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

*John Sumelius (ed.)*



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

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*Centrum för uthålligt lantbruk*



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

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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).

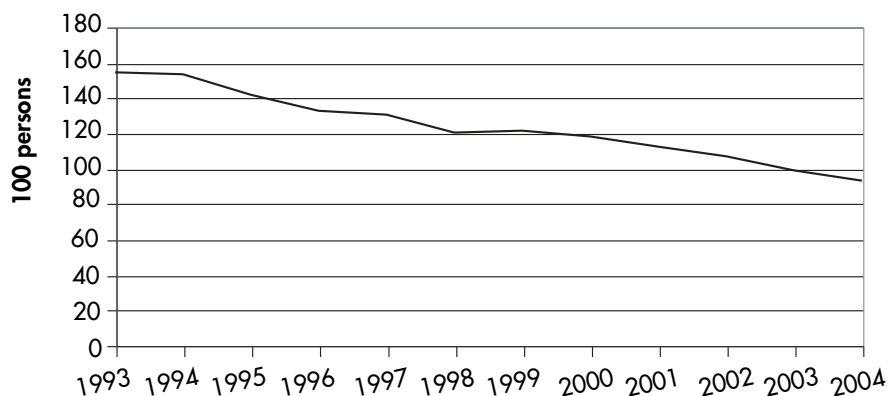


Figure 1. Employment in agriculture (including fishing and hunting) in Finland, 1993 – 2004 (Statistics Finland 2005)

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

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.<sup>1</sup> 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-

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<sup>1</sup> 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.

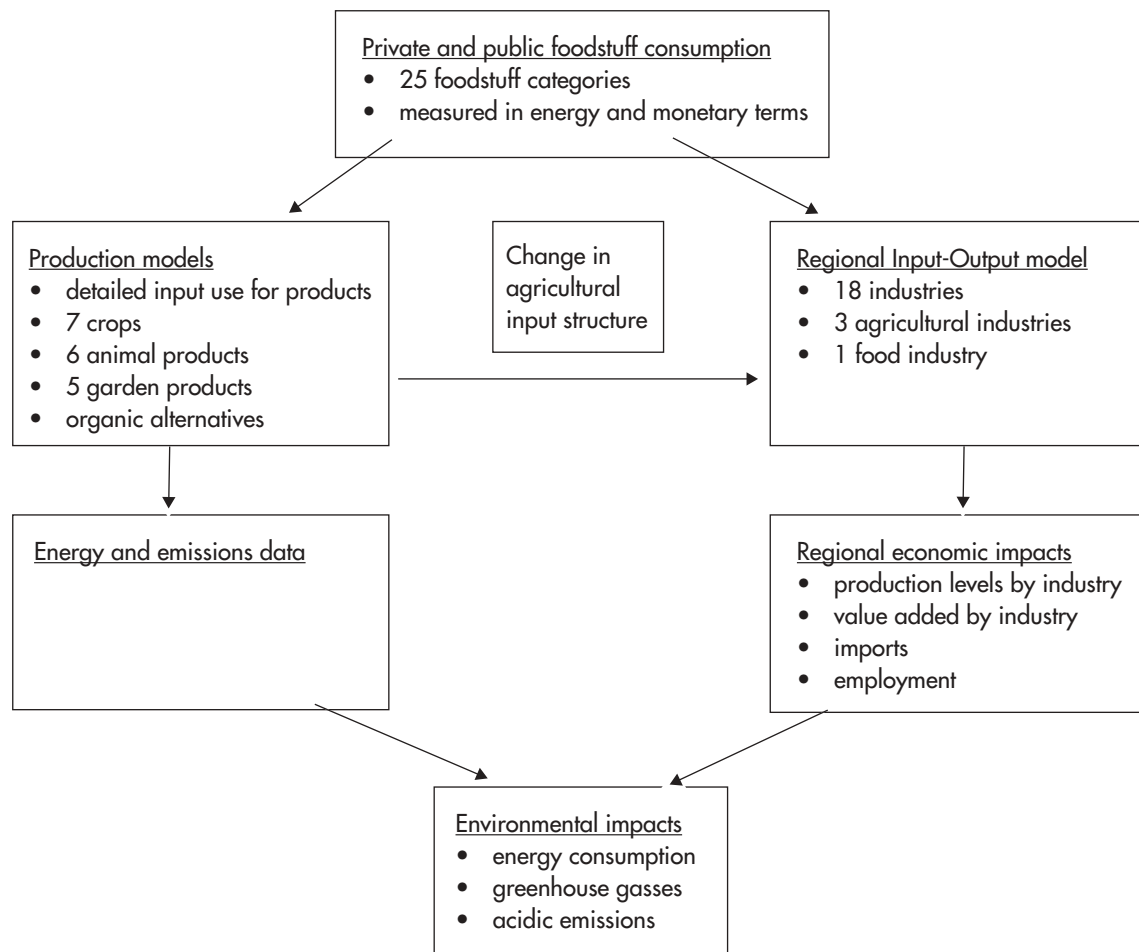


Figure 2. The structure of the RegAE model.

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 ( $z$ ).

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

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.

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

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:

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

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

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



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

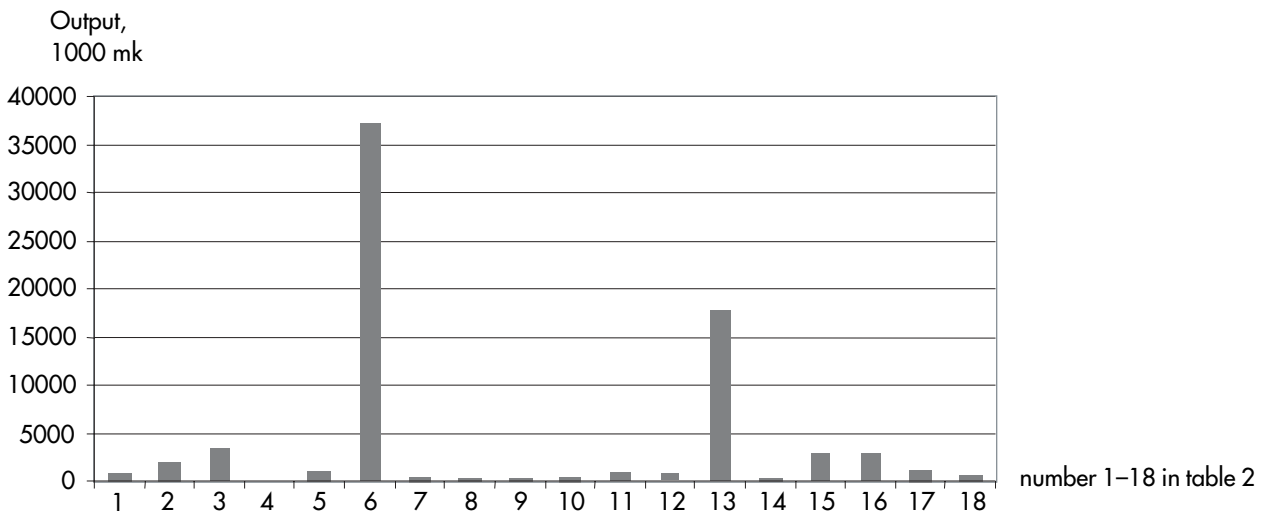


Figure 3. Growth of output by industry as a result of a 5% increase in regional foodstuff demand, A1, 1000 mk.

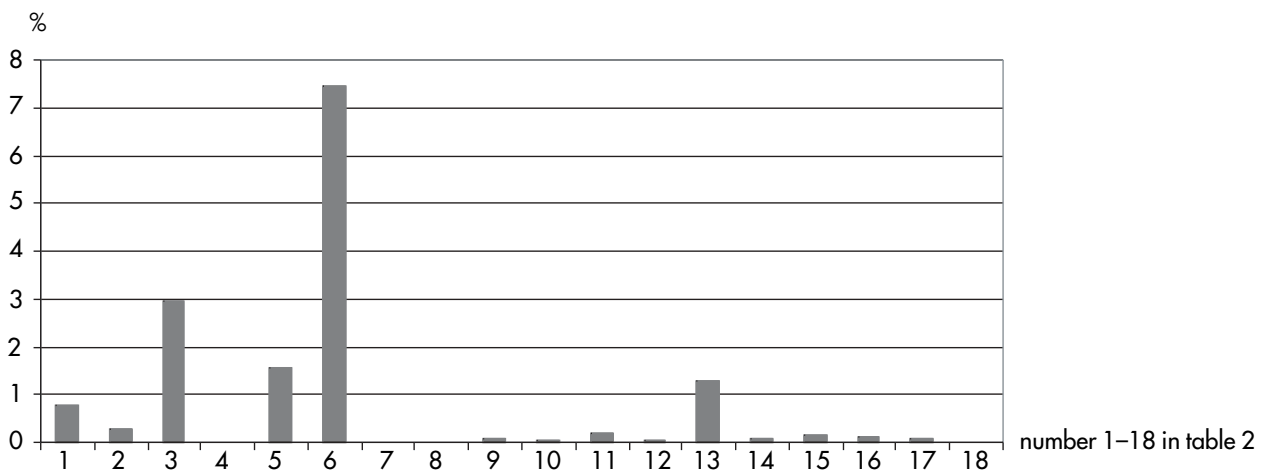


Figure 4. Growth of output by industry as a result of a 5% increase in regional foodstuff demand, A1, %.

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 exogenous 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.).

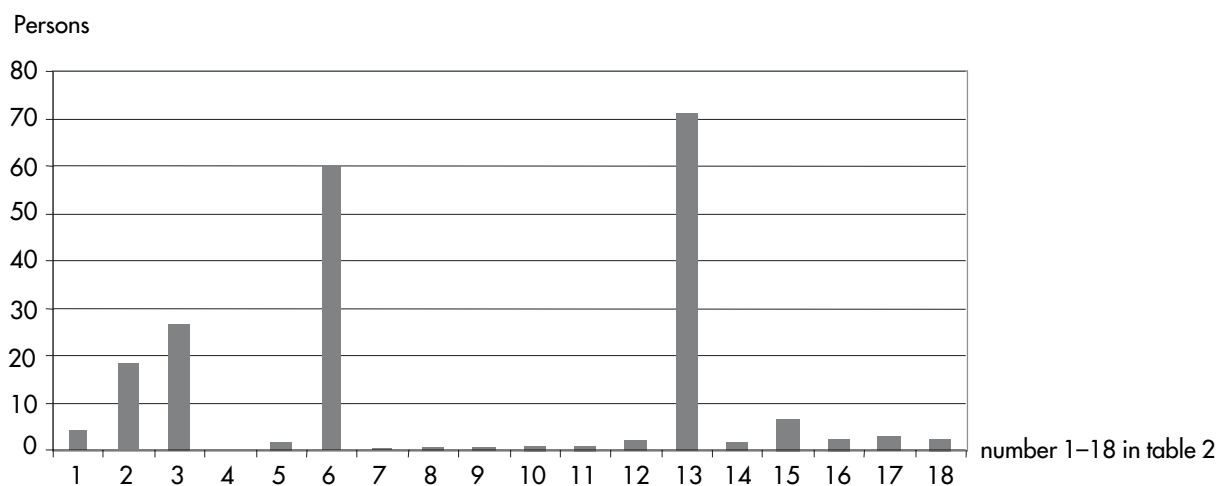


Figure 5. Growth of employment by industry as a result of a 5% increase in regional foodstuff demand, A1, persons.

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).

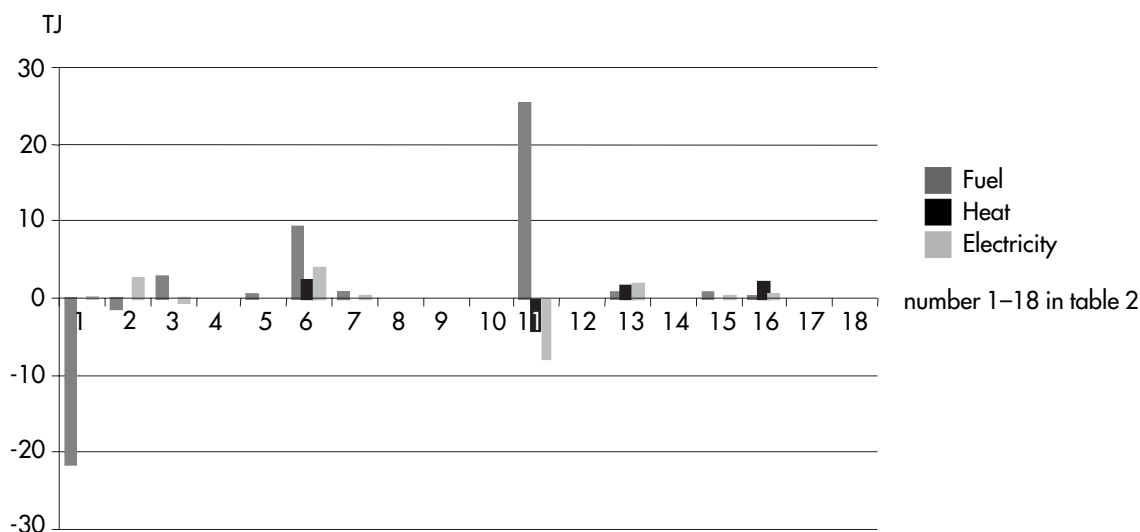


Figure 6. Consumption of energy as a result of a 5 % increase in regional demand, A2, 15 % organic.

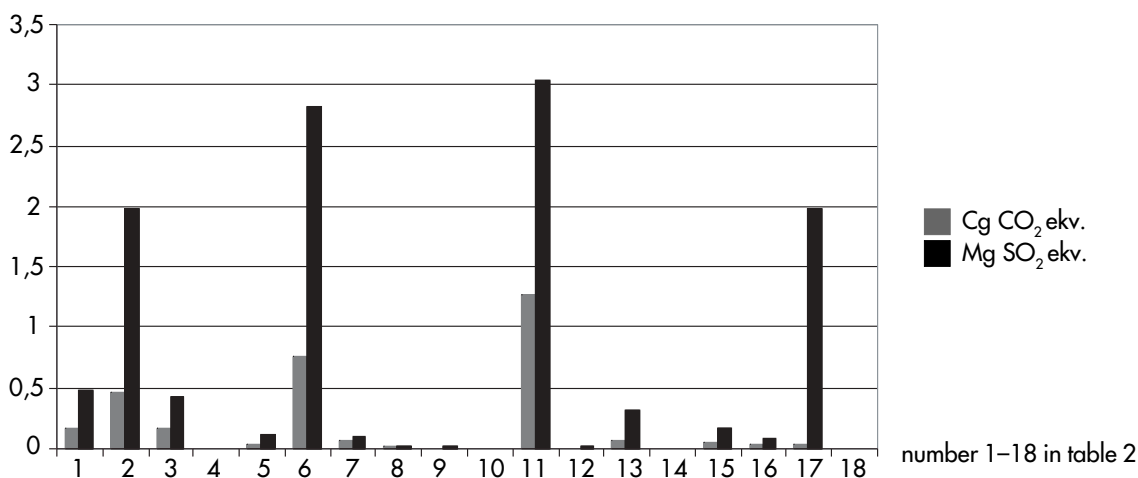


Figure 7. Acidic emissions and greenhouse gas emissions as a result of a 5 % increase in regional demand, A2, 15 % organic.

## 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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