About 55 of the farms are organic, and their average size is 24 hectares of agricultural land (i.e. excluding forest). The organic farms are therefore slightly larger than the conventional farms. Organic farming in the region is predominantly based on animal husbandry and the land use is nearly 60% grasslands; if including cereals 90% is grass. In 2002 it appeared that the diversity of land use in Juva was lower on organic farms than on conventional farms (Table 1).

Table 1. Land use of organic farms and all farms in Juva (2002).

	Organic farms (ha)	(%)	All farms (ha)	(%)
Ley	762	57	4016	45
Cereals	448	34	2971	33
Fallow	62	5	545	6
Horticulture	10	1	143	2
Other	52	4	1226	14
Total	1335		8901	

The linear programming method

The linear programming (LP) model is a method that can represent the whole farm planning. The LP-model shows how the farmer could respond to changes in policies and markets. In the short run the variability of costs are in the annual factors while the land, machinery and building capacities are fixed. In the long run also these factors are assumed to be variable. We have chosen to look mainly at the short-term changes. The feasibility area is formed from a combination of the farm's existing production possibilities.

The theoretical model is

$$\max\{Z=c'x\}$$
$$\text{s.t. } Ax \leq b,\ x \geq 0$$

where Z is the sum of gross margins and costs, x is the vector of activities, c is the vector of gross margins or cost per unit of activity, A is a matrix of coefficients and b is the vector of constraint values. The later part in s.t. states the non-negativity of activities.

Empirical model construction

The linear programming model maximizes the sum of gross margins and costs of farm activities. These consist of crop production activities, animal production activities and other related agricultural activities. Gross margins for all the activities were calculated separately and then applied for the linear programming model. Gross margins should cover costs of own labour, capital and investments. The prices of intermediates were not given but costs were included. The buying and selling of farm products and subsidies/payments were picked out as separate activities for the purpose of creating sensitivity analyses. The activities were subjected to constraints. The number of the constraints depended on the individual farm and is based on a questionnaire. The constraints basically consisted of available land, labour and feeding ratios. Additional constraints concerning crop rotations, buying possibilities and machinery/buildings capacities were added, as were some institutional constraints. The legislated environmental constraints were also imposed.

In theory, the direct payments (coupled ones), which are based on production factors like acreage, do not affect the choice of intensity of crops. However, some of the direct supports affect the choice of crops since they differ between crops. An example of this is the CAP support, which is different for cereals and protein crops, for instance. The supports also vary between countries and regions. In our model the supports were included and tied to the elements of achieving them. The supports that affect choice of crops or animals were included in a way that allows them to be analysed from a sensitivity point of view, which means as separate activities tied to the support gaining ones. The prices are similarly included in the model to achieve additional information about validity ranges and sensitivity.

The modelling started by using the existent amounts of activities as the reference point. Thereafter one additional change is made for each scenario. Scenarios were created such that from the reference point the next run is done in a manner allowing for all activities to be chosen freely by the model, then additional constraints were added accordingly to capacities and assumed markets. In this way we determined the importance of each constraint. Next, the binding activities were investigated further by adding purchasing possibilities on feeds and labour etc. Changes in supports and prices were added in order to get additional information about how stable the solutions are. As well, the scenarios showed the consequences of institutionally, biologically and technically constrained production.

Data

Information about activities, gross margins and constraints was gained by farm interviews. A questionnaire was developed for a purpose of data collection and consisted of questions concerning family labour use, land use, animal structure and feeding ratios, yields, prices and distribution channels, variable and fixed costs, revenues and other issues connected with management and marketing of farm products. The choice of farms was based on production lines, organic farming activity and participation in a local food system. Data was collected for the year

Table 2. Basic information about case study farms.

	Farm 1	Farm 2	Farm 3
Organic certification since	1985/95	2002	1996
UAA (ha)	16.8	42	90
Forest area (ha)	43	77	30
Main product line	Dairy	Forage	Beef
Other activities	Employment	Baling service	
Total LU	9.4	0	108
Animal density	0.56	0	1.2
Labour: Full time	1	1	3
Seasonal workers	1	0	3

2002 and consisted of detailed information about resources, technologies, costs and revenues, and structure of production. Attention was given to product flows, mainly the distribution of farm products.

Processing and results

Labour per hectare of cultivated crops was determined with use of published standards and surveys. The prices of the organic forage products (silage, hay) were taken from the questionnaire. Calculation of the prices according to fodder unit of cereals was used if information about price was missing. The yields were taken from the questionnaire and represented the approximated average yields that the farmer can give. No heterogeneity is assumed between fields, which is a strong and incorrect assumption but by using average yields greater accuracy was achieved. Furthermore, by changing the yield assumptions the stability of the calculations was verified.

Farm 1:a dairy farm

Farm 1 has been in organic production for 20 years. The land was converted in 1985 and the cattle ten years later. The farm now has 17 hectares of arable land and 43 of forest. There were 8 dairy cows on the farm and milk is the main product. In addition, the farm engages in direct selling of potatoes and rye flour from own grain (milled in a nearby mill). One of the family members worked full time on the farm and one works during summer in crop production. Additional labour is arranged for some of the seasonal work (hay, straw and potato harvesting).

The land use was fully adjusted to dairy production and the farm is close to being self-sufficient in fodder production. The farmer bought only some minerals and proteins (organic rapeseed). The rest of the land was utilized for cash crops: potatoes (0.2 ha) and rye (1.63 ha). The crop products were packaged on the farm and distributed directly to consumers.

Animal production consisted of dairy cows. Bull calves were sold to a beef farm for meat production. Cow calves that were not used for replacement were sold to a slaughterhouse. Feeding in winter consisted basically of silage for free, a mixture of barley, oats and peas, and in summer, pasturing and a mixture of grains and legumes. The farmer used his own straw from cereal fields for bedding, as well as bought peat.

The farmer had made no recent investments in buildings or machinery. Investments for wastewater and manure storage were made eight years ago. One year later, a one-quarter share of a harvester was bought. Some farm services (baling of silage and hay) were used to be purchased.

Constraints

The total labour was calculated to be 4 000 hours. Herd rotation allowed replacement from own calves only. The replacement was assumed to be 25%. The cowshed capacity was 11 cows.

Scenarios

Five scenarios in addition to the reference scenario, which is the actual situation at the farm, are presented. The unconstrained land-use scenario allows the model to choose the most profitable activities existing on the farm but the area of directly sold potatoes was limited to its reference value. The crop rotation and fodder purchase possibilities (FPP) scenario introduces new activities concerning fodder purchases while limiting land use to the maximum area for cereals, rye and potatoes. A fallow land possibility was added as an alternative land use activity for the next scenarios. The limited FPP scenario was derived from the previous scenario and its purpose was to present the consequences of constraining fodder purchases (up to 30% of total fodder units). The last two scenarios (GM2: gross margin 2) shows the effects of introducing gross margin 2 (labour included in variable costs: 11.35 Euro/h), which meant a crucial change in the model construction.

Results of the scenarios

Table 3. Results for dairy farm.

	Reference	Unconstrained land use	Crop rotation and FPP	Limited FPP	GM2 and FPP	GM2 and no FPP
Total GM, Euro	-	+3000	+6600	+5500	-13600	-14100
Labour use, h	1380	1670	1830	1820	1530	1070
Dairy cows	8	10	11	11	9	6
Silage, ha	5.9	7.4	7.4	8	6.5	4.3
Barley & grass, ha	2.5	1.9	0	0	1.2	1.1
Oats & peas, ha	2.2	1.9	0	0	0	1.1
Oats, ha	0.7	0.8	0	0.9	0.7	0.5
Rye, ha	1.6	0.2	4.2	2.3	4.2	4.2
Fallow land, ha	-	-	0	0	0	2.9
Bought cereals, kg	-	-	7400	8500	5100	-
Bough silage, bales	-	-	38	0	0	-
Land shadow price		1750	900	1440	650	670

In the scenarios, the tendency was to use the land for cereals as little as possible. The purchasing possibility introduced in the "Crop rotation and FPP" scenario clearly improved the total gross margin (for more than 6000 Euro compared with the "Unconstrained land use" scenario). Silage crops were relatively more competitive, which could be seen in the "Limited FPP" scenario. As well, the alternative use of land for fallow land did not eliminate silage from land use. It seems silage performed relatively better or had a higher price to purchase. The opposite could be said about the cereals. The sensitivity analysis of the scenario showed that the price for cereals could still be increased by 20% and in the case of oats & peas (a mixed cropping) nearly doubled. Labour was not a limiting factor in this farm case. The model therefore suggested an increase in dairy production that would require relatively large amount of labour.

Cash crop activities were a special issue in the scenarios. The potato area had to be limited in all the scenarios since it would be the most preferred by the model. The main reason was high price through the direct sale channel. Because potatoes for food were a very special crop on such a farm and because of the type of marketing, the missing knowledge about maximum production and distribution capacity was a crucial factor in constraining their production. In the case of rye, the maximum capacity was adjusted to the crop rotation. The "rye for flour" activity operated to be rather competitive when fodder purchasing possibility was allowed, and this activity reacted to changes in the model scenarios.

The "GM2 and FPP" scenario did not choose dairy activity to the maximum capacity of the cowshed. One of the fodder cereals was already included and no silage was bought (compared to the similar scenario "Crop rotation and FPP"). Fallow land was not included, which was a positive indication about the competitiveness of the farm production activities. Correspondingly, the "GM2 and no FPP" scenario could be compared with the "Unconstrained land use" scenario except for that the maximum area of rye was constrained. The dairy activity was a less competitive activity compared to the rye production. Fallow land was included since the area for cereals was limited and silage crops were adjusted by the model to decreased dairy production. (No selling activity for silage was included in the scenarios for this farm.)

Farm 2:a forage producer

The farmer started his farm in 1995. The farm had 42 hectares of arable land of which 23 were rented. The forest area was 77 hectares. The farm was converted to organic production in 2002. The farmer worked full time on the farm and did contractual work for neighbouring farms in the form of baling of silage and hay. This additional activity comprised 600 working hours in the growing season, amounting to approximately 1000 hours in total.

The agricultural activities were concentrated only on crop production. The farmer stopped dairy production in 2000. Silage (silage bales) and fodder cereals were the main crops and these were sold to neighbouring farmers. Important recent investments had been a tractor in 2001 and a silage wrapper and baler in 2002. The farmer owned 60% of the wrapper and baler. As well, the farmer had invested in other crop production machinery in the last five years (harrow, rock picker, wagon, plough) which he often shared with other farmers.

Constraints

The labour limit for the growing season was 1000 hours. Minimum obligatory area of fallow land 10% was included in the crop rotation. The maximum use of the wrapper and baler was 420 h/year and 360 h/year, respectively.

Scenarios

The scenarios were basically aimed at determining the consequences of crop rotation constraints as well as the competitiveness of fodder cereals. Particularly, respons to the selling activities and fallow land to price changes was observed. The "No constraint" scenario presented results for land use without constraints and with prices of crops reported in the questionnaire (cereals 0.168 Euro/kg). The theoretical "No CAP silage" scenario showed the effects of excluding CAP payments for silage crops. The "Rotation constrained" scenario aimed to balance cereal and silage production by requiring that the areas for silage and cereals should be equal. In the "Increased labour" scenario the impact of increasing labour availability was examined. The labour was increased by 200 hours.

Results of the scenarios

Table 4. Results for forage farm

	Reference	No constraint	No CAP silage	Rotation constrained	Increased labour
Total GM, Euro	-	+3900	+3100	+3400	+11300
Labour, h	1000	1000	1000	1000	1200
Silage, ha	17.2	37.8	0	7.3	11.3
Barley & oats, ha	9.3	0	0	0	0
Oats, ha	5.4	0	12.8	7.3	21
Oats & peas, ha	5.0	0	0	0	0
Fallow land, ha	5.1	4.2	29.2	27.3	9.7
Contract work, bales	1300	1200	2400	2285	2223
Shadow price: land Euro		513	526	520	583
Shadow price: labour	30	30	25	27	27

The farmer had limited labour and this seemingly led to greater competition between farm crops and silage baling activity. From this point of view the production of organic fodder cereals seemed to be the least competitive activity on the farm. This could be caused either by low prices or low yields. Moreover, the farmer had no animal production activity that would give added value to the fodder crops he produced. He had to sell all the fodder at prices that have been decreasing in recent years.

Optimization without the constraining of land use resulted in silage production only. The rest of the labour capacity was utilized for contractual baling. Total GM rose by about 4000 Euro from the reference model. In the theoretical scenario "No CAP silage" one could expect that cereals would be fully included in the solution if the silage crop would lose a significant part of income and hence its competitiveness would decrease. Nevertheless, the optimal solution chose the baling activity to be at the maximum of machinery capacity and fallow land as land use. According to the sensitivity analysis the price of the farm's silage bales would have to increase by more than 30% to include silage in the production. The total GM decreased by 800 Euro.

The solution for the "Rotation constrained" scenario resulted in increased fallow land area rather than an increase in cereal production, which must happen if silage area increases. (The CAP payment for silage was included again.) The baling activity was again highly preferred by the model.

The competitiveness of cereals was improved by increasing labour availability in the "Increased labour" scenario. Because the silage and the baling activity were constrained by machinery capacity, the rest of labour could be applied to more labour demanding activities (cereals) than fallow land. The constraint concerning crop rotation was diminished in the sense of including fallow land in the rotation. (The area for cereals should be greater than the area for fallow land plus silage.)

Farm 3:a beef farm

The farmer bought the farm in 1994. In 1996 the land was certified as organic and one year later the animals were certified. The farm had 90 hectares of arable land of which 50 were rented. Forest land area was 30 hectares. Production was concentrated on beef and forage. In addition, the farmer cut and baled silage for neighbouring farmers during the season, amounting to 80 hours of labour a year.

The farmer invested considerably in the last five years. He extended the animal shed to a capacity of 300 animals and bought more field machinery. The number of animals was doubled at the same time. He worked full time on the farm together with another family member and one employee. His spouse helped seasonally and the farmer also employed two seasonal workers in summer and one in winter.

The land was utilized mainly for perennial and annual silage (more than 50 ha). Some land was grazed. The only cereal grown on the farm was oats (around 20 ha). The farm also had natural permanent pastures that was utilised for extensive grazing.

The farm raised young bulls for beef production. There were approximately 108 LU in total on the farm. The farmer bought beef calves at the age of 3 months from neighbouring organic dairy farms. Part of the feed was bought: cereal side-products from mills, concentrates, minerals, proteins and some of silage bales. Nearly all the feed was organic, only the protein feed was half conventional. Most of the bedding material was bought (peat, wood shavings, some straw). The bulls were sold after 21 – 24 months of fattening. Some of the beef was sold through direct sales (nearly one third of beef sale income). In this case the bulls were slaughtered, butchered and the beef packaged and then distributed to shops. The shops were located in the Mikkeli region, mostly near the farm. The local slaughterhouse offered a complete service including distribution to the shops; however its service costs doubled just in the year of observation.

Constraints

The total labour capacity amounted to 6500 hours. The animal shed capacity was set for 300 heads.

Scenarios

The scenarios for this farm were set up with several intentions. First the reference scenario was calculated with the original settings. Then the free run was performed but with a crop rotation constraint limiting the area of oats. Another scenario included a labour-purchasing possibility to see to what extent the production could be increased. As well, a scenario where labour was included in variable costs was performed ("GM2" scenario). A direct selling possibility for beef was included in all the scenarios. Sensitivity to changes in cereal and silage prices was also investigated.

Results of the scenarios

Table 5. Results for beef farm.

	Reference	**Oats area constrained**	**Labour purchase**	**GM2**
Total GM, Euro	-	+8400	+23 100	-67 600
No. of bulls	184	192	300	192
Perenial silage, ha	40.1	0	0	0
Annual silage, ha	10.4	61	50	61
Annual pasture, ha	3.5	2	13	2
Oats, ha	23	27	27	27
Oats sales, kg	6900	18 000	0	18 000
Oats bought, kg	0	0	25 300	0
Silage bought, bales	66	29	895	29
Labour bought, h	-	-	2650	0
Shadow price: land Euro		603	701	611
Shadow price: labour		17	11	5

Farm 3 had relatively high yields of silage crops and oats. The daily growth of the animals was also relatively good. The model suggested maximizing the number of cattle and the area of oats. The buying of silage for the fodder producer was not causing changes in activities but this must be interpreted carefully since there was no other alternative use of land in the model if area of oats is limited. This was corrected by adding fallow land for alternative landuse. However, fallow land was not chosen in this case.

Buying extra labour and extending beef production was an option suggested by the model. However, this was valid only for scenarios operating with gross margin 1 (without labour costs included in the variable costs). Including labour costs to the variable costs (the "GM2" scenario) did not even suggest fully utilizing the existing labour capacity. The shadow price of the labour would be 5 Euro. If beef production were to be expanded to maximum capacity then extra purchases would be needed in the form of straw, silage and cereals. This would also require that enough organic straw, for example, be available in the region. Similarly, the purchases that were not included in the model such as calves, rapeseed etc. should be available. Direct selling of meat versus conventional selling was added to the scenarios. The second alternative was chosen as more profitable. This result was very sensitive according to the analysis (allowable increase/decrease in price only 0.002 Euro per kg). Nonetheless, direct selling would make sense if there were expectations of lower or unstable prices through the conventional channel.

Discussion

Generally trade between farmers improves the local economy. However, the dairy farm (Farm1) was closest to the goals of organic farming in the reference state. In the reference state this farm hardly purchased any fodder from other farms. (Only some services were bought.) In one scenario the farmer could increase his livestock and purchases of fodders, respectively, which would improve the sum of gross margins at the farm. This would imply that labour is available and that the capacity of the cowshed is being utilized. Moreover, if there would be sufficient markets the farmer could expand the direct selling of potatoes and rye flour.

The fodder producer (Farm 2) was more dependent on trade with other farmers. In the event of no trade, the farmer could choose to maintain more set-aside and labour opportunities outside the farm. There is, however, a scope for selling services and fodders to neighbouring farms. With the current assumptions, the best alternative was to produce and sell forage and baling services. Producing cereals was less competitive for this farm.

The beef farm (Farm 3) had the possibility to expand, as regards livestock. This would require purchasing both labour and fodder. In the current situation the farmer purchased already 30 tonnes of straw and some silage. In a possible expansion the dependence on increased purchases could cause insecurity, and the marketing of products would need to be analysed further. However, the expansion would add to the local economy since it would increase labour opportunities, fodder use and products for sale. Nevertheless, the organic requirements that are now appearing (8/2005) do not allow for such expansions (EC No 1804/1999). An increasing demand of organically produced feeding stuffs is occurring according to EC, but the availability of organically produced protein crops is a problem still to be solved. An even bigger task is how to find available straw for bedding material since this is also needed mostly for soil improvement in both conventional farms and even more so in organic farms. The purchasing of organic fodder is not actually limited. But to some extent it can be limited by missing or not well functioning markets for organic fodder or by the history/management of an organic farm (minimum reliance on external suppliers, balance between crop and animal production). At the time, the farmer was utilizing the capacities well since the farm is dependent on rented land. In the event of losing some of the rented land the number of livestock could be problematic from a fodder and environmental regulation point of views. A more environmentally secure approach therefore would be to have number of livestock correspond to the land area owned.

All investigated farms contributed to the local market, for which trade between the local farmers was the single most important element. Supporting the local market would require following up information on the demand for different products. A possible co-operation model for organic farming that can improve the performance of farms together as well as increase local demand (with milk and beef still remaining more as export products) is shown in this report.

Fertilizers that should replace the outtake were not considered and therefore a lack of nutrients, especially phosphorous, could develop for certain crops after some years. This concerns particularly the livestock farms since there the outtake of nutrients is higher. This should be investigated further in follow-up research.

Other considerations include:

- The CAP reform with a decoupling of supports and payments will have consequences, especially where productivity is low.
- Could low yields of organic cereals play a role for local production?
- Sharing of mechanization, though common in Juva, can be problematic for some farms.

What will happen when farmers can only buy fully organic feed? This should also be analysed further as an important factor for the future development of organic farms in the area.

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HOW AGRICULTURAL REFORMS CAN REVITALIZE THE BALTIC SEA – Cost efficient measures to curb eutrophication

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Sweden has adopted several environmental goals which are related to agriculture as well as the Baltic Sea. Sweden has also agreed in international conventions to reduce its emissions of nutrients into the surrounding marine ecosystems. Even so, the Baltic Sea could be heading towards ecological collapse. A main reason for this is pollution caused by agricultural production. Far-reaching reductions of emissions are required to tackle this unwelcome and damaging development. International cooperation is important for progress. The expansion of the EU leaves us with a choice. If the new member states follow in the footsteps of the old members, emissions of nutrients risk increasing considerably, by 50 to 75 per cent. If agricultural subsidies are used to steer production down an environmentally friendly route, there is much to be gained. The Baltic Sea wouldn't be the only beneficiary of such change since several other societal goals could also be achieved. One important element in the new policy is the local production of organic food. Today, consumers still pay the full price of food production, partly in the food store but also, partly, through their tax bill and a degraded environment. The people's willingness to pay for an improved environment is substantial. The agricultural production is causing large external costs. From a socio-economic perspective, extensive investments in environmentally sound farming practices are justified. The point of departure for the following pages is the research project Baltic Ecological Recycling Agriculture and Society, BERAS, involving all EU nations around the Baltic Sea. The aim of the project is to investigate environmental and socio-economic consequences of local, organic food production where plant nutrients are re-circulated and chemical fertilizers and pesticides are phased out.

Introduction

A research report from the Swedish Environmental Advisory Council (Miljövårdsberedningen) at the end of February 2005 had a large impact on the public debate in Sweden. After the launch of the report "Strategy for a sea and coast free from eutrophication" (Strategi för hav och kust utan övergödning), researchers repeatedly were asked to explain the reasons for, and the effect of an ecological flip in the Baltic Sea - a flip associated with a new situation characterized by excessive algae blooming and a fishing industry in crisis. To avoid further degradation of the state of the Baltic Sea "substantially greater reductions in emissions" are required (Miljövårdsberedningen, 2005:31). Political cooperation is seen as crucial for progress. Today eight of the nine countries around the Baltic Sea basin are members of the EU which can facilitate the cooperation.[1]

The Swedish parliament has adopted a number of environmental goals of which several are related directly or indirectly to agriculture as well as the Baltic Sea. The government has over-arching goals on ecologically, economically and socially sustainable food production, and rural development.[2] Apart from this, Sweden has agreed in international conventions to reduce its emissions of nutrients into the surrounding marine ecosystems. These agreements have attracted more attention since the publication of the above-mentioned report. If we are to take the stated goals seriously, a major change in the agricultural system, which is responsible for half the emissions causing eutrophication, is needed. Stefan Edman, who is investigating "sustainable consumption" for the Swedish government, devotes a great deal of his report to discussing food issues. According to Edman, locally produced organic food is part of the solution if we are to achieve sustainable consumption (Edman, 2004a). In the present text it is argued that efforts aimed at agriculture are, from a cost perspective, efficient at reducing the eutrophication of the Baltic Sea. In a farming system based on organic principles and nutrient recirculation, where chemical fertilizers and pesticides are phased out, several of the stated goals and international promises would be met. The focus, in the following pages, is on the emissions of nutrients from agriculture, but emissions of CO_2 and other environmental problems will also be discussed.

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[1] Lars-Erik Liljegren, director general at the Swedish Environmental Protection Agency and one of the authors of the report, commented on the report on National Radio, P1-morgon, 22/2 2005.

[2] The parliament has decided on 15 environmental goals. These are: Reduced Climate Impact; Clean Air; Natural Acidification Only; A Non-Toxic Environment; A Protective Ozone Layer; A Safe Radiation Environment; Zero Eutrophication; Flourishing Lakes and Streams; Good-Quality Groundwater; A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos; Thriving Wetlands; Sustainable Forests; A Varied Agricultural Landscape; A Magnificent Mountain Landscape; A Good Built Environment. The government has listed goals on: Biological diversity; 20 % organically grown acreage; Ecologically, economically and socially sustainable food production; Ecologically, economically and socially sustainable rural development.

The environmental pressure from agriculture

Agriculture is affecting the environment in different ways, ranging from severe changes in the rural landscape to the leaching of pesticides and eutrophicating nutrients. Many of these effects are not unavoidable or irreversible, but are determined by several factors including what is produced and how this is done. From the perspective of climate change, where the food is produced is also of interest. The ingredients in a typical Swedish breakfast have in all travelled a total of 36000 km and used up 0.6 litres of fossil fuel (Edman, 2004b). The price in terms of climate change caused by emitted CO_2 is something we don't have to deal with when enjoying coffee, orange juice and corn flakes. However, in terms of environmental pressure the effect is substantial.

More concrete, from a Swedish perspective, is the effect of food production on the Baltic Sea. The contribution of each country to the total flow of nitrogen and phosphorous to the Baltic Sea is shown in Table 1. Poland contributes the most nitrogen and phosphorous flowing into the Baltic Sea. However, measured as emission per capita the Swedish contribution is three times as high for nitrogen and almost twice as high for phosphorous compared to Poland's contribution. Finnish per capita emissions are even higher.

Table 1. Nitrate and phosphorous emissions from point and non-point sources including the natural background load into the Baltic Sea from its drainage area for the year 2000. Population refers to people in the drainage area of the Baltic Sea. The background load is, on average, 30 per cent of total emissions. Sources: HELCOM, 2003a and 2003b.

Country	Total drainage area 1000 ha	1000 tonnes nitrogen/year	% of total	kg/capita $year^{-1}$	Tonnes phosphorous/year	% of total	kg/capita $year^{-1}$
Poland	31190	230.4	28.3	6.1	18760	44.7	0.50
Sweden	44004	175.6	21.6	20.6	7320	17.4	0.86
Germany	2860	33.5	4.1	10.8	1230	2.9	0.40
Finland	30130	122.7	15.1	24.2	6370	15.2	1.26
Denmark	3111	65.4	8.0	14.6	1880	4.5	0.42
Lithuania	6530	37.2	4.6	10.1	1150	2.7	0.31
Russia	31480	61.5	7.6	6.0	2380	5.7	0.23
Latvia	6460	54.0	6.6	20.2	1460	3.5	0.55
Estonia	4510	33.7	4.1	21.5	1460	3.5	0.93
Total	160275	814	100		42010	100	

Agriculture is responsible for about half of the nutrients deposited in the Baltic Sea by the surrounding countries (HELCOM, 2003b). The input of nitrogen, in the form of artificial fertilizers, by agriculture drastically increased during the second half of the 20th century, as is illustrated in Figure 1a. Figure 1b reveals that far from all of this nitrogen is being used in production. On the contrary, only one third of the input of nitrogen is being exported from the system in the form of food products such as milk, meat and bread grain. If meat production alone is considered, the figures become even more disturbing. Tracing nitrogen on its way through the production chain from fertilizer to grain and finally to meat, we find, that out of 100 kilograms of nitrogen spread on the grain field only one to two kilograms are found in the meat in the butcher's shop (Clarholm, 2003). The rest is a potential source of eutrophication.

The levels of nutrient leakage is also affected by the geographical division of food production. Figure 2a shows a high concentration of animal production in southern Sweden with a lower concentration in the rest of the country. Together with extensive imports of concentrated fodder (Deutsch, 2004) a surplus of plant nutrients in the form of manure is found in southern Sweden. This part of the country also exhibits the most favourable conditions for leaching of nutrients in terms of soil texture and climate. Figure 2b illustrates the leakage of nitrate into the water in different parts of Sweden. Regions with the highest levels of leakage also have high densities of animal production. There are a few exceptions to this such as the counties of Gotland and Malmöhus.

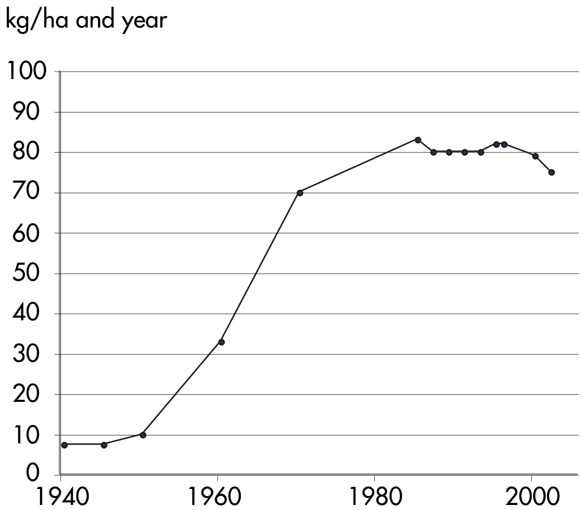

Figure 1a. The input of fertilizer nitrogen (kg per hectare and year) in Sweden during the period 1940 – 2002.

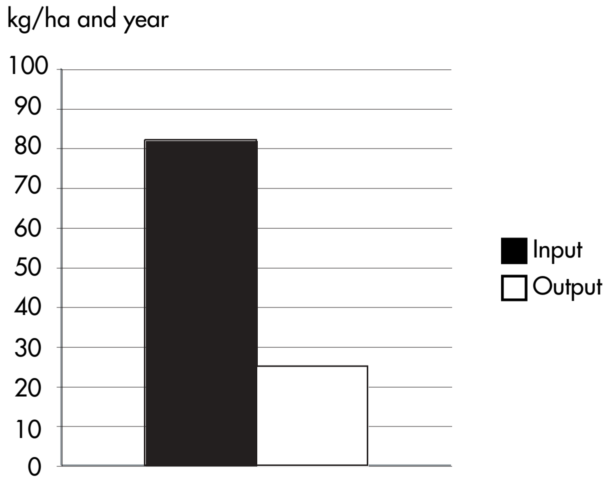

Figure 1b. In 2002 the input of nitrogen in the form of chemical fertilizers (black stack) was three times higher than the output of nitrogen in the form of agricultural food products (white stack). Source: Granstedt, 2000 and Granstedt et al. 2004.

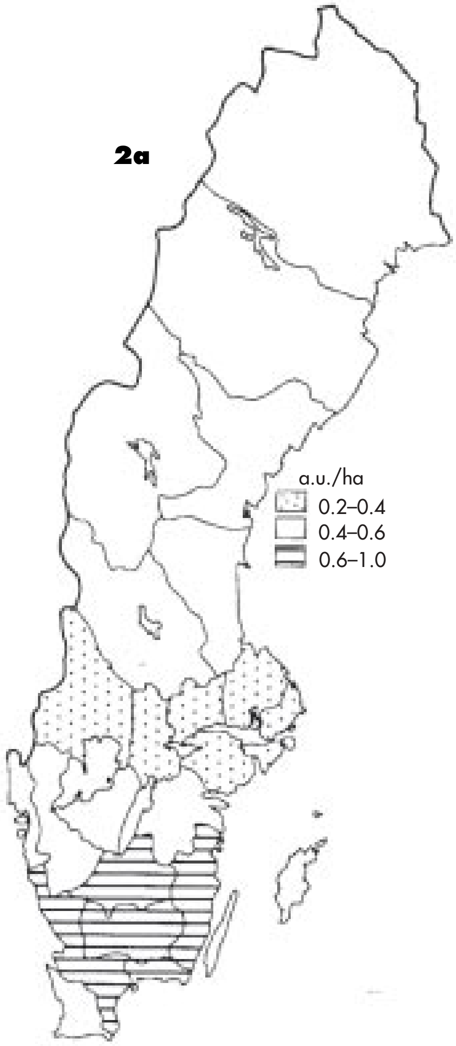

Figure 2a. Swedish counties grouped according to intensity of animal production. 1 animal unit (a.u.) equals one dairy cow, or two young cows, or three sows, or ten fattening pigs or 100 hens.

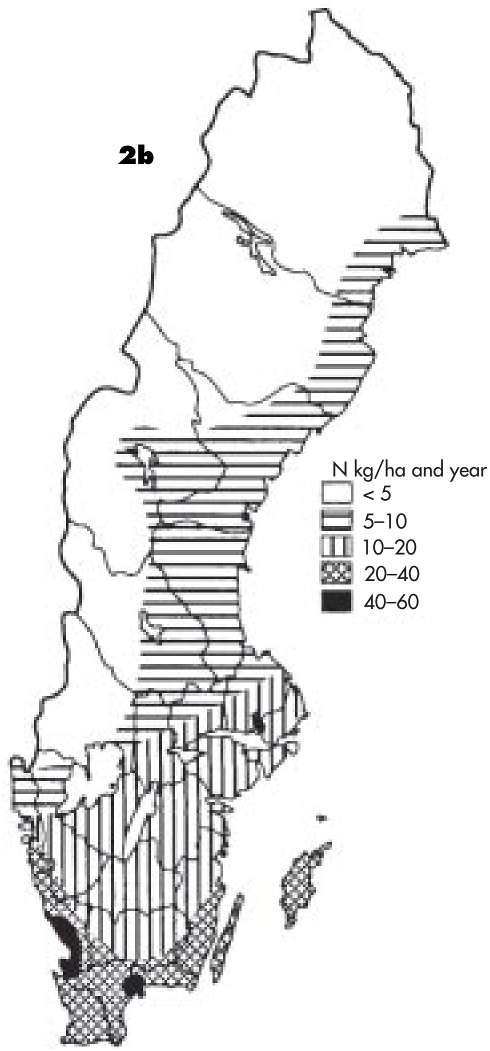

Figure 2b. Levels of nitrogen (N) leaching into the water in different parts of Sweden measured as kg N per hectare and year. Source: Granstedt, 2000.

A more environmentally friendly agriculture

One solution, as far as Swedish agriculture is concerned, would be to keep fewer animals particularly in southern Sweden. Furthermore, animals that are able to should change their feeding habits and eat more grass instead of grain. Of the total amount of grain produced in Sweden only 20 per cent is consumed by humans. The remaining 80 per cent is used as fodder, mainly for cows despite the fact that grass is their main natural food. However, cows produce more milk and grow faster if the amount of protein in their diet is increased. Thus, much more grain must be produced compared to a more extensive production system with grazing animals.

An agriculture adapted to recycling principles is, to a higher degree, self sufficient in plant nutrition. The ecological recycling production system studied in the BERAS project had substantially lower levels of nitrogen surplus compared to conventional production (see Table 2, column 2 and 3).[1] This has been achieved partly due to the integration of animal and vegetable production. In this kind of system it is possible to achieve an efficient use of plant nutrients in manure and reduce the surplus of nutrients. The need for external nitrogen in this system is much lower. To avoid the manure becoming an environmental problem, it is important to use it in an efficient manner. The inappropriate storage and spreading of manure would cause a loss of nutrients into the water and air.[2]

Table 2. Nitrogen surplus and acreage needed in different farming regimes. Source: www.jdb.se/beras

	Swedish average food basket based on agriculture production of today (mainly conventional)**	**Swedish average food basket based on an ecological recycling production system*****	**Ecological recycling production system and an increased share of vegetables******
Total acreage	2450	4760*	1700*
N surplus/capita	22	14	8
N surplus/ha	80	26	42
Total N surplus k tonnes, Sweden	196	123*	71*

*If all production was changed according to the principles of ecological recycling agriculture. Note that the total figures in column 3 and 4 are hypothetical. It is not realistic to change all production. **Adapted from Statistics Sweden (2005). Only arable land in production is counted. ***Granstedt et al. (2005). ****Hannula and Thomsson (2005).

[1] For a definition of ecological recycling agriculture see www.jdb.se/beras.

[2] The benefit of using organic instead of chemical fertilizers as a means to reduce eutrophication has been questioned. Critics point to difficulties in applying the right amount of organic fertilizers. Field trials have shown that chemical fertilizers can cause less leaching of nutrients and thus less eutrophication. This in turn could be criticized by arguing the in an agricultural system with regional specialization and the need for chemical fertilizers in vegetable production, a surplus of nutrients will occur in regions specializing in animal production. This surplus is far from always used in an efficient manner in production.

The role of consumption

Not only production methods but also consumption patterns determine the environmental impact. The Swedish Environmental Advisory Council (2005) point out that a diet consisting of two thirds animal products results in four times as large an emission of nitrogen from the agriculture into the water and air compared to a fully vegetarian diet. The far right column in Table 2 is based on recordings of food purchases from a group of reference consumers in the Järna region (Hannula and Thomsson, 2005). Compared to an average Swedish consumer less than half the nitrogen is emitted. When compared with an average food basket produced with ecological recycling methods the emission per hectare is higher, but the total emission of nitrogen is lower (Granstedt et al., 2005). This is explained by differences in the food baskets. The reference group consumed more vegetables than the average Swedish consumer and substantially more local and organic food. Hannula and Thomsson (2005) reported that out of "real food" purchases – i.e. excluding sugar, candy, beverages etc. – 73 per cent was organic compared to 2.2 per cent for the average Swede. The share of local and organic food was 33 per cent for the reference group. If all Swedish consumers ate as many vegetables as the reference group, the cultivated area in Sweden today, 2450 million ha, would be more than sufficient. Simply turning conventional production into an ecological recycling production system without changing consumption patterns would require an additional 2.3 million ha of arable land (Granstedt et al., 2005).

Socio-economic efficient investments

The Swedish Environmental Advisory Council mention in their report that it might not be enough to lower emissions in order to restore the Baltic Sea to its former state prior to the industrialization of agriculture. The degradation might have continued for too long, and today there are too many nutrients stored in the sediment. If this is true, the Baltic Sea has stabilized in a new state, or new equilibrium. For a return to its previous state a necessary, but perhaps not sufficient, condition is substantial cuts in emissions. In any case these reductions are needed anyhow to avoid further degradation (Miljövårdsberedningen, 2005).

What would this cost? To halve the total amount of nitrogen flowing into the Baltic Sea would cost an estimated SEK 12 bn (EUR 1.31 bn) per annum using cost efficient solutions (Gren et al., 1997a), that is, those methods resulting in the largest reduction per krona invested. To achieve this, cooperation between countries is required. For example, it is more efficient for the Baltic Sea region if Sweden pays Poland to reduce its emissions to a higher extent in order to offset, or compensate for, a lower reduction in Swedish emissions. The same sum of money will buy a bigger reduction in Poland than in Sweden. In a 50 per cent cost efficient reduction of total nitrogen emissions to the Baltic Sea, Sweden would reduce its emissions by 42 per cent at a cost of SEK 1.5 bn (EUR 0.16 bn). A reduction of each country's emissions by 50 per cent would cost a total of SEK 51.4 bn (EUR 5.61 bn). Sweden's share of this would be SEK 1.9 bn (EUR 0.21 bn) per year (Gren et al., 1997a).

A 50 per cent cost efficient reduction of phosphorous emissions into the Baltic Sea would cost a total of SEK 3.2 bn (EUR 0.35 bn) per year. Sweden's share would be a 19 per cent cut in emissions at a cost of SEK 81 million (EUR 8.84 million). If all the surrounding countries were to halve their respective emissions, the total cost would rise to SEK 13.6 bn (EUR 1.48 bn) per year. Sweden's share would increase to SEK 10.4 bn (EUR 1.14 bn) mainly due to the fact that Sweden already has efficient water treatment plants. To substantially reduce emissions would therefore require more expansive measures to be taken regarding agriculture (Gren et al., 1997a).

In a cost efficient mix of measures to reduce nitrogen emissions three main ingredients are required: measures aimed at agriculture; extending the capacities of municipal waste water treatment plants, and the (re-)creation of wetlands as nitrogen traps. Each measure accounts for approximately 30 per cent of the reduced emissions (Gren, 2001).[1]

On a broader perspective, efforts aimed at creating a more environmentally sound agriculture look even more attractive than other measures. Efforts aimed at agriculture contribute more clearly than other measures to reaching the goals of sustainable food production and sustainable rural development as set out by the government. The environmental benefits that can be attributed to investments in agriculture include cleaner ground water in regions suffering from high levels of nitrate. Installing filters eliminating nitrate from drinking water would cost SEK 100-1000 million (EUR 11-110 million) in Sweden while the willingness to pay (WTP) for avoiding nitrate in drinking water is in the range of SEK 38-2200 million (EUR 4-240 million) depending on whether to include only those exposed to high levels or all users (Larsson, 1997) .[2] Another benefit is reduced emission of CO_2, which Sweden has already agreed to by signing the Kyoto protocol. Producing one kilogram of nitrogen, in the form of chemical fertilizer, requires one litre of oil. If the share of locally produced food is increased there is the potential to lower the emissions of CO_2 further through shorter transportation.[3] A healthier Baltic Sea would also mean improved opportunities for the fishing industry and for tourism, etc. Many peoples' well-being would also be improved whether they make use of the Baltic Sea or not.

The combined total WTP, among the population in the region, to reduce eutrophication to sustainable levels in the Baltic Sea adds up to SEK 31.5 bn (EUR 3.44 bn) per year according to one study (Gren et al., 1997b).[4] The WTP varies, however, quite significantly between countries depending on income levels. The WTP of a Swedish citizen, for example, is ten times higher than that of someone from Poland. Swedish taxpayers were willing to pay SEK 21.8 bn (EUR 2.38 bn), or an average of SEK 3000 (EUR 330) per person and year. A study of the WTP for reducing eutrophication in Laholm Bay, in southern Sweden (Frykblom, 1998) arrived at a mean annual WTP per person of SEK 747 (EUR 82). An estimate of the WTP for reducing eutrophication in the Stockholm archipelago (Söderqvist and Scharin, 2000) came to a somewhat lower figure, namely, SEK 436-725 (EUR 48-79). The difference in these estimated figures can be explained by differences in the regions studied. Since Laholm Bay and the Stockholm archipelago are subregions of the Baltic Sea, it is understandable that lower estimates of WTP were obtained. The rather high total WTP indicates that tax payers would experience an increase in welfare if investments were made in measures to reduce eutrophication.[5]

However, not all measures will induce costs. Some can, on the contrary, result in savings for society. The large proportion of grain being used for animal fodder (80 per cent) can be partly explained by subsidized production. Artificially low grain prices stimulate its excessive use for fodder. Furthermore, there are few incentives to reduce the leakage of nutrients, cut greenhouse gas emissions, or protect biodiversity. If the agricultural sector had to deal with the negative effects it causes this would be reflected in food prices. Today, consumers still pay the full price of food production, partly in the food store but also, partly, through their tax bill and a degraded environment.

A recent study (Pretty et al., 2005) reveals that food in Britain today travels 65 per cent further than it did two decades ago. Localizing food production could, according to this study, substantially reduce the environmental costs due to transport. According to Pretty et al., the annual UK government subsidy for agriculture is, on average, £3102 million, not counting additional subsidies for foot and mouth disease. However, some £219 million of this was used to create positive externalities, e.g. rural development and agricultural-environment sche-

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[1] The most cost efficient methods reducing nitrogen leakage into the Baltic Sea is to increase the cleaning capacity of water treatment plants followed by the recreation of wetlands, the cultivation of nitrogen fixing crops, reduced fertilizing and reduced air borne pollution, in the order mentioned.

[2] For the filter solution, the cost of the best available techniques was used. The WPT was arrived at from mail out questionnaires.

[3] The relation between distance travelled and emissions of green house gasses is, however, not as clear as one might expect. A study of the Farmers' Market concept (Bondens egen marknad) (Carlsson-Kanyama et al., 2004) shows that, apart from products transported by air, there are no significant difference in energy intensity between food bought at the Farmers' Market and similar food bought at a supermarket. Although the distance from producer to consumer is much shorter, the transportation to the Farmers' Market is inefficient. Inefficient vehicles are used and there is poor logistics whereas supermarkets are part of an efficient optimized transport system. However, steps could easily be taken to make transportation more efficient.

[4] The respondents of the questionnaire were asked to suppose that international, cost-effective actions would be taken. These would be financed by an environmental tax for households, farmers, firms etc. in all countries around the Baltic Sea. In 20 years eutrophication would have decreased to sustainable levels.

[5] The figures should, however, be interpreted with some caution. The WTP could be overestimated and the cost for reducing the emissions underestimated. Even if the reduction costs prove to be higher than the WTP for a cleaner Baltic Sea, the study shows that from a socio economic perspective it is well worth making substantial efforts to improve the situation in the Baltic Sea. Another reason for interpreting the WTP figures with caution is the uncertainty as to whether a certain measure results in the desired improvement or not.

mes. Removing these from the cost leaves a total subsidy of £2883 million per year. This is equivalent to £0.93 per person/week. To this is added: external production costs of £1.51 bn per year; external transport costs of £2.35 bn per year – agricultural and food produce accounts for 28 per cent of goods transported on the UK's roads; and road transport to carry food home from the shops is estimated to impose a further £1.28 bn in external costs, etc. The total external cost for the whole food system adds up to some £8045 million per year. This is the equivalent of £2.91 per person/week or 12 per cent of total food expenditure.

If the food basket were all organic, and if all subsidies were used for agricultural-environmental purposes, and if food was all locally-sourced or transported in an environmentally friendly way, then external costs would fall from 12 per cent to 1-2 per cent of the total food price; thus saving each person in the UK approximately £2.5 per week. Localized production alone would save £2.1 bn per year in environmental costs if all food were sourced within 20 km of the place of consumption. An additional £1.13 bn, out of £1.51 bn in total external production costs, could be avoided if all production was organic (Pretty et al., 2005).

The adoption of large scale organic farming and localized food systems implies a substantial saving potential – in terms of avoiding environmental costs – for UK conditions. Transposing these figures to Swedish conditions is somewhat difficult. However, considering the long distances and low population density found in Sweden, using the same per capita figures could be considered conservative[1]. The total UK cost for externalities and ill-directed subsidies of £8045 million per year could suggest a comparable cost for Sweden of £1227 million or SEK 16 bn (EUR 1.75 bn)[2]. The potential savings in transporting food, that is, savings from localizing production, of £2119 million corresponds to a potential saving of SEK 4.2 bn (EUR EUR 0.46 bn) for Sweden. The corresponding figure for external production costs is SEK 2.2 bn (EUR EUR 0.24 bn) per year. Thus, using these somewhat arbitrary figures, at least SEK 6.4 bn (EUR EUR 0.70 bn) could be saved annually by localizing food production and by switching to organic production.

Unfortunately there are also costs associated to changing farming practices. For example, many farms specialized in animal production in southern Sweden would become obsolete in a change to a system of localized food production. Meanwhile, moving animal production from southern Sweden would require large investments in new production units in central Sweden. It is reasonable that these costs, at least to some degree, are borne by society at large and not by individual farmers. These costs have to be considered when deciding on future policies.

Ecologically, socially and economically sustainable food production

If nitrogen emissions into the Baltic Sea are reduced, the first step towards an ecologically sustainable agriculture would have been taken. However, for food production to be characterized as genuinely sustainable, economic as well as social sustainability are also required. Sustainability in agriculture from an economic perspective may be described in a somewhat simplified way as providing a satisfactory return on work and investment; a satisfactory degree of employment within the sector; and value for money for consumers. Social sustainability may be summed up under the following headings: satisfactory work conditions, high quality food, and a vibrant rural community including access to locally produced food (adapted from Edman, 2004a). For agriculture to be characterized as sustainable, a common view of what is meant by the term 'sustainable' is required by those involved. If not, there is a risk that some of the actors involved might lack the incentive to continue if, for example, an activity is ecologically sustainable but not socially or economically sustainable.

In a forthcoming BERAS publication a study of farmers, the processing industry and retailers of organic food in the Järna region outside Stockholm is presented (Larsson et al., 2005). Close cooperation amongst organic entrepreneurs is observed which results in confidence and trust. This, in combination with satisfaction in their profession, helps to create social sustainability in their trade. The close cooperation between the actors and strong local ties with loyal customers has resulted in economic stability. Restrictions regarding terms of the use of pesticides and fertilizers are double-edged. On the one hand, they can result in extra work for the farmer and lower yields. On the other hand, there are benefits such as the opportunity to certify one's produce as organic and thus obtain a higher price. The conclusion is that the actors engaged in organic production contribute to sustainable development in a social, as well as an ecological, sense. The contribution to economic sustainability is more ambiguous.[3]

Solutions within reach

To act in support of an ecological recycling agricultural system, different controlling instruments can be used including the banning or taxing of different inputs. A system of quotas for livestock could be used. Among economists, a popular tool to curb emissions of CO_2 is tradable emission rights. A corresponding tool could, at least in theory, be used for animal production. In southern Sweden the quotas could be reduced to the desired levels. In central Sweden, on the other hand, subsidies could be used to increase animal density. One alternative would be to ban chemical fertilizers which would result in an increased demand for livestock in order to get hold of the plant nutrients contained in manure.

When choosing instruments of control, it is important to consider what effects they might have. If farmers are hit so hard that, for example,

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[1] Low population densities may imply low environmental pressure. The long transports in Sweden are however assumed to be of greater importance.
[2] Assuming similar per capita costs for Sweden and the UK, £1=SEK 13 and EUR 1=SEK 9.16, with the UK and Swedish populations being 59 and 9 million respectively.
[3] The results are also presented in Andersson and Enberg, 2004.

the Swedish, or northern European, agriculture is threatened, then the proposed solution is not sustainable. The same applies if production experiences a sharp fall, if produce becomes so expensive so that consumers switch to imports, or if tax payers believe that the new agricultural system is too expensive. Tax payers in general think it is fair to use common resources (e.g. tax revenues) to subsidize common goods. Today, there are plenty of examples of the opposite happening in the agricultural policies of Sweden and the EU. Tax money is used to finance activities that the majority find destructive. This is, of course, unsustainable. The expansion of the EU leaves us with a choice. If the new member states follow in the footsteps of the old members, emissions of nutrients risk increasing considerably, by 50 to 75 per cent (Granstedt et al., 2004). If agricultural subsidies are used to steer production down an environmentally friendly route, there is much to be gained. There is a potential for profitable rationalization of the farming sector as well as reduced emissions.

Providing incentives to attract the actors' interest could be a step in the right direction. Publicizing positive examples where environmental efforts have been coupled with high quality products and good profitability is another. The demand for organic and locally produced food can be encouraged if the supply in stores and, for example, at the Farmers' Market increases and if positive role models use local organic products. For example, the "Chef of the year 2005" in Sweden, Stefan Eriksson, prefers to use locally produced organic food in his cooking (Dagens Nyheter, 2005).

One measure discussed by the Swedish Environmental Advisory Council (2005) is to stimulate radical lifestyle changes. By consuming more vegetables instead of meat the emission of nitrogen can be reduced. Stockholm County Council already runs a campaign to change consumption patterns. Eat Smart (Ät S.M.A.R.T) is run under the motto: "Eat so that both you and the environment feel good". They recommend that consumers increase the share of vegetables consumed; increase the share of organically certified food; choose meat from grazing animals, like lamb; choose food according to season; and choose local food more often (Centre for Applied Nutrition, 2001). Several of the Eat Smart recommendations are thus supporting local and organic food.

Stefan Edman suggests (2004a) that the government should strengthen domestic science subjects at school and provide earmarked funding for buying organic food. Out of all food provided by public institutions 25 per cent ought to be organically certified by no later than 2010, according to Edman. Edman's suggestion is constructive – increased public procurement is an efficient way to increase the volume of organic food – but the figure could of course be higher. Why not aim at 100 per cent? To buy products that contribute to a problem, in this case the eutrophication of the Baltic Sea, and only then invest in measures to address the problem is a circuitous route indeed. The Swedish government has a goal in that different areas of politics will act in the same direction (Regeringens proposition 2002/03:122). This is a goal that coincides with an increase in the demand for organic food.

Conclusion

The state of the Baltic Sea is from an ecological perspective far from good. Agricultural production contributes half the emissions of nutrients, and to combat eutrophication agricultural practices have to be pushed in an environmentally friendly direction. Taken separately, the measures aimed at creating a more environmentally sound agriculture might seem too costly and discourage one from taking action. It is, however, important to obtain a comprehensive view. If not, there is a risk of sub-optimizing. Reducing the emissions of nitrogen and phosphorous by 50 per cent would cost Sweden in the range of SEK 2 bn (EUR 0.22 bn) if cost efficient measures were used. The total cost is estimated at SEK 15.2 bn (EUR 1.66 bn) (Gren et al., 1997a). This must be compared with the potential gains to be had.

By localizing food production, Sweden could reduce the external costs from food transportation by SEK 4.2 bn (EUR 0.46 bn) per year. By turning all food production organic, another SEK 2.2 bn (EUR 0.24 bn) in externalities could be avoided in Sweden alone. These figures should be interpreted with caution since UK figures have been converted to Swedish conditions, but even so they say something about the magnitude of the potential savings to be made. Thus, Sweden could be substantially better off after emission reduction measures had been taken. If we bear in mind that the willingness to pay of Swedish taxpayers for improving the condition of the Baltic Sea adds up to SEK 22 bn (EUR 2.40 bn) per year (Gren et al., 1997b) it appears that there would be an increase in welfare even if Sweden were to bear the full cost on its own.

The cost of substantially reducing Swedish nutrient emissions is thus more than offset by the gains. If one adds the potential gains from localizing food production, and turning it organic, in other countries on the Baltic Sea and includes their WTP for a cleaner Baltic Sea, it is easy to justify such far-reaching measures. And since substantial reductions are achieved if conventional agricultural production is converted to organic production the equation of costs and benefits looks even more attractive.

Table 3: Costs and benefits of different measures. Several health and environmental benefits are not included.

Measure taken	Cost	Benefit
50% reduction of N and P emissions	SEK2 bn (Euro 0.22 bn) for Sweden, 15.2 bn (Euro 1,66 bn) for the Baltic Sea in all	
Localizing food production	?*	SEK 4.2 bn (Euro 0.46 bn), for Sweden alone
Turning food production organic	?*	SEK 2.2 bn (Euro 0.24 bn), for Sweden alone
WTP for a sustainable Baltic Sea environment		SEK 21.8 bn (Euro 2.40 bn), for Sweden alone SEK 31.0 bn (Euro 3.38 bn) for all countries around the Baltic Sea

*There are large costs associated with switching to local and organic production. Large investments in new production units would be required, and many existing ones would become obsolete. The benefits presented here are thus not net benefits.

A local organic agricultural system is not a wonder cure to solve all problems. However, one advantage is that a couple of the more cost efficient solutions for reducing the eutrophication of the Baltic Sea are, at the same time, steps in moving agriculture towards a localized production. The same measures are also helping to increase biological diversity and reduce emissions of greenhouse gases as well as helping to achieve several other environmental goals identified by international treaties. The people's willingness to pay for an improved environment is substantial. From a socio-economic point of view it is rational with major investments to change the agricultural sector. If the Swedish government is serious in its ambition to improve the status of the Baltic Sea and to create ecologically, economically and socially sustainable food production then the smorgasbord is ready. One simply has to choose from the ingredients offered, including local organic food systems. To be successful and efficient, the measures taken should be coordinated internationally. Sweden can not change the negative environmental development of the Baltic Sea alone. For this, coordination with neighbouring countries is required.

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MEASURING THE EFFECTS OF LOCAL FOOD ON A REGIONAL ECONOMY
Regional Agro-Economic Model (RegAE) – An extended Input-Output approach

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Abstract

This study focuses on the concept of local food, from a regional and structural economics perspective. The empirical research concerns the effects of changes in foodstuff demand, food industry and agricultural production in South-Savo region, in rural eastern Finland.

The subject region of this study is the most agriculture-dominant of the Finnish regions. It is also a structurally peripheral and economically underdeveloped region, continuously growing slower than the national average. The research is carried out by constructing and utilising Regional Agro-Economic Model (RegAE). The RegAE - model uses extensive input-output quality in combining material and economic flows in the same framework. The data is collected from Statistics Finland and earlier models constructed at MTT Agrifood Research. "Local food" is a young concept and phenomena, which has not yet been strictly defined. This gives some more challenge to the impact study. One purpose of the study is to bring regional economics perspective to the public discussion surrounding the local food system and rural policy. The data and the analysis illustratively show the weak linkage between food industry and agriculture in South-Savo region. Also other regional multiplier effects are quite limited. Although an input-output model system has severe constraints, it was possible to apply it on the subject of local food. According to the structural point of view, it would be important to localise the whole food chain, "from field to the table". Otherwise there is a considerable risk of economic leakages, and the local food rural policy might not deliver its promise to bring more "viability" to the countryside.

Introduction

Finnish agriculture is experiencing a period of intense structural change. New technology and increased efficiency, the liberalisation of world trade in agriculture, and reforms in the European Union's agricultural policy are causing major social and economic changes across rural areas in Finland and the EU.

In Finland, the number of farms has fallen from over 100 000 to the current ca. 70 000 in ten years. The size of farms has grown at the rate of one hectare per year. The increase in farm size has been achieved for the most part by renting additional fields. In the summer of 2004, Professor Jyrki Niemi estimated that every second Finnish farm would have disappeared by the year 2020 (STT 2004).

Eastern Finland, especially regions such as South-Savo and Kainuu, has been the area most severely affected by this ongoing process of agro-industrial structural change. Agricultural production is shifting to western Finland, where there is more farm land available for rent. The future for milk production, regions main agricultural activity, is seen especially uncertain with diminishing export subsidies. Again, according to a forecast by Niemi, two out of three Finnish milk farms will be out of business by the year 2020 (MTT 2004; STT 2004).

The share of agriculture (including fishing and hunting) in GDP has fallen from 2.2% to 1.4% and in the food industry from 2.5% to 1.7% between 1995 and 2002. For Finnish farmers, EU membership (Finland joined the EU in 1995) has meant a 40% fall in income from the sale of their produce; however, this was largely offset by national and EU hectare based subsidies. Overall production has been quite stable, but structural change has had a substantial effect on agricultural employment (see Figure 1).

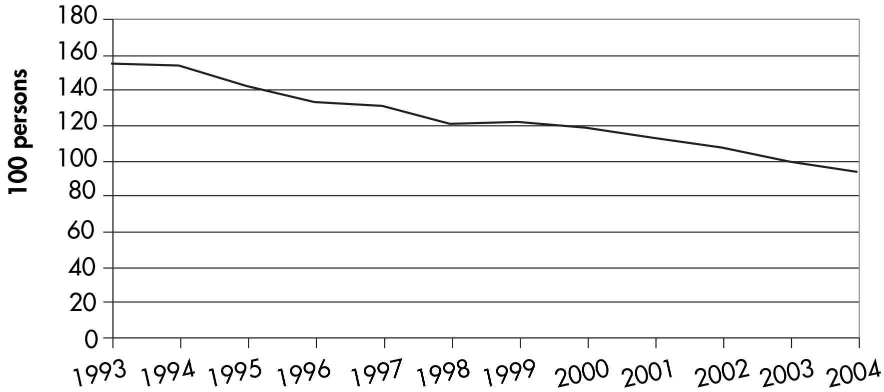

Figure 1. Employment in agriculture (including fishing and hunting) in Finland, 1993 – 2004 (Statistics Finland 2005)

The indications are that this trend is set to continue. The OECD (1996, 49) has reported that "the continuous pressure to improve competitiveness and to compete in global markets will continue to increase substitution of labour for capital in traditional resource industries and as such these industries are not expected to provide major sources of new employment". Hence, a decline in employment in traditional sectors has made the encouragement of economic diversification one of the primary goals of regional policies (ESDP 1999, Dissart 2003). A policy of encouraging the local food production, and local consumption of farm produce may be regarded as an alternative to export-led mass production and a means of encouraging the diversification of agricultural production and adding value to farm production in a rural region.

"Local food" is a young concept and phenomenon, which has yet to be properly defined. Many hopes have been pinned on the concept of "local food" in recent debates. It has been variously regarded as environmentally friendly, a support for the local economy, a new source of income for farmers and an important factor in the general "viability" of the countryside. The idea is that local food could deliver significant social and economic benefits at the local level, which in regional terms could compensate for the potentially higher production cost of local food produce compared to mass produced imported foodstuff. This study uses an input-output model (RegAE) to calculate, albeit approximately, the effect of a 5% increase in regional foodstuff consumption.

Economic diversity and rural policy

Finland is the most rural of the fifteen EU member states as rural areas constitute 94% of the total.[1] There are only 5.1 million inhabitants, of which 60% live in urban areas. Most urban areas are found sparsely scattered across the south of the country resulting in long distances between cities. Hence the 'mosaic' of urban and rural area is significantly different from that found in the densely populated urban-rural geography of most European member states.

The subject region of this study is the South-Savo region, which is the most agricultural of all Finland's regions. It is also a structurally peripheral and economically underdeveloped region, with a growth rate persistently below the national average (Statistics Finland 2002). Peripheral areas are generally seen as areas that specialise in traditional resource based industries such as agriculture, forestry, mineral extraction and fishing. According to Siegel et al. (1995), "Peripheral regions are considered specialised because they tend to concentrate on a narrow range of export-oriented natural resource-based raw materials or low-technology goods and services, with limited inter-sector production and consumption linkages."

The problem with the increasing agricultural and other economic specialization and economic concentration of the rural areas is that it has led to an overemphasis on the use of a single resource and an excessively narrow focus on a large external market. The relationship between economic diversity and economic performance has received much attention in recent economic literature. There is a clear understanding in regional studies that the presence of several production sectors in an economy reduces economic fluctuations (Malizia and Ke 1993; Xu et al. 2002; Dissart 2003). It has also been hypothesized that the more similar a region's sector composition is to that of the country's as a whole, the more stable it should be vis-a-vis other regions (Siegel et al. 1995). However, empirical research on the relationship between

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[1] In EU-15 the average of rural area is 80 %. An area is accounted rural if the population is under 50 persons/ km^2.

economic diversity and regional economic stability is somewhat scarce (Dissart 2003).

Specialization in a rural area is likely to reduce economic diversity, because specialization is likely to occur in low value-adding primary production, which reduces demand for labour and services. Moreover, the intermediate goods used in specialized production are likely to be imports. In urban and suburban areas, where the production base is more diverse, the specialization of an industry is also likely to generate inter-industrial demand within the region, which creates positive multiplier effects in the economy. Furthermore, labour released from a specialized industry is more likely to be reemployed by other industries. It may be argued that specialization and economic diversity can successfully develop in parallel within a region providing the region has enough production bases. If not, specialization is likely to reduce economic diversity which might be risky for the long term economic performance and stability of a region.

The debate on economic diversity is concerned, on the one hand, with theories of economic development in rural regions, and, on the other hand, with the question of how rural development policy can stimulate economic growth in rural regions.

A straightforward multiplier approach gives us some basic insights to understanding economic diversity and regional policy: the performance of a rural policy instrument is strongly influenced by the size of a regional multiplier, which can be defined by the degree of regional resource use in production (e.g. Archer 1976, Dow 1982, Dobbs and Cole 1992, Woller and Parsons 2002). Generally speaking, the smaller and less diversified the region, the more open the economy, and, consequently the greater the "leakage" from the area.[1] The more diverse the production structure, the higher the multiplier effect potential of internal or external economic impulses. In less-developed rural regions industry wide linkages are absent due to a one-sided production structure, which in turn leads to value added leaking to more industrially diverse areas. This tendency is especially strong in areas which concentrate on primary production (Mulligan 1994, Säynätmäki 2000).

The logic of the Regional Agro-Economic Model (RegAE)

The Regional Agro-Economic model (RegAE) is an extended regional input-output system currently being developed by MTT Economic Research and the University of Helsinki. Its purpose is to analyse the regional impacts of household and public sector foodstuff consumption choices. These choices result in changes in regional output and employment. In addition to economic indicators, the RegAE model also analyses the impact of these choices on the environment through environmental indicators. The variables, derived from agricultural in-

[1] In this context a leakage means, roughly, the share of imported inputs in production of the region (Schaffer 1999).

put data and industrial average values, are regional energy consumption and greenhouse gasses and acidic air emissions. The base year of the model is 1995, which is the only year for which regional input-output tables have been published (Statistics Finland 1998). According to Statistics Finland, the next series will be ready by early 2005, with the base year being 2002.

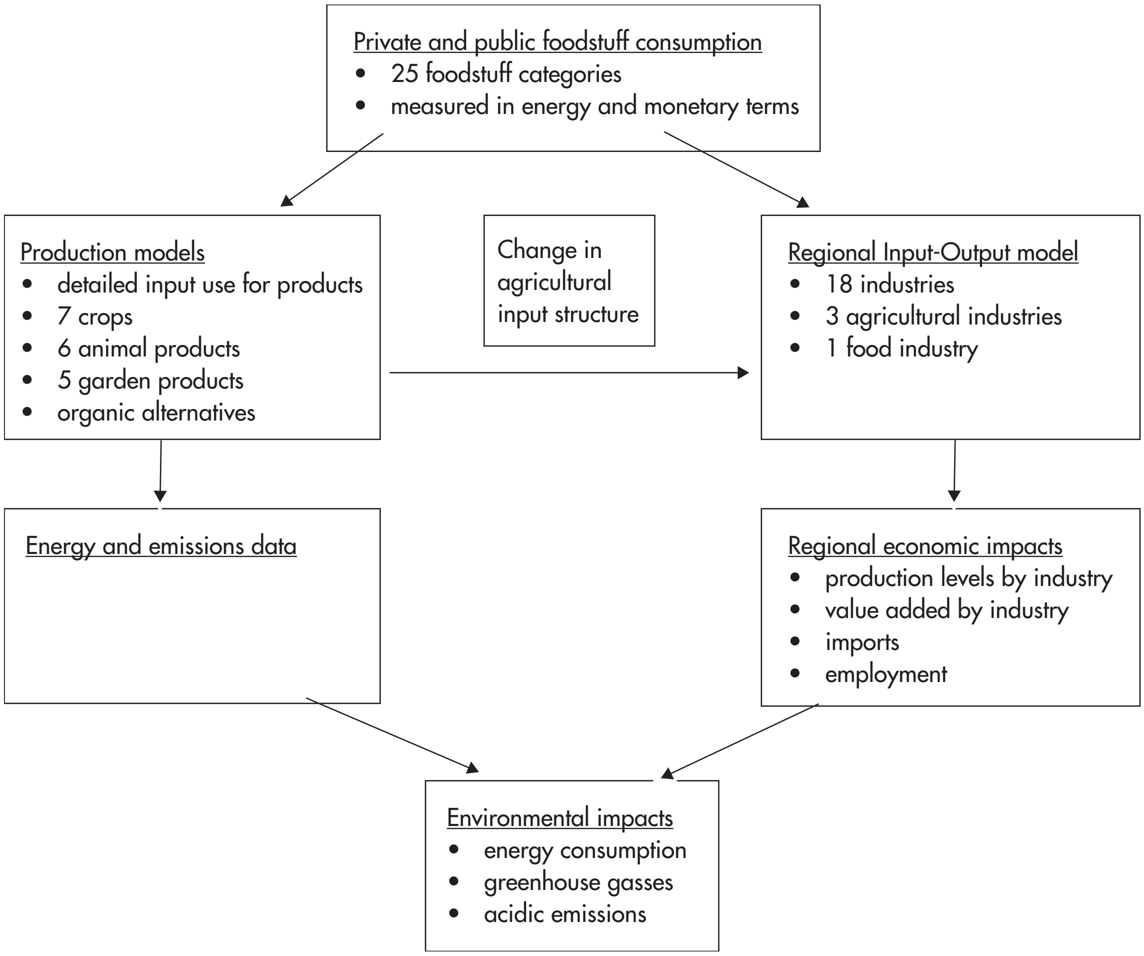

Figure 2. The structure of the RegAE model.

The RegAE model uses extensive input-output quality in combining material and economic flows in the same framework. The model consists of three different parts interacting together: a foodstuff demand model, agricultural production models and a regional input-output model. Two types of effects can be modelled, ranging from a 0 to 100% change:

a) Change in production structure -> change in inputs -> multiplier effects
b) Change in foodstuff consumption -> change in final demand -> multiplier effects

A type a) change means raising the proportion of organic production. A type b) change allows one to analyse the influence of consumer behaviour and public policy on the region in question.

The regional input-output model lies at the heart of modelling multiplier effects. The RegAE model follows the standard logic of input-output impact models (Midmore 1993; Midmore 1996; Schaffer 1999). An input-output model begins with the inter-industry transactions table, where the rows add input demands (x) to exogenous final demand (y) to give total demand (z).

[1] $$x_{11} + x_{12} + x_{13} + x_{14} \ldots + y_1 = z_1$$

The columns enter industry's input demands together with imports and final payments such as taxes, subsidies and value-added (compensation to employees, operating surplus, consumption of fixed capital). The row and column totals are equal, which means that the double bookkeeping account is balanced.

[2] $$a_{ij} = \frac{x_{ij}}{q_j}$$

First set multipliers, the production coefficients, are formed by dividing a region's input delivery from industry i to industry j (x_{ij}) by the total production of industry j. Multiplier a gives us the direct requirements (first round effect) for industry i, as the production of industry j changes. All rounds, or total requirements, we receive from the Leontief inverse:

[3] $$B = (I - A)^{-1}$$

Here I is the identity matrix and A is a matrix formation of a_{ij} multipliers. The Leontief inverse is used for estimating employment

[4] $$EMULT_j = \Sigma_i (e_i / q_i) * B$$

The employment effect is obtained by multiplying the employment coefficients of each industry (the employment/output ratio, e/q) by the Leontief inverse. The same sort of method is also used for modelling the effects on the environment, with indicators such as greenhouse gas emissions. The industry's average emission rate (c) is divided by its output (c/q), and then multiplied by the Leontief inverse.

An input-output system such as the RegAE model has certain limitations. Firstly, its static, fixed multiplier approach results in an "extreme Keynesian" view of the economy. The model is demand driven and is best suited for a short time period and relatively small exogenous changes. All resources are available at the same price with no bottlenecks in production. These assumptions and limitations are commonly referred to as "Leontief technology". Results from this type of model are not to be taken as exact figures, but rather as quantitative tendencies or "directions".

An input-output model is mathematically simple and part of a strongly empirical modelling tradition. One of its major drawbacks is that it is not based on optimisation behaviour of economic units. The microeconomic foundations of the model are somewhat lacking. In practice, there is some evidence that fixed multipliers in input-output models tend to overestimate the multiplier effect, compared to more sophisticated general equilibrium models (West 1995; Susiluoto 1999).

Results

The Regional Agro-Economic Model (RegAE) was used to estimate the effect of a 5% exogenous increase in Southern Savo foodstuff demand (scenario A1). Imports by industry are reduced by a similar amount; hence, South Savo may be seen, in effect, as substituting foodstuff imports. This rather modest increase (52, 2 Mmk, ca. 9, 2 M EUR) was chosen for two reasons. Firstly, input-output models like the RegAE model are theoretically best suited for modelling the effect of a rather small change. Secondly, a 5% growth in foodstuff demand could in theory be achieved through the public decision making. The share of public foodstuff demand (communal catering in schools, hospitals etc.) is estimated to be roughly 7, 5% of total demand (Etelä-Savon maakuntaliitto 2001; Vihma 2005).

This scenario was also combined with an increase in organic production. In the base year (1995) organic agriculture was only a marginal activity, so the base data set the level of organic production at 0%. An increase to 15%, the target figure for Finland in 2010, was modelled together with the above mentioned increase in demand (A2).

Table 1. Aggregated results in numbers, A1, 0% organic.

Changes, aggregated	**Output**		**Employment**		**Imports**	
	1000 mk	%	persons	%	1000 mk	%
Agriculture	6214	0,66	49	0,59	-2905	-0,72
Food industry	37434	7,45	60	7,45	-14358	-5,67
Other industries	29774	0,14	92	0,32	-13731	-0,26
Regional economy	73422	0,31	202	0,34	-30994	-0,52

Table 2. Industries in the RegAE model.

1	Crop production
2	Livestock production
3	Garden production
4	Forestry and logging
5	Hunting and fishing
6	Food industry
7	Forest and paper industry
8	Metal, machinery and equipment industry
9	Chemicals and chemical products
10	Other manufacturing
11	Electricity, gas and heat supply
12	Construction
13	Wholesale and retail trade
14	Hotels and restaurants
15	Transport, reservoir and communications
16	Real estate, renting and business activities
17	Private services
18	Public administration and services

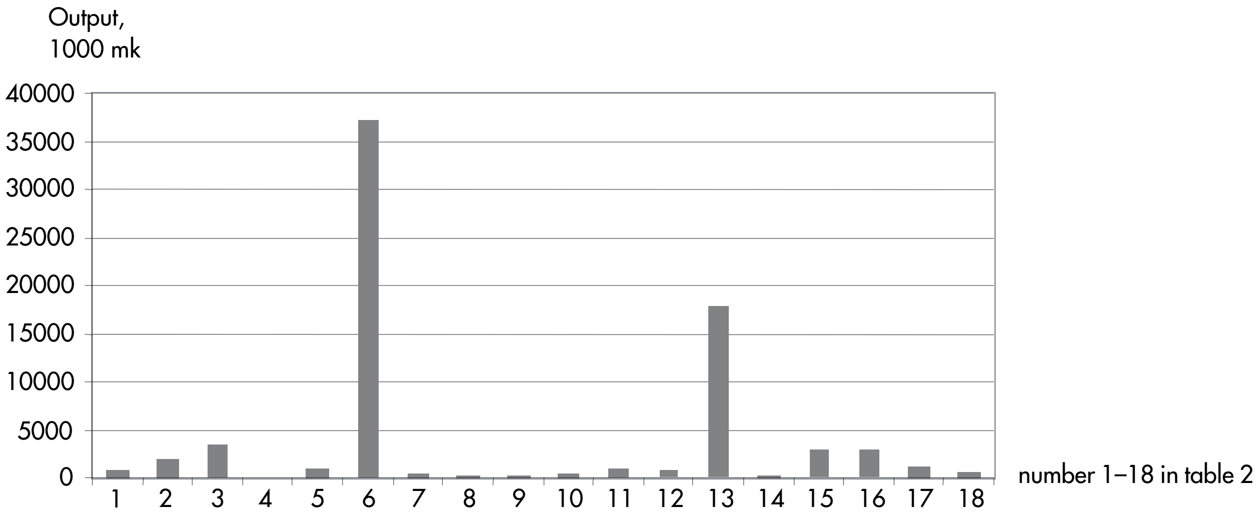

Figure 3. Growth of output by industry as a result of a 5% increase in regional foodstuff demand, A1, 1000 mk.

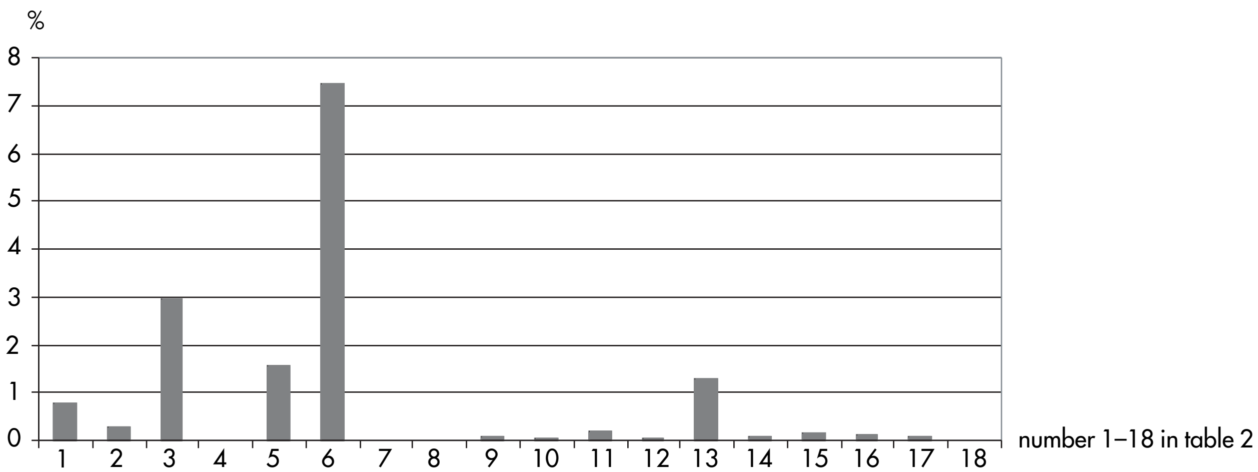

Figure 4. Growth of output by industry as a result of a 5% increase in regional foodstuff demand, A1, %.

It is important to remember that in input-output modelling the change follows existing structures of the economy. The concept of "local food" here is used in the limited sense that food is produced in the South-Savo area. The rest of the production chain is as "leaky" as it was, on average, in the base year of data (1995). This, of course, does not conform to the idea of a completely local food chain.

One's attention is immediately drawn to the relative weakness of the multiplier effect in comparison with the direct effect. The "first round" is strong, meaning that growth only occurs in the industries that are directly hit by the exogenic demand impulse (Figures 3 and 4). With South Savo's current economic structure, the demand for foodstuffs doesn't have a strong effect on agriculture. The effect on regional agriculture is about the same as the effect on the transportation (15) and real estate (16) industries. Gardening (3) sees a 3 % increase, respectively.

In terms of employment, the effect on agriculture is more significant as it accounts for approximately 25 % of total growth, c. 50 persons (Figure 5). Most of the employment growth is in within the trade (13) and food industry (6). Other industries register a modest share of 10 % of the total effect. Employment growth naturally has a positive effect on the public economy as well. In Finland, the average annual income with normal working hours in 2004 was 29 544 EUR. In the South Savo region an average worker pays 4546 EUR in communal taxation. Two hundred workers therefore would pay c. 0, 9 M EUR in communal taxes to the communes of the region (Oksanen 2004.).

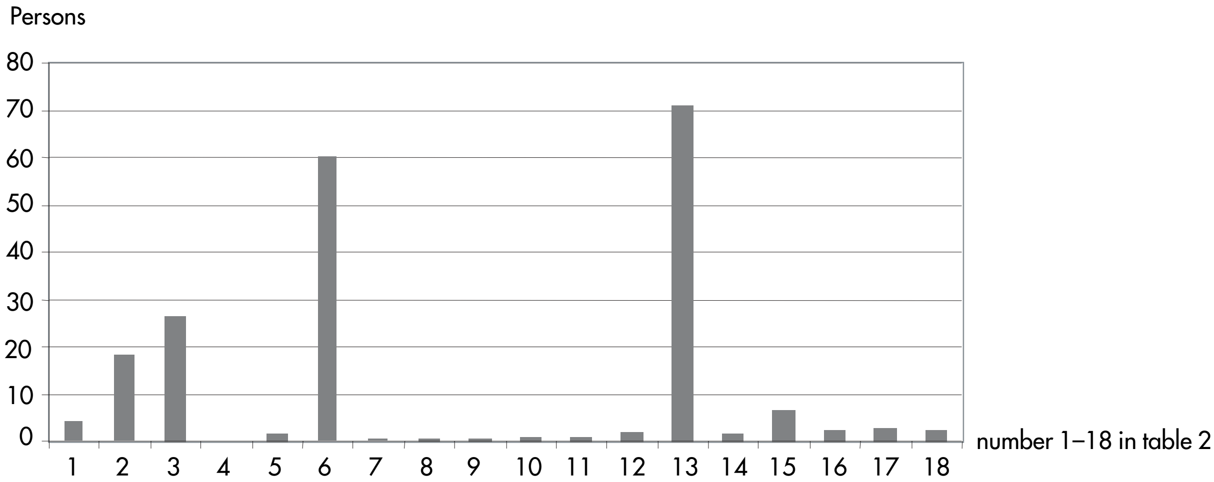

Figure 5. Growth of employment by industry as a result of a 5% increase in regional foodstuff demand, A1, persons.

Table 3. Aggregated results in numbers, A2, 15% organic.

Changes, aggregated	Output		Employment		Imports	
	1000 mk	%	persons	%	1000 mk	%
Agriculture	5400	0,58	157	1,88	-3526	-0,88
Food industry	39541	7,87	64	7,87	-15334	-6,06
Other industries	31333	0,14	96	0,33	-14302	-0,27
Regional economy	736274	0,33	316	0,53	-33162	-0,56

Looking at the economic indicators, an increase in organic production has the largest effect on employment (Table 3). Agricultural employment growth has more than tripled. Neither the growth of output nor the division of growth between industries is much affected.

In the organic scenario we see that the shift to organic production clearly upsets the growth (scenario A1) in fuel consumption of crop production (industry 1, Figure 6). Acidic emissions and GHG emissions show marginal increases (Figure 7). This is mostly due to an increase in the cultivated area. In RegAE production models it is estimated that yields with organic production are on average 35% lower than yields with conventional agriculture. This means that a 15% share of organic production requires a 10% growth in the cultivated area (also Risku-Norja et al. 2002, 29).

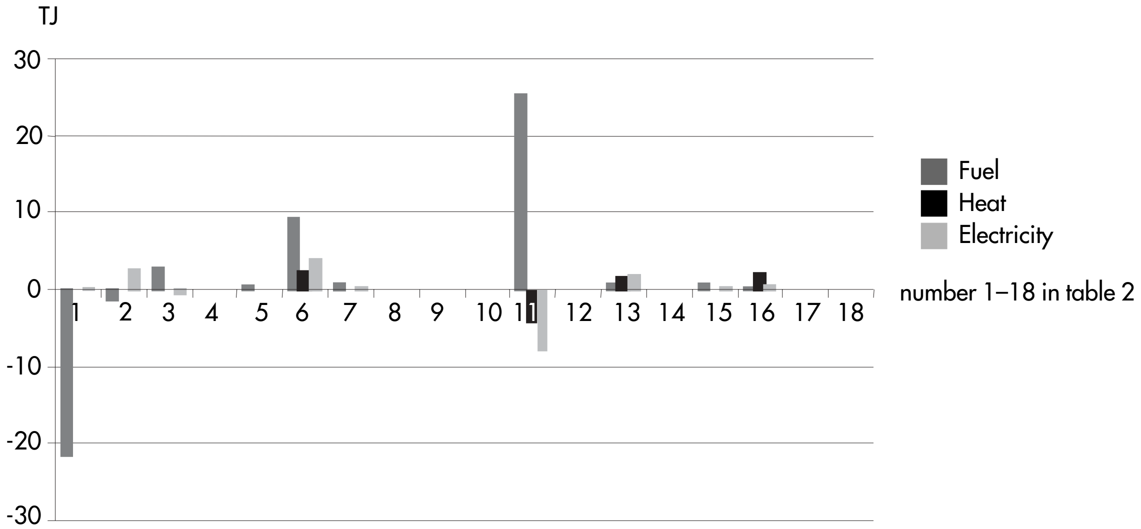

Figure 6. Consumption of energy as a result of a 5 % increase in regional demand, A2, 15 % organic.

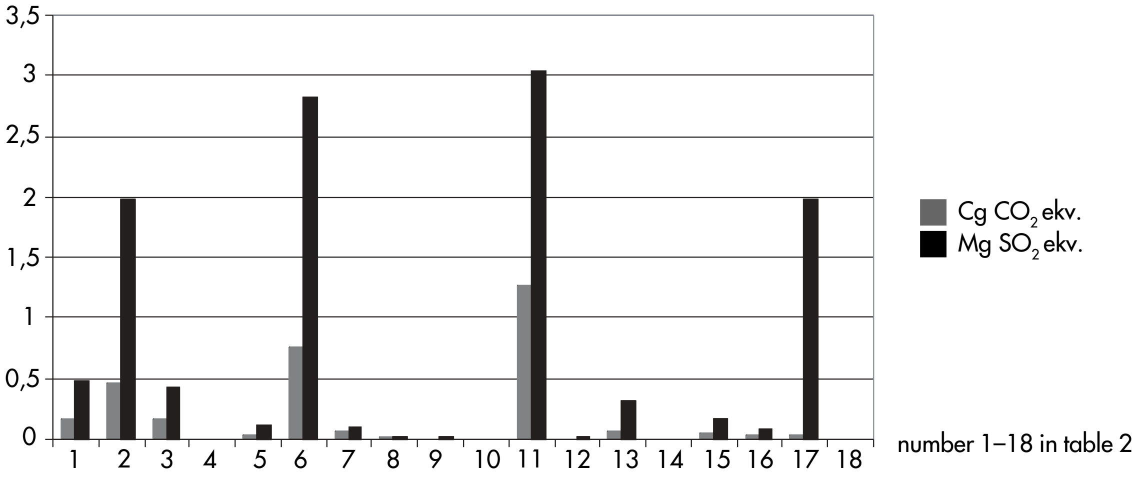

Figure 7. Acidic emissions and greenhouse gas emissions as a result of a 5 % increase in regional demand, A2, 15 % organic.

Conclusions

These results indicate that the inter-industrial linkages are quite weak, which is due to the openness, small size, and production structure of the South Savo economy. The growth in foodstuff demand has a direct effect on the processing industry, but the impact on agricultural production is limited. This somewhat contradicts the image of, and current discussion about, local food.

The input-output modelling approach gives a clear insight in the structural economic dimension of localizing food demand. Although the input-output system has certain limitations, it was, nevertheless, fruitful to apply it to the issue of local food. The data and the analysis reveal a weak link between the food industry and agriculture in the South Savo region. Both the economic and ecological indicators highlight the fact that the effect of increased foodstuff consumption doesn't have a strong effect on other regional industries. The result might sound trivial, but this point has been largely neglected in the current discussion about local food (Packalén 2001; Etelä-Savon…2001; MMM 2002; Anttila 2004; MTK 2004; Efektia 2004; Sinkkonen ym. 2004).

Since the image of local food relies strongly on the "viability" of the countryside, local food policies should have an effect on the region's agriculture. However, a more precise instrument than the general growth of foodstuff demand is needed. Supporting local food chains with a certificate system could be one way to implement a food system localization policy.

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HOUSEHOLD FOOD EXPENDITURES IN JÄRNA, SWEDEN

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A consumer survey investigating food purchases in 15 environmentally conscious households in Järna, Sweden, was performed during 2004. The primary aim was to put together a realistic example of a Swedish food basket (consumption profile), containing mostly locally and ecologically produced foodstuffs; i.e., the aim was not to give statistically valid data for any one group of consumers.

This food basket is mainly used for a comparison with the average Swedish food basket, concerning environmental impacts and use of resources in the whole food system. However, economic data was also obtained and will be presented here. The objective of the economic assessment of the food basket is to indicate whether this supposedly more "environmental-friendly" food basket is more expensive or not. For the environmental assessment, the objectives are to show what difference it makes if a consumer does as follows: 1) buys organically produced food, 2) buys locally produced food, 3) eats less meat, and 4) buys products of the season. A similar survey was performed in Juva, Finland.

The methodology used for the data collection was based on the families collecting their food purchase receipts for two two-week periods: one period during winter/spring (when local products are scarce) and one in late summer/early autumn (when local products are easily available). The periods were chosen in order to obtain representative results for the yearly consumption. After each period, the households were interviewed to see how representative the purchases were for the season. When needed, amounts of food (and expenditures) were corrected for food put into and taken from storage.

The measured units were kg food in different product groups and SEK (Swedish Kronor) per household per two week period. The data were then extrapolated and recalculated to kg and ¤ per capita (and consumption unit factor) and year.

Figure 1 shows the expenditures for food per person for different household types. Figure 2 shows the equivalent results per consumption unit factor; a unit that compensates for household structure to make more relevant comparisons between different household types. The Swedish average is supplied by data from Household Budget Survey 2003. Statistical Report PR 35 SM 0401. (In Swedish with English summary and headings, available on www.scb.se). Data also available in the Statistical Database as "Type of household – expenditures per household during 2003 in SEK", at http://www.ssd.scb.se/databaser/makro/start.asp?lang=2 (omit ?lang=2 for Swedish version).

As can be seen, the average expenditures for food are somewhat larger for the investigated Järna households compared to the Swedish average. Counted per person, the difference is about 10%. Per consumption unit factor, the difference was about 24%. However, the variation between household types was large, the households were few and no socio-economic data about the households were collected. Deeper conclusions can not be drawn from the results since we do not know whether they are due to the higher prices of ecological (organic) food, the socio-economic status of the households, a higher prioritising of "good" food, eating fewer meals outside the home, or something else.

Further conclusions would be possible by dividing the expenditures per food group and doing a deeper analysis of eating outside the home. This could be done from the raw data, as the receipts and documentation have been saved, but time-consuming since it would all have to be gone through again.

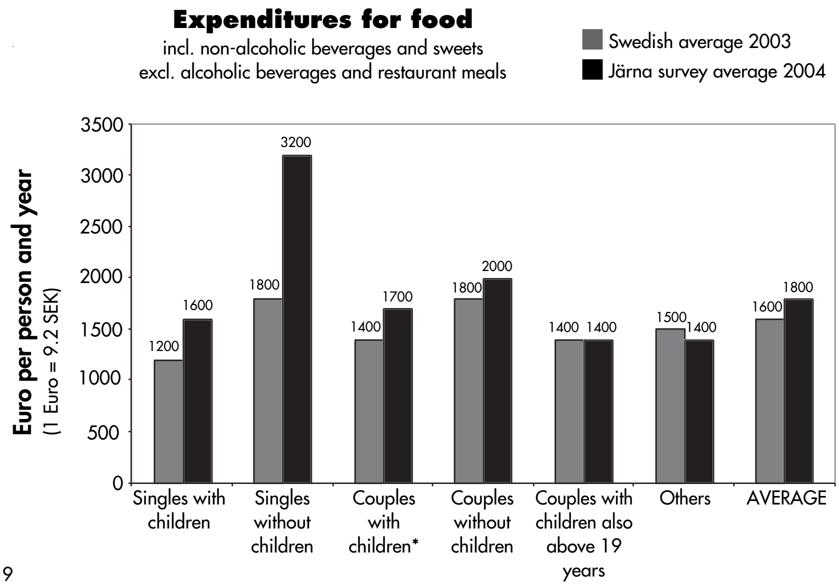

Figure 1. Household expenditures for food (including non-alcoholic beverages and sweets but excluding alcoholic beverages and restaurant meals) per capita (person) for different household types in Sweden and 15 "environmentally conscious" households in Järna. [Euro per capita and year]

* children aged 0–19
number households in surveys 128:1 374:1 888:8 678:3 87:1 118:1 2273:15

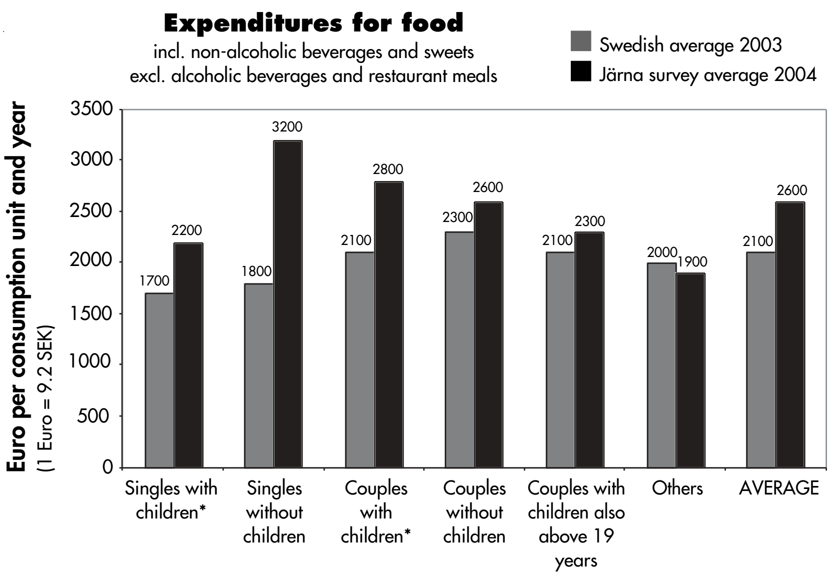

Figure 2. Household expenditures for food (including non-alcoholic beverages and sweets but excluding alcoholic beverages and restaurant meals) per consumption unit factor for different household types in Sweden and 15 "environmentally conscious" households in Järna. [Euro per consumption unit factor and year]

* children aged 0–19
number households in surveys 128:1 374:1 888:8 678:3 87:1 118:1 2273:15

SOME JUVA HOUSEHOLDS' FOOD EXPENDITURES

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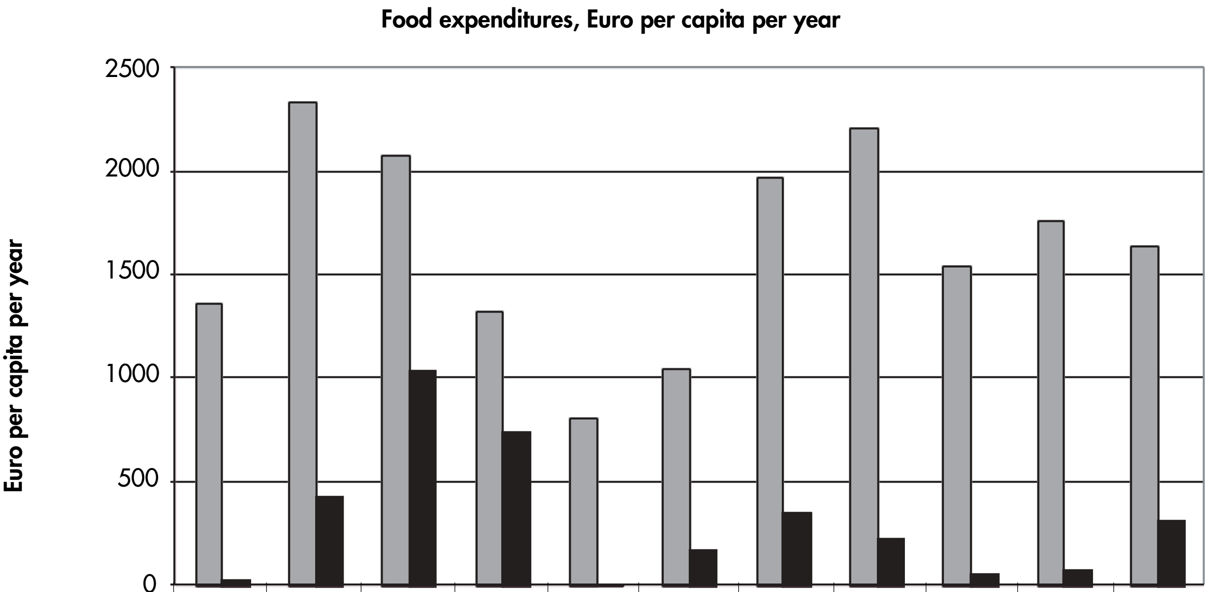
A consumer research study of food purchases in 10 households in Juva, Finland, in 2004 suggests that few households are environmentally conscious as was the case in the Järna study. The primary aim of this consumer survey was to see what a typical Finnish food basket might contain (consumption profile). A secondary goal was to find out how many of the items in that basket were locally and ecologically produced foodstuffs. As the data presented here is based on purchase habits of ten households, it lacks statistical validity.

The methodology used for data collection was the same as in Thomsson's study. Families collected their food purchase receipts for two two-week periods. Nine families (15 adults, 12 children aged 3-18 years and one child < 3 years old) participated to the first two-week period during the spring of 2004, and nine families participated in autumn (15 adults, 10 children aged 3-18 years old and two children < 3 years old). After each period each household was interviewed about it food choices, food consumption and food purchasing habits in order to get a picture of how representative the purchases were.

In Finland the purchases were recorded in terms of kg food and Euro per household per two-week period and then extrapolated to produce annual figures per household and per person per year. The amount of energy (MJ) supplied by the purchased food was also extrapolated on an annual basis.



	Hh1	Hh2	Hh3	Hh4	Hh5	Hh6	Hh7	Hh8	Hh9	Hh10	mean
all	1363	2332	2072	1322	811	1047	1968	2208	1541	1757	1642
ecological	25	429	1035	739	4	171	345	225	49	71	309

Households

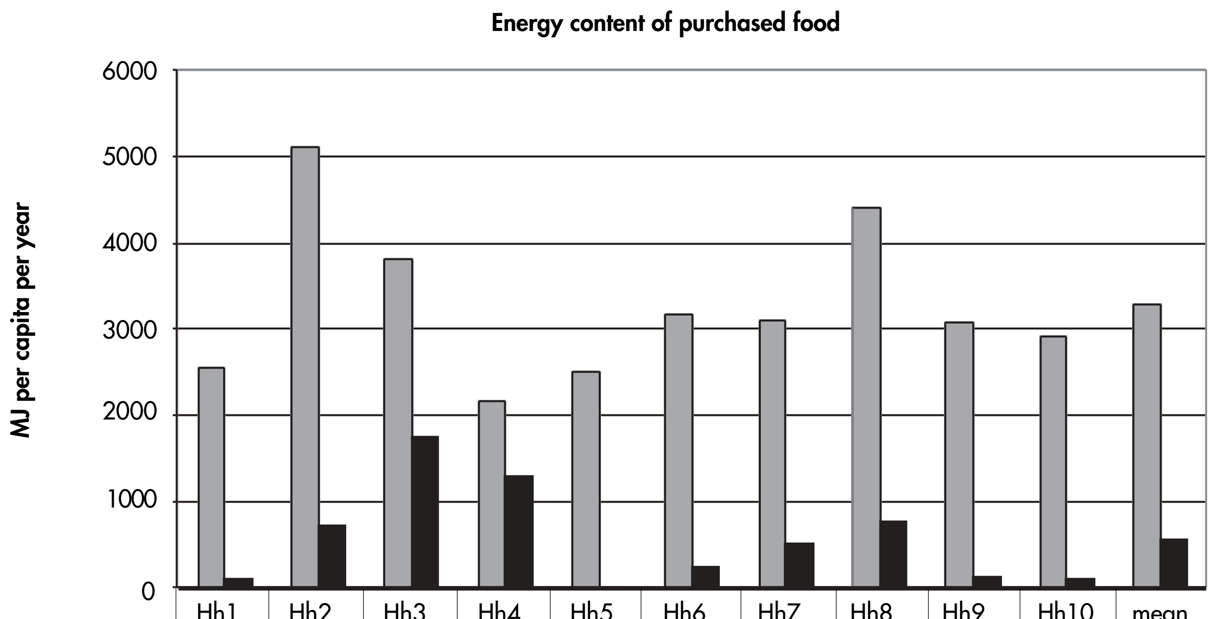
Figure 1. Expenditures on food per capita per year.

In 2001/2002, the average Finnish household's expenditure on food was 1580 Euro/person/year (Statistical Yearbook, 2004). In Juva the average expenditure on food was only slightly more at 1642 Euro/person/year but the variation between households was considerable, ranging from 811 Euro to 2332 Euro/person/year. In six households the expenditures were higher or almost the same as the Finnish average.

Expenditures on ecological food also differed between the households. In four households' expenditures came to less than 100 Euro/person/year, while one household spent more than 1000 Euro/person/year on ecological food. Despite the fact that the incomes of two households were quite low one bought a lot of ecological food and the other bought almost none.

The annualized energy content of the purchased food also varied considerably from household to household. The mean energy content was 3286 MJ/capita/year. Average energy intake extrapolated from the Findiet (Männistö, 2003) study was 2847 MJ/capita/year. The results of the Findiet2002 study were based on actual food intake. The results calculated here from purchase diaries are higher but reasonable compared to those of the Finndiet 2002-study. The energy intake of three households were much higher than those of the others. In future an effort must be made to account for such differences. Some of the differences might be explained by bulk purchases that do not reflect consumption over two-week period.

In Juva the expenditures on ecological food per households range from 0.5% to 56.0% of total food expenditures (mean=17.8%). The expenditures on ecological food of two households were 50% or more



	Hh1	Hh2	Hh3	Hh4	Hh5	Hh6	Hh7	Hh8	Hh9	Hh10	mean
all	2574	5117	3818	2159	2518	3178	3104	4404	3080	2930	3286
ecological	102	724	1754	1289	7	250	513	773	122	110	564

Households

Figure 2. Energy content of purchased food MJ per capita per year.

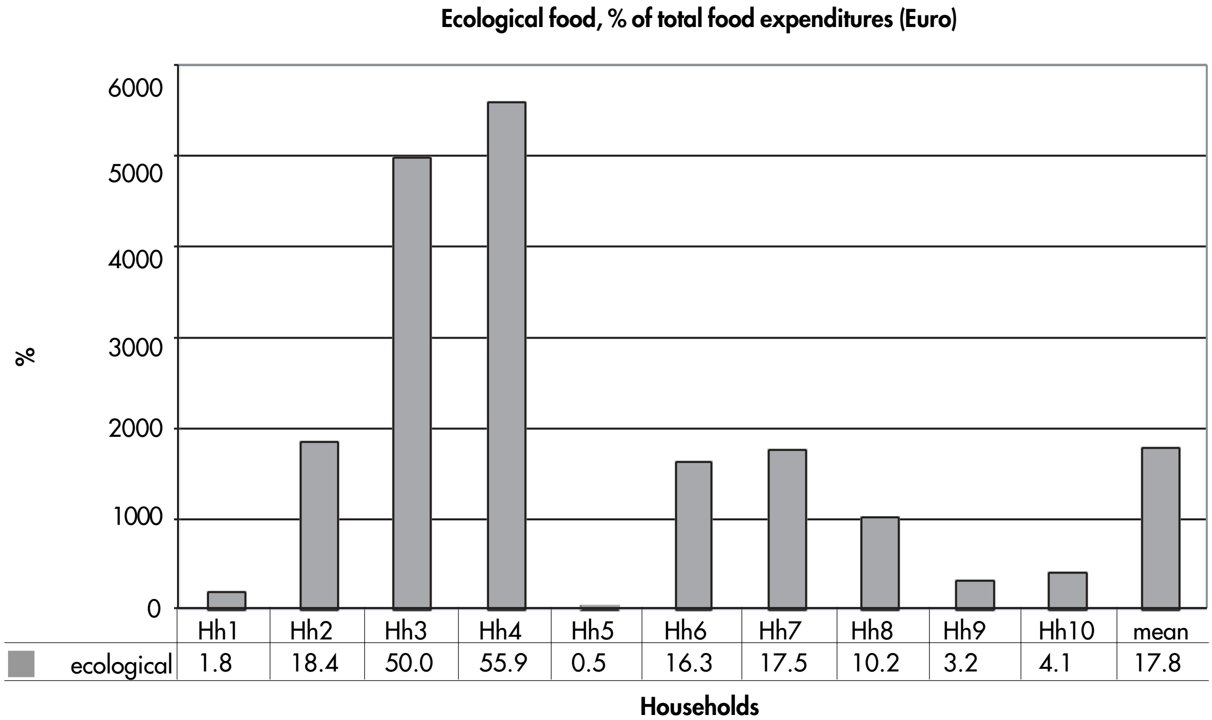


Figure 3. Ecological food, % of total food expenditures.

of total food expenditures. Six households spent more on the ecological food than average Finnish family. In 2003 the average expenditure on ecological food in Finland was 9.1% (limited to bread, grain products, milk, cheese, vegetables, fruit and berries).

Analysis of these data is one going. The next step is to compare the different food groups purchased by the households in order to determine what ecological and eco-local foodstuffs these households bought. It should also be possible to calculate from the data how much more expensive the ecological food was compared to the ordinary food.

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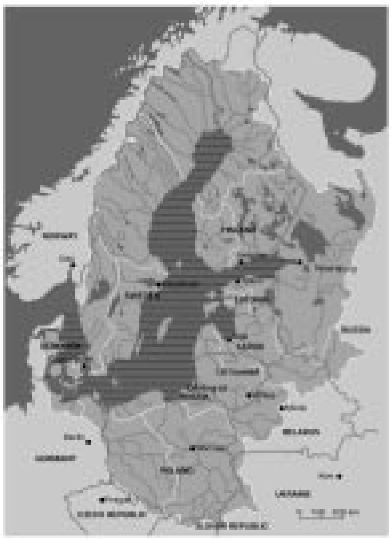

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