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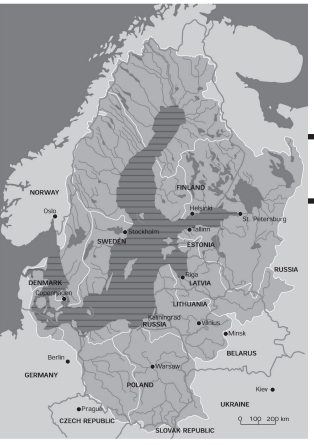
THE POWER OF LOCAL

– sustainable food systems around the Baltic sea

Editors:
Helena Kahiluoto
Per G Berg
Artur Granstedt
Holger Fisher
Olof Thomsson

Interdisciplinary Synthesis of the BERAS project



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The Power of Local
- sustainable food systems around the Baltic sea
Interdisciplinary Synthesis Report of the BERAS project

Centrum för uthålligt lantbruk
SLU
Box 7047
750 07 Uppsala

Centre for Sustainable Agriculture
Swedish University of Agricultural Sciences
S-750 07 Uppsala

Authors are responsible for the factual contents of the report

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Results and discussion

Helena Kahiluoto
Kari Vesala

In this chapter, the interdisciplinary synthesis of the results of the BERAS project is presented and discussed. First, the effects of localisation and enhanced recycling on the ecological, economic and social dimensions of sustainability based on the case studies are reported,the cases where food systems and farms studied in their present state. Thereafter, the positive additional effects on sustainability obtainable by further promotion of localisation and recycling in the cases are suggested. The impact of a total conversion to recycling organic agriculture is then considered. Obstacles to and solutions for localisation and recycling are identified. And finally, on the basis of these, conclusions about the sustainable way to localise and recycle are presented. The disciplinary results have been published in detail in the disciplinary reports and summarised in the executive summary (see *List of work package reports of the BERAS project*, for the scope of each work package, see fig. 2).

Impacts of localisation and enhanced recycling on sustainability

Results based on cases in their present state

Comparison of the relatively local, recycling case food systems and farms in their present state with the dominant food systems and agriculture indicates the following effects of localisation and recycling on the ecological, economic and social dimensions of sustainability.

In comparison with dominant food systems localisation decreased fossil energy use and global warming potential (GWP) in transportation, except in the meat chain, due to shorter transportation distances. This was despite the smaller quantities in each delivery. In processing, fossil energy use and GWP depended less on the scale (local vs. centralised) and more on the energy source. According to the actors, local marketing increased costs and labour use for producers and institutional kitchens, but profitability was not perceived as a problem. Local marketing also strengthened the market for organic food thus supporting recycling. Localisation of processing invigorated the regional economy through gains in employment and public financing. Locality of the food system, including consumption, increased perceived equity through greater means of influence, and improved the viability of the rural communities. For those effects, locality was more important than recycling (organic mode of production), in line with the conclusions of Trobe and Acott (2000) and Miele (2001) on the importance of combining organic farming with local and regional sourcing to fully address the social and economic problems associated with globalisation of the food system.

Relative to dominant systems, recycling decreased N and P surpluses and loads, P outputs being slightly higher than inputs on the recycling organic farms. It decreased fossil energy use and GWP in agriculture. Recycling within the farm however reduced farm income. Benefits of reduced eutrophication around the Baltic Sea measured by a willingness

to pay appeared substantial and higher than societal costs, when both point and diffuse sources were included. The organic (recycling) mode of production increased perceived social sustainability so long as the production was local.

The environmental benefits of recycling were achieved, because recycling substituted for the linear nutrient flows to agriculture in N and P fertilizers, which are also manufactured with non-renewable energy and using limited P resources. Additional decreases in fossil energy use on the case farms were achieved by use of biological N fixation to compensate unavoidable N losses. The decrease in GWP per product unit was reduced by the larger than average emission of methane from animals on the recycling farms. This was due to the higher proportion of ruminants among the animals, lower productivity per animal and higher proportion of roughage in the diet of the ruminants. Income forgone was mainly due to loss of the opportunity to achieve higher productivity through purchase of additional nutrients in the form of fertilizers and feed, and to loss of the opportunity to lower fixed investments through specialisation and trade between farms. The increase in the perceived social sustainability was attributed to safety in regard to environment, working conditions and food, to successful business strategies and to rural vitality. The values linked with the mode of food production appeared to have the potential to form a value base for a cooperation network and to become a key to social sustainability in terms of mutual trust, respect, community and social resilience, so contributing to economic sustainability as well.

Ways to promote localisation and recycling in the cases

Inspection of the case food systems and case farms suggested the following ways to further promote locality and recycling and favourably affect sustainability in the cases:

Further localisation would reduce fossil energy use and GWP and improve local economies through the use of local, renewable energy (e.g., wood, biogas, biofuel) in the whole food chain. To reduce energy use and GWP of transportation, increase in volumes of local, organic food as well as choice of the vehicle appeared to be important. Taking fuller advantage of the benefits of local food to the local economy requires locality of the major stages in the food chain (also agricultural production, inputs to agriculture, inputs to processing), involving local and/or regional cooperation with other industries in the form of inputs, raw material and services. Better social sustainability in local, organic food chains would be achieved 1) through further improvement of equity in influence, especially for farmers, and 2) through including consumers and the local, organic activity of large-scale enterprises in the partnership network.

Our findings on environmental benefits of localisation are parallel with those of another, non-BERAS study (Poikolainen, 2004) on vegetables in the Finnish case food system (Juva), where localisation was

found to decrease fossil energy use and the climatic effects of transportation, despite the smaller amounts transported at a time. Further, our transportation findings are in agreement with the conclusions of Jones (2002) on fresh apples and of Blanke and Burdick (2005) on imported vs. domestic, stored apples and of Carlsson-Kanyama (1999) on imports vs. domestic food production generally. Also relevant are the results of Pretty et al. (2005) that the external cost of transportation in local food systems (food basket sourced from within 20 km of retail outlet) would be less than one tenth of the current one in the UK, depending on the transport vehicles, however. Localisation contributes to environmental benefits as well, because it encourages a diverse production structure with easier internal recycling and easier recycling from processing and consumption in the vicinity. Localisation also removes the environmentally harmful effects of concentrating big units of animal production in limited areas, allowing ecosystem's buffer capacity a larger role. Further, localisation and increased reliance on local resources can re-establish feedback relationships that allow adaptive management of the human-nonhuman, thereby promoting ecologically sound land-use and building of vulnerability-reducing redundancy into the global food system (Vergunst, 2002; Sundkvist et al., 2005).

The environmental advantage of local food over regional imports to the food system might, of course, be reversed if too generous a definition of local were allowed and local transport were too inefficient. According to Carlsson-Kanyama et al (2003), with poor logistics such as an absence of coordinated transport and allowing food from up to 200 km away, virtually no environmental benefits would be achieved with a farmer's market relative to similar but non-local products bought at supermarkets. The total effect of localisation also depends on the energy input to production. If production is clearly less energy-intensive when performed outside the region (Cowell and Parkinson, 2003), as it can be for greenhouse vegetables (Poikolainen, 2004) and for cereals with higher yields and lower energy need for drying in warmer regions (Sinkkonen, 2002), the benefits of reduced transportation may be more than offset by the increased energy costs for production.

The benefits of localisation to local economy and the consequent potential of local food to equity among regions is often less appreciated than the overall economic efficiency or firm profitability. Even if globalisation and liberalisation of agricultural trade lead to apparently more efficient production, underutilization of the released resources radically changes the effect. Transfer of the labour to other regions and sectors from declining agriculture is both a social problem causing inequity and an economic problem (Huan-Niemi, 2004). Thus, the counter-effect of local demand addressed to local and regional production obviously is beneficial not only for the local economy, but reduces also the total short-term costs of the structural change. In addition, as noted by Forsman and Paajanen (2002), using local products provided by local actors may result in both economic and non-economic advantages for catering businesses

for example, and many non-economic aspects may turn into economic advantages, at least in the long run. The higher equity in control found in a local, organic food chain as compared with the dominant system, was in line with the results of another study on the same local food system (Kahiluoto et al., 2005).

Enhanced recycling of nutrients in fodder and manure would further reduce nutrient loads and energy use. This could be obtained by including more roughage from the recycling system (a farm or a group of cooperating farms) in the animal diet and correspondingly decreasing the cereal-based concentrates imported to the system. If recycling was carried out between nearby farms engaged in animal husbandry and plant production (distances should not be too long for manure transportation) and not within a farm, the loss in farm income associated with recycling would be reduced or nullified. Enhanced recycling from the demand chain would reduce the need for biological N fixation and reduce loads, and at the same time decrease P depletion in soils. Potentially most of the N and P flows to consumption could be recycled back to agriculture. A higher level of societal investment directed to decrease nutrient loads through recycling is well justified by societal gains and by the fact that the greatest reductions in loading today are achievable through agriculture (HELCOM, 2003). The total investment in load reduction could be reduced through cooperation between countries and thus targeting investments to regions where they will have greatest effect.

Our results, that recycling of nutrients in agriculture and food systems notably reduces nutrient surpluses, are similar to those obtained for Sweden by Granstedt (2000). Enhanced recycling and thus lower nutrient load is achieved through lower stocking rates within the recycling system and through more efficient utilization of N inputs into the system (Nielsen and Kristensen, 2005). P depletion in soil occurs in organic, recycling farms because, although the unavoidable N losses are compensated through biological N fixation, no new P is imported to the system except in feed, and there self-sufficiency is sought. Some degree of decrease in plant-available P in soil is even desirable, to consume the P earlier enriched by fertilizers and so increase the conservation of and reliance on ecosystem services (e.g., mycorrhiza) and achieve a decrease in P loads (Kahiluoto, 2000). In the long term, however, compensation of even the decreased losses will be necessary through recycling either from the demand chain and/or from eutrophied watercourses. Integrating a specialised crop farm with an animal farm was by the present study found to be more profitable than recycling within a farm, but an example from Maine, USA, suggests that coupled crop and livestock farms are also more profitable than separate, specialised ones; systems coupled for more than ten years had the most favourable profitability and sustainability measures (Hoshide et al., 2004).

Consideration of all impacts on the different dimensions of sustainability presented above indicates that there is good potential for sustainability through localisation and enhanced recycling. Localisation and enhanced recycling promote sustainability in all its dimensions, providing that firm economy is improved through fair cooperation and/or through interventions and/or price premium. Thus, the weakest loop is firm economy, and the keys to achieving sustainability are cooperation and change of the economic environment. Recycling is essential for and localisation contributory to ecological sustainability. Localisation is key for benefits to local economy and social sustainability.

Further research should consider how localisation of a food system would reduce the total transportation volume in society, including commuting to and from work, and thereby decreasing environmental impacts and costs. It might also reduce the need for expensive high-speed infrastructure.

Impact on sustainability of a total conversion to local, recycling organic agriculture

If all agriculture within the Baltic Sea drainage area were to adopt a similar regime to that on the recycling organic case farms in Sweden, the present N surplus from agriculture could be reduced by 47% and a small P deficit would be resulted. Similarly, if all agriculture of a Danish county were converted to recycling organic agriculture, a 41% reduction would be achieved in N loads to the Baltic Sea from agriculture of that county. The P deficit was estimated to be 6 kg/ha, with only 0 to 25% reduction in P load, since the P load is mainly influenced by particle bound P which, it was assumed, would stay constant within a time frame of 30 years. In addition, the pesticide emissions would be reduced to zero. Because the present conventional and organic forms of agriculture in Poland and the Baltic countries are extensive, conversion of those countries to a recycling organic agriculture regime on the Swedish model would not result in a decrease in agricultural production relative to the present situation in the Baltic Sea drainage area. Scenarios based on the Swedish case showed, however, that if the portion of meat in the diet were to decrease, a higher level of (and even more than) self-sufficiency could be achieved, as well as further reduction in environmental emissions per capita (less decrease per ha). It should be noted, however, that the recycling case farms represent a more recycling agricultural system than present organic farming on average, and that these results are based on case farms in Swedish conditions, which are not fully representative of the ecological conditions in other Baltic Sea countries.

The enhancement of recycling should also be beneficial for societal economy since the societal gains from reduced eutrophication appear to exceed the costs and, given the presently highest potential to reduce emissions from agriculture, the motivation for increased allocation of resources to reduce agricultural loads is strong. Indeed, from the perspective of farm economy, carrying through a conversion to recyc-

ling agriculture would require economic incentives. The performance of farm economy contributes to the local economy, too. For local and regional economies, as well as for social sustainability, localisation is more important than enhanced recycling. In other words, the effects on sustainability of conversion to recycling agriculture critically depend on, whether and how this change would affect locality of production and consumption. Therefore, benefits of recycling organic agriculture to local economy and social sustainability require that the decrease in productivity and the larger area needed for fodder production in recycling organic agriculture, do not lead to decrease in local or regional supply. It is important, however, to take the production of inputs also into account. The present food production regimes also include hidden hectares, for Sweden approximately one million hectares (Johansson, 2005). This is the field area outside the country that is used, especially for production of fodder, as an input for food consumed within the country (Deutsch, 2004; Kratochvil et al., 2004; Johansson, 2005). With no change in diet, the national self-sufficiency in Sweden could not be reached, and in Finland it would require a decrease in food exports and the use of field for industrial purposes.

In an earlier Danish scenario, the socio-economic consequences of 100% conversion of Denmark to organic farming was seen as extremely difficult to predict because the change would be dramatic (BICHEL, 2001). The effects would depend on the size of the total production, product prices and the environmental benefits. The modelling efforts were concentrated on estimating the effect of reducing primary production and consequently employment in the food chain of the export-oriented country. It was estimated that with unchanged consumer preferences, the gross national product (GNP) would be reduced by 1-3% and private consumption by 2-5%. If the preferences of foreign consumers were to change with the imposition of price premium of 10% on milk and 20% on pork, the impact on the GNP would be clearly less and the decrease in private consumption only 10-30% of the value noted above. In any event, stated by the report, according to current economic theory, a market-driven change is synonymous both with a more effective resource allocation in society and from the viewpoint of consumers. Therefore, as long as there is a market prepared to pay a premium for organic (and local) products, the conversion will increase the welfare of the society. According to the Danish study, since a switch to organic farming would be accompanied by environmental (and other public) benefits, it would not need to be driven by market forces alone, but could also be encouraged by government regulation. This conclusion was supported by the results of Huhtala and Marklund (2005a).

According to our findings, if rural food systems around the Baltic Sea were appreciably localised, this would facilitate recycling and invigorate regional and local economies in terms of public finance and employment. These changes would promote rural vitality. Further, increased embracement of local actor networks and local food chains

would clearly improve equity in control and benefits through greater opportunity to influence, and would increase social capital in terms of trust and resilience of rural communities.

Enhancing sustainable localisation and recycling: Obstacles and solutions

The obstacles to enhancing locality and recycling to maximise sustainability were identified by research (documented impact analyses, interviews, workshops) and confirmed through a participatory process in cooperation with actors. Means to promote sustainable localisation and recycling, though based on the findings, were mostly identified in an interdisciplinary and participatory interpretation process and discussion. The proposed three solutions are characteristically inter- or transdisciplinary and represent win-win solutions, not trade-offs, for the different dimensions of sustainability. In the text below, the solutions are linked to the identified obstacles. That is, in the discussion of solutions, the numbers in parentheses refer to the corresponding obstacles.

Obstacles to localisation

1. Field area (e.g. in Sweden) may be insufficient to satisfy national food demand if production is based on recycling.
2. Present organic standards, in contrast to organic principles, do not require locality. Also, products where processing is local, but most stages of the food chain are not, can be referred to and sold as local. This leads to reduced positive impact.
3. The match between demand and supply of local food (in both volume and quality) is poor; processing and centralised retailing are bottlenecks; and share of consumption is low, which means small volumes, energy-extensive transportation and low benefits of locality.
4. Labour requirements are high, and logistics of local marketing are weak due to small scale.
5. There is a lack of equity in influence, especially for farmers. There is also insufficient embracing of consumers and the local organic activity of large-scale enterprises within the partnership network.
6. Risk for social division exists, due to envy incited by exclusion from the local chain, and by disagreement on price of organic products.

Disagreements can occur between farmers and producers on the one hand and strong centralised retailers on the other.

Obstacles to recycling

7. Recycling between crop and animal husbandry farms is complicated by regional specialisation.
8. Recycling between farms may result in income forgone due to loss of the opportunity to achieve higher productivity through purchase of additional nutrients in the form of fertilizers and feed.

9. Recycling of sewage sludge from the demand chain holds risks due to heavy metals, human and animal pathogens, drug residues etc.
10. According to actors in Finland and Sweden, strict regulations (though not requiring recycling) and bureaucracy in organic farming negatively impact the supply of organic, local food. ("Organic" is the only present label for recycling).
11. Demand for organic products is weak due to higher price (though there is no correlation between the portion of local, organic food purchased and family income) and due to insufficient availability and lack of information.
12. The divided attitude to organic farming creates a risk for social di vision.

Partnership a key solution

Cooperation with equity in influence, i.e. partnership, between farmers and local food system actors (including consumers), between different industries locally and within the region and even between countries was identified as key to achieve enhanced locality and recycling in food systems and win-win relations among the ecological, economic and social dimensions of sustainability.

In addition to the higher price conjoined with lack of commitment, the major constraint on consumers to purchase local organic food was poor availability. Better congruency of demand and supply and thus fuller exploitation of the local market would be achieved in a sustainable manner through tight and fair cooperation within the chain among farmers, processors, retailers and consumers (e.g., through communication, detailed contracts for production, product development and marketing). This kind of cooperation creates solutions for several of the possible obstacles to both localisation and recycling (3, 4, 11). Such cooperation would also enhance the opportunity of actors to influence and accelerate the reactions of producers to market changes, and thus improve availability, firm economy and social sustainability within the local, organic food sector (3). Enhanced local processing and local or regional marketing (e.g., by a farmers' and/or consumers' cooperative) would assist the development of local markets. As an example, processing of vegetables and berries is the prerequisite of supply to institutional kitchens (3, 4, 5, 11). Diversified local distribution channels would reduce the dependence on consolidated retailers, and improve equity in control for both farmers and consumers (5, 6) and, crucially, the availability of products (11). Food baskets, consumer groups, farmers' markets and electronic ordering systems with a middleman for groups like institutional kitchens are some examples of incorporating consumers in partnership networks (5).

Localisation can be initiated by any actor in the food system, e.g., almost all of the initiatives in the case food systems were started by a single individual. Thus, localisation can be demand driven (householder,

processor or retailer asks for local products) or supply driven (farmer or processor introduces a local product to the nearby market). Partnership of local actors also create a peer group to develop ideas and initiatives. Some form of common values appeared to facilitate for cooperation within the local food system, and could be a means to promote the involvement of consumers (5, 6). According to Carlsson-Kanyama et al. (2003), the building of trust between farmers/producers and consumers was the most important contribution of a farmer's market to sustainable development. Strengthening of local identity could provide a general opportunity for sharing the process of food production with engaged citizens within the food system. In the case of (recycling) organic agriculture, values linked with the mode of production offer another opportunity for sharing, as organic farmers and purchasers of organic food have common concerns (also Torjusen et al., 2001). Specific options for the common values could be identified and utilised in each case.

The main problems identified for local organic food chains in the present study have earlier been reported for organic supply chains generally. These are imbalance between supply and demand; high operating costs; lack of cooperation and incompatibility of values and goals of actors, not least due to the different strategic roles of organic food for companies; poor information flow; and poor supply reliability (Baecke et al., 2002; Hamm et al., 2002; Wycherley, 2002; Finfood, 2003; Franks, 2003). Kottila et al. (2005) have, in accordance with the present study, identified two important things: closer collaboration and exchange of information within the chain and involvement of actors outside the chain in, for example, management and delivering of information on values of organic food. Likewise, cooperation and deeper understanding of the customer value creation process have been found to play a crucial role in the development of local food supply chains (Forsman and Paajanen, 2002). In the case studies of Vergunst (2003), the reinforcement of the local stock of social capital was perceived ultimately to facilitate and reinforce the local economy. Local partnership in food systems require new structures for communication and collaboration (Guptill and Wilkins, 2002), but has greater potential and feasibility than partnership within national and global food chains and more potential for feedback from ecosystems to actors for the change (Vergunst, 2002; Sundkvist et al., 2005). Further, conscious efforts to find common features of a value base promoting commitment to the partnership network might have more potential in local than in larger systems.

Global and local food systems have even been regarded as dual economies, where the global food system is characterised by general-purpose money, while local food systems employ personalised special-purpose money that is based on trust, and that cannot be exchanged between localities (Douglas and Isherwood, 1978; Hornborg, 1999; Vergunst, 2002). The two forms co-exist, they can give inspiration to alternate ways of being in the food system (Hendrickson and Heffernan, 2002) and they can even benefit from each other (de Haan, 2000; Forsman and

Paananen, 2002). However, opportunities to influence and profit from local development processes are not the same for all (Vergunst, 2002). Moreover, as pointed out by Hinrichs (2000, 2003), Winter (2003) and DuPuis and Goodman (2005), in the development of local food systems attention should be paid to open, continuous, reflexive and democratic processes that also allow a respectful, productive disagreement. In interaction between actors, broad involvement (also Haden, 2002) and equity in influence are especially important for social justice and sustainability. Farmers have also previously found to be the actor group perceiving an impoverished social situation due to lack of control and recognition in the food chain, with a potential improvement through collaboration among actors (Nordström-Källström and Ljung, 2005).

Cooperation between adjacent regions, even across national borders, can ensure reasonably local food to regions with insufficient field area to satisfy demand on the basis of sustainable recycling. Reduction in meat consumption and a higher share of ruminant meat would reduce the requirement for field area, increase the potential for food localisation (1), reduce environmental loads and press down the price of organic, local diet (3, 11). Exporting products in processed form would keep the value added in rural and less-developed regions, reducing the economic and social food print (Johansson, 2005) of the importer (1). The *appropriate scale of locality* would depend on the population density and business strategies. Entrepreneurial skills and modes of action would need to be generated for full exploitation of the local market as well as for extending the market scale (4). That may, however, demand more social and economic resources than individual farms or small firms usually possess.

The strategy of enlargement of the firm scale through fuller coverage of the local market by few, diversified enterprises would introduce competition with serious threats to social sustainability. It would also decrease the coverage of community members by the local network, limiting the social benefits of locality and increasing the risk for social division. Cooperation, and increase in market scale beyond the local rural community, at least to the regional level, while still maintaining a local image would decrease labour and scale problems, stabilise demand, improve firm economy and increase the supply of food to urban communities and regions with high population density (1, 4). Therefore, a strategy of encouraging wide participation in the local market and enlargement of product markets beyond local scale through local partnership, would appear capable of producing benefits in all three dimensions of sustainability.

Ways to get consumers to participate in the partnership network require further study. The same applies to large-scale enterprises that only in a minor way work with local organic food, and towards small local food suppliers so that they become more customer-oriented and willing to cooperate (see also Forsman and Paajanen, 2002). Finding ways to initiate and maintain processes of open communication and

equal influence of actors and community members, is another challenge (Pelletier et al., 2003).

For recycling of nutrients in the form of fodder and manure, cooperation between farmers decreases costs, increases ecological sustainability with no economic costs, and promotes social sustainability (4, 6, 8, 11, 12). Cooperation also improves diversification and crop rotation, acquisition and use of machinery, land use, work division, production planning and trade. The improvement, found also by Hoshide et al. (2004) and Anderson et al. (2005) is in both biological and technical factors. As quantified by Lötjönen et al. (2004), savings of as much as 40% were achieved for animal sheds and machinery through different forms of cooperation. A biogas plant compensates costs of recycling within the farm by supplying local, renewable energy and reducing energy costs (7, 8).

Partnerships within the food system and organisational changes are required to improve safe recycling of nutrients and organic matter from the demand chain and watercourses back to agriculture. Recycling from the demand chain and watercourses is of special importance for P management, for which no mechanism corresponding to biological N fixation is available to compensate the unavoidable losses of P within agriculture. Even in rural food systems with small-scale industry, recycling of sewage sludge to bio energy fields would appear, at least in some cases, to create risks for heavy metal contamination and soil deterioration in the long term. These risks could be considerably reduced, and the main part of the N and P flows from agriculture could be returned to crop production through separate collection of urine on the one hand and bio waste from households and processing including slaughterhouse waste, on the other. Of all nutrients in house hold waste waters 80% of N and 60% of P was found in urine in the present study. According to Jönsson (2002), urine represents 70% of N and 50% of P and K of all household waste and waste water fractions. Although risks cannot be totally removed, the hygiene could be much improved through storage of urine (Höglund, 2001), composting, and energy production in biogas plants (9). Cooperation between the countries of the Baltic Sea drainage area would reduce the total cost of environmental investments promoting recycling (8).

Internalising externalities a second key solution

Economic incentives for localisation and recycling would appear to be crucial for sustainable development of food systems since, in the present economic environment local, recycling organic agriculture is much less attractive from the firm economy than the societal point of view. The interdisciplinary interpretation suggests that including the environmental and social benefits and costs in prices (i.e., internalising of externalities) by half of government imposed regulations, subsidies and taxes would be the best form of economic incentive for localisation and recycling (3, 4,7, 8, 11). Price premium (4,7) could contribute to such

development, but there are also problems in relying on a voluntary support by individual consumers.

Price premiums require the prior development of organic and local standards (see below) (2,7, 10). According to the interviews, along with availability, price is the main obstacle to consumers increasing their consumption of local organic food. This finding was supported by estimates of price elasticity and is in agreement with previous studies (e.g., Shepherd et al., 2005). Thus, reliance on price premiums to improve the firm economy could work against the conversion to more sustainable food systems. Interviews with consumers and other actors nevertheless suggested that the willingness to pay might be somewhat increased if there was more information about the impacts of choosing local organic food (3, 11). This was indicated also by the fact that even though high price was mentioned as the main constraint against purchase, there was no correlation between family income and share of local organic food. Engagement of consumers in the local network of trust and common values would contribute to willingness to pay (5, 11).

Price premiums could be justified on the grounds that they cover the additional costs incurred by organic farmers to avoid damage to the environment. At present, the difference between farm externalities for an organic compared with the conventional food basket is much smaller than the premium charged to consumers (Pretty et al., 2005). In the Bichel report on conversion of the Danish agriculture to organic farming it was estimated a maximum of 10-25% price premium allowing a continuous growth in the market share, while the present level varies between 5 to 90% to the farmers (BICHEL, 2001). Harwood (2001) notes the need for corrective forces since there are areas crucial for sustainability which market forces are unlikely to adequately address (production ecology, resource protection, technology for "regional " staples, appropriate local food systems, and strong civil sector action). Noteworthy is also, that demand cannot direct development until there is a sufficient selection of products available and accessible to consumers.

Price premium based on a willingness to pay is, in any case, less promotive of equity in control and benefits for consumers than societal intervention would be (Lang, 1999). Given the societal benefits and the willingness to pay for ecological benefits demonstrated by interviews but for several reasons not on the market, public sector intervention would appear to be justified: Consumers often find themselves "locked in" to unsustainable consumption patterns, due to the architecture of incentive structures, institutional barriers, inequalities in access, and restricted choice (Jackson, 2005). On the other hand, as concluded in the report concerning organic farming (BICHEL, 2001), with the current EU rules it is hardly possible to implement a compulsory conversion to local organic food, because importation of food and feed cannot be prohibited. Voluntary change based on societal intervention seems to be the most realistic option. Thus, "internalisation of externalities" turns out to be the best economic solution for sustainability in its different

dimensions (3, 4, 5, 6, 7, 11), helping market forces to work towards the social optimum. Alternative and complementary instruments for discouraging negative externalities and encouraging positive ones include penalties (Jackson, 2005), environmental taxes, subsidies and incentives, institutional and participatory mechanisms (Pretty et al., 2001).

Legislation and regulation, e.g., restrictions on livestock density and on fertilizer inputs to the system, could contribute to the break down of regional specialisation and thus to the development of more local, recycling systems (7). Subsidies for recycling could be allocated on the basis of for example animal density within the recycling system, P content in manure, or balances of P and/or N in the system (the system possibly including several farms and recycling from the demand chain). Use of the primary nutrient efficiency (PNE) as a measure (see *Material and methods, Disciplinary approaches*), rather than other common nutrient balances, has the advantage of making crop and animal production commensurable.

The current crisis in agriculture, with its economic, political, social and ecological dimensions, is often seen to have arisen because of the narrow pursuit of a productivity technology and policy model (e.g., Ogaji, 2005). Thus a logical remedy would be a multifunctionality of agriculture and food systems and a move away from the economics of scale and towards the economics of scope (e.g., MacRae, 1999). In the report to the European Commission Creating an innovative Europe, public procurement and taxation are mentioned as useful catalysts for environmental innovation. The report, published in January 2006, considers energy technologies and conservation, recycling and waste and emissions control among the environmental innovations, mentioning agriculture as a main sector to focus on. Not only the subsidies and taxes directly addressed to agri-food systems are of significance, but all the regulations, taxes and subsidies affecting the price relations of factors of production.

According to Pretty et al. (2005), only £219 million of the annual UK government subsidy of £3102 millions to agriculture (not including the additional subsidies for foot and mouth disease) was used to create positive externalities. If this proportion can be considered valid elsewhere, internalising the environmental and social benefits and costs would not necessarily imply increase of subsidy but rather a reallocation. Bahrs (2005) mentions the need to reduce the windfall profits associated with simple land-based subsidies for organic farming, though without making a reduction in the incentive effect since successful businesses should be rewarded. He proposes a change to profit-based tax systems as an effective way to provide selective subsidies for supporting and co-financing incentives. The linking of subsidies to performance and the low transaction costs are the advantages. Miele's (2000) case study comparing different European countries indicated the need to apply EU policy in support of organic farming according to the context, since the same policy can bring about divergent effects in different contexts.

Some current incentives are even directly addressed to promote localisation (e.g., funds reserved for public purchase of local food in some European countries). Tools already exist for promoting recycling in the environmental scheme as an additional voluntary measure. An example is the subsidy for receiving manure for fertilizing crops. The existing regulations on the maximum N and P supply per field area become incentives for localisation and recycling at very high levels of nutrient surpluses. Thus, there is no incentive for the deliverer within a sustainable range. In Maine in the United States, economic performance was better for the specialised integrated crop and animal farms than for separate specialised ones. Coupling was concluded to require close proximity of farms and adequate working relationships of farmers (Hoshide et al., 2004). Nutrient balances are included in the proposal for the new Finnish agri-environmental scheme. In the case of the tax on commercial fertilizer, the problems are implementation (avoidance of smuggling etc.) and legitimacy due to low prices of products.

Research is needed to determine the justified degree (e.g., Huhtala and Marklund, 2005a,b) and the most effective tools to internalise the externalities. The new incentives should directly address the key benefits or costs, instead of being technology-bound. This would ensure not only that a particular existing technology would be supported but also the development of existing technologies, and of food and farming systems, towards sustainability. In addition, the effects of incentives on all the interrelated dimensions of sustainability (e.g., ecosystem goods and services, local economies, and equity and social interactions) should be taken into account.

Information a key tool for citizen consumers

With the increasing transfer of control and responsibility from political decision-makers to the market adequate, accessible information on the market is essential. Information is a prerequisite for the localisation and enhancement of recycling, whether this is achieved through internalisation of externalities and/or price premium (3, 5, 11). Information on impacts and appropriate standards add to social sustainability by enlarging the means of influence of those with little control of the market (e.g., individual farmers and consumers) (5). Consumers and other actors in the market have diverse values, and to accomplish their citizenship they should be able to make informed choices on the basis of their own value judgements (5). In this vein, the Bichel report concluded that a growing organic market depends on consumers' own values being the basis for choices (BICHEL, 2001). Information about the impact of local food choices, especially the impact on the local economy, would increase the market and improve the opportunity for price premium on local food. This impact was, namely, considered important by the actors in the present study (3). Similarly, information about the health and environmental aspects of organic food appeared to play a role in persuading consumer decisions (11). Lack of commitment to consumer-citizenship

was seen as a contributor to ignorance. Actors mentioned schools as an important forum of education for the accomplishment of citizenship through food choices (5). In a similar way, Winne (2005) and Lacy and Lockeretz (1997) argue that education of "food competent citizens" is central to the promotion of a more sustainable food system, or as Kloppenburg at al. (2000) put it, "becoming activated as citizen-eaters".

Appropriate standards are a prerequisite to conscious choice (2, 3, 10, 11) and also form the basis for market information and potential price premiums that will promote the supply of local, recycling (organic) food. Less detailed and more principle-oriented standards for organic farming, as also noted in the European Action Plan for Organic Food and Farming (EC, 2004), would decrease the main restraint on increased organic production, i.e., too detailed and inappropriate regulations and bureaucracy (10). The recent reformulation of the IFOAM Standards (IFOAM, 2005) offers a good basis for this. Allowing adaptation to local conditions, and setting requirements for recycling and locality, would enhance the availability of local organic food. A label for local, organic food has been proposed by Forsman and Paajanen (2002), and environmental and social labelling, to complement the direct communication in the chain, by Sundkvist et al. (2005). To take full advantage of the benefits of localisation to the local economy, it was found by the present study to be crucial, that local labels give information on locality of several stages of the food chain including production of raw material and other inputs, for example feed and energy.

Changing consumption behaviour is often proposed as the tool to increase sustainability of food systems (e.g., Heller and Keoleian, 2000). Previous studies too have shown origin/locality to be a more important aspect than the production mode for consumers (e.g., Isoniemi et al., 2006). In addition, local food arose more negative images among consumers in the capital region of Finland than in other parts of the country, suggesting the greater potential for local food in rural food systems. Besides the perceived problems of high price, poor availability and inappropriate quality, local food was also poorly recognised (Isoniemi et al., 2006). Mere consumer information seems not to be sufficient for sustainable consumption, however. Other information may catch a person's main attention and affect behavioural choice (Biel et al., 2005; Shepherd et al., 2005). In addition to the institutional and economic barriers (see Internalising externalities a second key solution), consumer lock-in is created by social and psychological ones such as habits, routins, social norms, expectations and dominant cultural values (Stern, 2000; Bagozzi et al., 2002; Jackson, 2005). Yet, little attention is given to information directed toward changing habitual behaviours.

Change of existing behaviour usually requires that the behaviour is raised from the level of practical consciousness to discursive consciousness, or become an object of conscious analysis and questioning. Behaviour can, however, also change preceding the attitudinal change. For example, an imposed change in services like in municipal waste

collection may lead to a slight change in self-perceivance even "spilling over" into other behaviours (Jackson, 2005). In fact, other ways of learning than through information campaigns (e.g., through trial and error or by model) are known to often be more effective. Because consumer behaviour is created in social and institutional contexts rather than being the result of independent individual choices, behavioural changes may be more achievable at the collective, social level.

This underlines the need for policy intervention in the social and institutional context, including market structures, business practices, helping communities to help themselves and the environmental and social performance of governments (Jackson, 2005). This need was expressed by the actors of the alternative food chains in the case food systems of the present study also.

More research is required about, what kind of information is needed by consumers and other actors interested in conscious food choices based on their value considerations, and to generate that information. Better understanding of the effective means to learn about informed choices, would be of great value. In addition, a good understanding is required of the institutional and social constraints and means to remove them in the interests of sustainable eating.

Comparative analysis of the case food systems

The regional imbalance between crop and animal production is a significant obstacle to localisation and recycling in Denmark, Finland and Sweden. Recycling within farms and local food supply face more problems than in Poland and the Baltic countries, where mixed farming is more dominant. Added to this, the present extensiveness of agriculture in Poland and the Baltic countries means that effective recycling would result in marked increase in productivity at no extra cost. While cooperation between farms in recycling is not so crucial in these countries, it might give rapid profits in the sharing of machinery, for example.

In the industrialised Baltic Sea countries, the demand for organic food based on recycling is faced with problems such as strict and ineffective regulations, lack of standards for local food, lack of information appropriate to the perceived value priorities of the actors, and inadequate education of citizen-consumers. In the less industrialised countries, exemplified in eastern and southern Poland, food chains tend to be more local; there the main problems are poor purchasing power and lack of basic product information, and therefore lack of supply and market for organic products in particular. Thus, a change in price relations through internalising the externalities and supplying basic information on the impact of local organic food and production would be the solutions best able to facilitate localisation and recycling in Poland and the Baltic countries. Development of local and regional processing and cooperation among the local actors of the food chain would be important in all rural areas around the Baltic Sea.

In the Swedish case (Järna), a higher rate of consumers and other

actors stressed the importance of local organic food than in the Finnish case food system (Juva). Especially the environmental and social performance of recycling organic production and its impact on local economy and vitality was perceived by actors more positively. The difference is evidently due to the values of the anthroposophic movement in Järna, and the longer history of the local organic initiative dating back to the early 1960'ies. The change in values and attitudes is a long-term process: according to the actors, a clear increase in the demand was perceived as late as in 1999 and 2000.

The differences in importance of the obstacles and solutions in countries of the Baltic Sea drainage area primarily reflect differences in the stage of industrialisation rather than geographical, ecological, demographic or cultural features. Thus, though viable solutions may vary in the short term, in the long term the same guidelines for development will apply over the whole area. However, the practical solutions and issues (type of products, method of delivery, pricing) will likely need to be tailored separately for each community (Stephenson & Lev, 2004).

Sustainable localisation and recycling

Investigation of the impacts of localisation and recycling and consideration of the obstacles and solutions for enhanced localisation and recycling, as reported above, suggest the following synthesis in regard to achieving sustainable rural food systems around the Baltic Sea.

A sustainable way of localising and recycling in Baltic rural food systems would be recycling of local organic fodder and manure between farms in close vicinity through a tight cooperation or local markets, complemented by recycling from the demand chain in form of bio waste and urine. The food system, including processing, would rely heavily on local, renewable energy. Sufficient shares of local organic food, together with choice of low-energy vehicles, would ensure good energy efficiency in transportation. All stages of the food chain and inputs to it would be local. Depending on the population density, markets might be extended outside the local rural community to allow sufficient scale from the firm economy point of view and to ensure supply to urban communities and regions with insufficient local production.

The solutions that were identified to generate benefits for all the dimensions of sustainability (win-win solutions) are 1) partnership, i.e., cooperation, with equity in influence, among food system actors locally, within the region and between countries; 2) internalising of externalities, i.e., increasing price according to ecological and social costs and reducing price according to the ecological and social benefits; 3) information in the form of standards for local organic recycling production and labels that inform about locality of most of the stages of the food chain.

Interdisciplinarity

As well as the primary, instrumental objective of answering the common research questions of the mainly multidisciplinary BERAS project, the

interdisciplinary work had the epistemological objective to learn from failures and successes and to develop the interdisciplinary approach in research on food systems. In pursuit of the latter goal a critique of the interdisciplinary process is presented below in terms of the success of the process, quality of the research and suggestions for the future.

Success of the process (for the generic model that was followed see *Material and Methods*, *Interdisciplinarity*).
The classic model of the interdisciplinary process (Klein, 1990; see Material and Methods) could not be applied in its entirety since the interdisciplinarity came late in the project and, related to this, there were shortcomings in commitment, understanding and experience. For the most part, it was necessary to rely on the ongoing studies, without the ability to direct the work to prespecified common questions. The short presentations and discussions, formal decisions, group work and workshops were not sufficient to convince everyone of the usefulness and feasibility of the interdisciplinary approach, nor of the suitability for scientific publication. Thus, the interdisciplinary process was weakened by the only partial commitment of the researchers, the insufficient time invested in the process and learning and the inexperience in communicating and making oneself understood across disciplines.

The disciplinary organisation of the work packages and working groups was a disadvantage, as was the imbalance in resources and timing between the disciplines. The latter resulted in insufficient opportunities for interaction between the disciplines in the course of the work, even at the interpretation and publishing stages. The international character and large size of the group made the process still more challenging. Because of the perceived secondary importance of the interdisciplinary process, the possibility to exchange views by e-mail was not fully exploited. Also, conflicts in roles arose as a result of the delayed adoption of the effort, varying devotion and the subsequent separate coordination of the interdisciplinary work. A coordination group formed of the work package leaders for coordination together with the coordinator of the interdisciplinary work, could have been helpful. Despite all this, the process was completed, increased the congruity of the disciplinary work and thus the synergy attainable and resulted in interdisciplinary conclusions. Not least, the process was a useful learning experience.

Quality of the research (for the three quality criteria applied see *Conceptual Framework*, *Interdisciplinarity*).
(1) Consistency with the separate disciplinary antecedents was not the foremost challenge in the study since the main approach of the BERAS project was multidisciplinary, and most of the work was performed within separate environmental, economic and social teams. However, if discipline is defined in the narrow, traditional way, there were researchers from several disciplinary backgrounds in each team. And the economic team, in particular, adopted the approaches of several

disciplines. Thus, in many cases the mediation of the disciplinary tradition depended on one or a few people only, but these individuals had compensating connections to their disciplinary institutions with their scientific communities.
(2) Achieving balance in weaving together perspectives was a problem of the original multidisciplinary study, in the interdisciplinary work. A major reason for this was the project plan and resources which were biased toward certain disciplines and toward the ecological dimension of sustainability. In the end, a fair balance was achieved, thanks to the hard and successful efforts of the teams with least resources. And, in the end, it was not difficult to construct a coherent whole based on the common, interdisciplinary research questions.
(3) Effectiveness of the integration of the different disciplines for advancing understanding, as compared with the situation in which the disciplines work separately, is the ultimate quality criterion of interdisciplinarity. Only effectiveness justifies the effort. The study was successful in this respect. A view of sustainable localisation and recycling in rural food systems was formulated, including obstacles to and means to achieving this, taking into consideration the different dimensions of sustainability. A merely multidisciplinary study would have resulted in contradictory conclusions on the impacts of localisation and recycling on sustainability (especially from the firm economy perspective vs. the ecological and social perspectives) not allowing the further step. Also, different ideas about the sustainable way to localise and recycle would have been raised in different teams. Means to promoting sustainability in all three dimensions simultaneously were identified. The most important of these were partnership and internalisation of externalities. Their priority over alternative solutions, and their key importance and forms, could not have been resolved without interaction between the dimensions of sustainability and thus between the disciplines and researchers representing them.

Ways to improve interdisciplinarity

The disciplinary tradition in science embracing education, conventions, evaluation by financers, publishing channels and the merit system, is so strong that disciplinary work will always be prioritised if included in a plan. For interdisciplinarity to be really fruitful, disciplinary work must be consciously discouraged at all stages of a project. Ideally, the project should be planned in interdisciplinary interaction and be primarily interdisciplinary in objectives and content, organisation and publishing. A shared understanding of interdisciplinarity and its requirements and a full commitment to the interdisciplinary approach should be sought among the contributors at the outset of the planning process. There should be balance in perspectives of the involved disciplines and correspondingly, of the researchers involved in formulating of the goal or problem and research questions or hypotheses, as well as in choosing the material and methods. A well-balanced distribution of resources among

the disciplines is preferable unless the character of the substudies dictates otherwise. An interdisciplinary organisation of a study involving only interdisciplinary work packages or tasks organised around interdisciplinary research subquestions or subhypotheses and multidisciplinary teams would create the best starting point for interdisciplinary work. Special communication tools like collaborative development of conceptual models were useful not only to relieve formulating questions, clarifying system boundaries and identifying gaps in data, but also revealing the thoughts and assumptions of fellow scientists across the disciplines (Heemskerk et al., 2003). Similarly, it would be best if only interdisciplinary reports and papers were included in the plan.

It has been proposed that agroecology could be developed and defined as an embracing discipline for studies on the entire agrofood system in all its dimensions (e.g., Francis et al., 2003). A transdisciplinary approach or new, common theory and methodology for an emerging discipline, was not found necessary in the present study. Rather, the results and conclusions have benefited from the accumulated knowledge, methodologies and traditions of the contributing disciplines. The greatest value of any emergent, integrating discipline in the present study would have been in establishing a common language and concepts for the participating researchers. A good alternative to this is gaining proficiency in interdisciplinarity through deepened understanding of the philosophy and theory of alternative approaches and methodologies in science, through development and adoption of procedures and tools for communicating, and through practicing interdisciplinarity as part of researcher education. In accordance with Heemskerk et al. (2003), the present study points to that in many cases, interdisciplinarity would supply a broader and more flexible selection of the expertise and methods required for a sound result than would reliance on the continuous creation of new disciplinary approaches. This is true especially given the time frame of one study and the continuously evolving research needs and objectives.