

A paper to be presented in the Fourth European Symposium on European Farming and Rural Systems Research and Extension, in Volos, Greece, April 3 to 7, 2000.

Workshop "Learning Processes in Research and Extension".

## **Activity Theoretical View on Crop Rotation Planning in Organic Vegetable Farming**

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**03/30/2000**

### **Abstract**

Crop rotation is an essential basis of an organic farming system. An activity theoretical concept of object shall be used in examining planning processes of crop rotations. Farmers' object construction means their creating and maintaining the social meaning and purpose of the material farming activity. I shall assume the farmers' object construction in planning crop rotations to reflect their overall object in organic vegetable farming. First, this paper examines theoretically the object in organic vegetable farming by devising a framework of different types of object constructions. Second, two farms with organic vegetable production will be described, and the farmers' objects will be shown in the light of the histories of the farms. This will show that the different types of objects have not evolved at random. Third, the dynamic movement of the object construction in the crop rotation planning processes is explored. The results will show that the farmers' object, although historically understood, is not fixed. On the contrary, the object is in a constant move and even contradictory.

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## 1. Introduction

With the integration to the European Union, Finnish agriculture is going through an intense change. In a short period of time, organic agriculture in Finland has transformed from a farmers' movement to an institutionalized part of agricultural policy. In 1998, nearly 6 % of the Finnish farms were converted to organic production (Sirén 1999). This paper deals with organic vegetable farming. It is still undeveloped in Finland, owing to the fact that the actual cultivation techniques require a lot of manual work, and, partly, because the subsidy policy does not encourage organic vegetable farming (Koikkalainen 1999, p.73). But organic vegetable farming is on its way to a more specialized, mechanized production.

Röling and van de Fliert (1994, 96) suggest that "Sustainable agriculture is not an 'innovation' that farmers 'adopt'. Changing to more sustainable practices is more like a paradigm shift, involving a learning path leading to new perspectives on risk avoidance, new professionalism, a greater reliance on one's own expertise and observation...". By analyzing crop rotation planning, this paper examines this learning path of the farmers. Rather than starting from predetermined goals to learn, the farmers' learning is looked at within their object construction in planning crop rotations<sup>1</sup>. This paper assumes organic farming to be an attempt towards sustainable agriculture.

In the next chapter, the concepts of object construction and crop rotation will be dealt with. After that, a theoretical model of different types of object construction of organic vegetable farmers will be created. Two farms as research sites will be described in chapter 4, and chapter 5 gives an overview of the crop rotation planning processes on the two farms. In chapter 6, the dynamics of object construction within the planning discussions will be analyzed. In the end, I conclude, what the dynamics of object construction mean for the farmers' learning.

## 2. Object in planning a crop rotation

What is an object? According to Webster's dictionary (1987, 257), an object is both "anything presented to mind or senses" and "an end or aim". It is an important concept in activity theory (Vygotsky 1978, Leont'ev 1978, Engeström 1987).

"So the object is both something given and something projected or anticipated. This very duality of the meaning of the term indicates that the concept of object carries in it the processual, temporal, historical nature of all objects. Objects are objects by virtue of being constructed in time by human subjects. This in no way diminishes their reality and materiality. But despite its materiality, an unknown particle or a mineral in the rock is not object for us before we somehow make it our object - by imagining, by hypothesizing, by perceiving and by acting on it." (Engeström 1990, 107)

The object is always part of a collective human **activity**, and part of the material world as well. The object of organic farmers consists of what they are working on, like soil and plants, vegetables and customers. The object is heterogeneous and farmers construct it in different ways. The societal motive, why vegetables are cultivated in organic way, is embedded in the object. In object construction, the farmers constantly reproduce, or change, the farming activity.

Learning may occur at several levels. Everyday problem solving means learning on the level of actions, such as buying a fax machine to facilitate communication with customers. But sometimes it is not enough to solve everyday problems only: the whole farming activity has to

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<sup>1</sup> In activity theory, an object refers to a collective activity, and a goal to individual actions.

be perceived differently than before. In other words, the object of farming has to be constructed and understood in a new way.

The role of crop rotation is crucial in organic farming (Council regulation (EEC), 1991). In planning the crop rotation, a sequence of crops is formed that would benefit the yields and sustain the farming system. Especially important is the use of green manures with nitrogen-fixing legumes, such as clover or vetch, in order to produce locally this important nutrient for plant growth. Besides nitrogen production, green manures have many other beneficial effects in the farming system, like maintaining the soil structure. Crop rotation is often represented as a table for several years (see table 3). A successful crop rotation plan makes all the elements of the farming activity fit together. The way different elements are taken into consideration depends on farmers' construction of the object: To what extent are the customers part of the object? Is the environment, such as the water courses outside the farm, considered? Because the crop rotation has a crucial role in organic farming, I shall assume that the way the farmer constructs and plans crop rotation, reflects his or her way of constructing the overall object in organic vegetable farming.

Crop rotation requires a longer time perspective than one productional year. "An organic farmer must always look ahead over at least one year, when choosing, for instance, crops for the next growing season, while in the conventional production, solutions can be made for one growing season only" (Partanen 1999). The paradigm change from conventional to organic being a vast one, learning and managing crop rotations is not always easy for the farmers. Crop rotation plans have an institutional role as well: A crop rotation plan for at least five years is required for the status of an organic producer, and the changes in crop rotation plans must be confirmed by the authorities.

For finding out different types of objects within organic farming, I have outlined two dimensions of the object. The first one, drawn from the history of sustainable and organic farming, I shall call **sustainability in resource use** (fig.1). An ecological and sustained use of soil, energy and other natural resources is crucial in sustainable agriculture and organic farming (Helenius 1998, Granstedt 1999). In sustainability, the use of local resources and natural processes is preferred to external inputs (Altieri and Rosset 1995, Pretty 1998, 26).

The other dimension, which is drawn from the history of Finnish agriculture, I shall call **entrepreneurship and customer-orientedness**. Agriculture has been a protected sector in Finland for a long time, and therefore, entrepreneurship and customer orientedness are relatively new learning challenges for farmers. (Katajamäki & Kaikkonen 1992, Routamaa & Vesalainen 1992). Entrepreneurship has been studied in many ways (e.g., Sireni 1996, Levander 1998, Turkki 1998). Here, I shall concentrate in the customer orientedness, because farming is economically dependent on demand, and taking into consideration the customers' needs is essential in entrepreneurship. Marketing is especially important in horticulture and vegetable production. In the latter, subsidies play a role in the economy, but they are not pivotal.

### 3. Theoretical framework

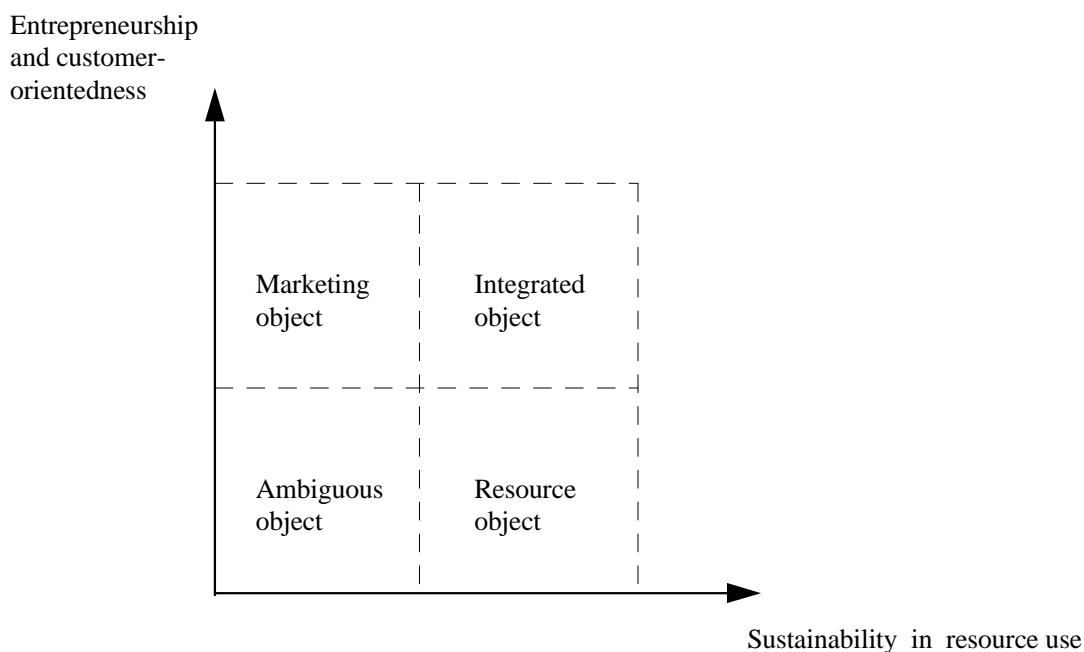


Fig. 1. Four types of object construction in organic vegetable farming.

Theoretically, four different types of objects of organic vegetable farming can be found within the matrix formed by the dimensions "entrepreneurship and customer-orientedness", and "sustainability in resource use":

1. *Ambiguous object*. Farming is oriented neither towards sustainable use of resources nor towards customers. The so called "quasi farmers" (Peltola 1999), converted to organic farming in order to maximize the subsidies, can be grouped here, as well as traditional farmers interested mainly in maintaining the old rural lifestyle. The time-dimension in the planning is short, consisting mainly of one-year productional cycle.

2. *Resource object*. In this type, farmers are mainly concerned about the maintenance and improvement of natural resources, like soil fertility. Crop rotations are considered as an essential tool in this. A prolonged time perspective, important in planning and implementing crop rotations, corresponds to the old peasant time conception over generations (Kuisma 1992, 10). The linkage of the production to the markets is not playing an important role.

3. *Market object*. In this type, economics and entrepreneurship are emphasized. The customers and the products with organic label are of importance to the farmers. The time perspective is short. The ecological ways of resource use, such as crop rotations, are considered as a rule limiting the marketing possibilities.

4. *Integrated object*. The sustainability of resource use is not opposite, but an intergral part of marketing the products. Crop rotation brings continuity to production and quality to the products. The time perspective is long and exceeds the short term marketing possibilities. Here, integrated means that there is a fruitful integration of organic ideology and sound microeconomics (see also Kallio 1998, 112-113).

#### 4. Research sites

The empirical data in this study come from two farms producing organic vegetables. They both converted to organic farming in 1991 and started with field vegetable production some years later.

The Kola<sup>2</sup> farm with nine hectares of fields, used to produce flower bedding plants in greenhouses. The growers, Maria (49) and Kai (60), have been running a horticultural enterprise rather than a farm. Entrepreneurship is important in the object of the farming activity of the Kolas.

LS: What is best, in your mind [in being a farmer, LS]?

Maria: What would be the best? Surely, it must be the same as in entrepreneurship in general, that you can be your own master.

(Maria Kola 14.4.1997)

The crop rotation carried out on the Kola farm, after the clover ley during the conversion period, has been quite intensive (table 1). The farmers themselves sell the vegetables to retail markets. Based on the crop rotations and on the conceptions about entrepreneurship, the Kolas can be grouped into the “Market object” type in figure 1.

Table 1. Examples of the crop rotations carried out on three field plots on the Kola farm.

Year	Field plot 1	Field plot 2	Field plot 3
1994	Clover ley	Clover ley	Clover ley
1995	Potato	Potato	Clover ley
1996	Potato	Various vegetables	Onion
1997	Onion	Onion, leek	Carrot

The Alanen farm, with 22 hectares<sup>3</sup> of fields, has its history in conventional milk production. The farmers, Antti and Eeva, are around 40 years old. Eeva works outside the farm. The continuity of the farm over generations is important to Antti, which is reflected in his ideas of maintaining and improving the soils.

LS: What is best in being a farmer?

A: Surely it is that you have such a living element, like soil. It is totally different than to cut iron or the like (...) and it is continuous, like the leaven of bread, which is tens and tens of years old, maybe not even from this century (...)

(Antti Alanen 11.4.1997)

The crop rotation carried out on the Alanen farm is based on perennial green manures (table 2). They belong to a marketing company which is owned by farmers and sells vegetables to wholesale markets. In addition, potato is sold to local customers of the municipality. Because the soil fertility is of such importance to Antti Alanen, and because of the extensive crop rotation (table 2) of the farm, I consider the Alanens to represent the resource-type of the object (figure 1).

Table 2. Examples of crop rotations carried out on three field plots of the Alanen farm.

Year	Field plot 1	Field plot 2	Field plot 3
1994	Potato	Barley with undersown	Clover ley
1995	Barley with undersown	Clover ley	Vegetables and potato
1996	Clover ley	Clover ley with chinese cabbage	Barley and undersown
1997	Clover ley and chinese cabbage	Potato	Clover ley

<sup>2</sup> The names are fictional.

<sup>3</sup> In 1997, the average field acreage on Finnish farms was 24 hectares (Sirén 1999).

## 5. Planning processes

The data of this article consist of audiotaped crop rotation planning discussions and documents. On the Kola farm, three hours of discussion was audiotaped at the planning meeting on March 27, 1998. On the Alanen farm, the data were gathered from six planning discussions about crop rotation, during a period of nine months (from July 1998 to May 1998). The audiotapes were transcribed. First, the planning processes, described below, were analyzed by finding the grounds for different proposed crop rotation plans.

Until the end of 1997, greenhouse production was the main income of the Kola farmers. In 1996, they had rented 5,5 hectares more of fields. In autumn 1997, the greenhouses were taken down - the Kolas had to rely economically on organic vegetable production. They were pursuing larger and mechanized vegetable production. According to their old plan made by an advisor, their own fields were going to be covered, to a large extent, by green manures. Maria and Kai were worried about the next summer 1998, how the new unknown rented fields would produce in a situation of increasing demand of their products. Therefore, they wanted to devise a new crop rotation plan.

The new crop rotation was planned on March 27th, 1998. Besides Maria and Kai, a relatively new advisor from the rural advisory center and myself were attending the meeting. After the crop rotation model, or sequence, was ready, the fields of the farm were divided into six groups, in order to correspond to the six-year rotation scheme. Finally, the crop rotation was placed, rather mechanically, to the fields for the next five years (table 3). The planning process has been reported elsewhere (Seppänen 1999).

Table 3. The outcome of the planning in a simplified form: the crop rotation scheme for the next five years for the Kola farm. The rented fields are shown in white and the farm's original fields in shaded rectangles. (The column 1997 shows the preceding crops).

<b>rotational turns:</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>
<b>1.</b>	perennial green manure	vegetables	vegetables	annual green manure	vegetables	perennial green manure
<b>2.</b>	vegetables	annual green manure	vegetables	perennial green manure	perennial green manure	vegetables
<b>3.</b>	perennial green manure	perennial green manure	vegetables	vegetables	annual green manure	vegetables
<b>4.</b>	vegetables/ green manure	vegetables	perennial green manure	perennial green manure	vegetables	vegetables
<b>5.</b>	vegetables/ green manure	vegetables	annual green manure	vegetables	perennial green manure	perennial green manure
<b>6.</b>	vegetables	perennial green manure	perennial green manure	vegetables	annual green manure	vegetables

On the Alanen farm, a reason for changing the existing crop rotation plan was the unbroken tufts of clover, grass and soil, that bothered the tillage and planting in July 1997. This prompted the idea of having vetch (*Vicia sp.*), instead of perennial green manure, as a preceding crop for chinese cabbage. This was the only time in the planning process that Antti thought of starting a more intensive rotation with annual green manures. Also Antti wanted to include rye in the rotation. Before sowing the rye in autumn, the spring and summer season could be used for soil improvement by controlling perennial weeds and picking up stones, if necessary.

On August 15, the same year, the new crop rotation plan was shortly discussed during organic inspection. The inspector indirectly regarded Antti's rotation plan with vetch as too short. In the telephone conversation of January 28, 1998, between myself and Antti, one of his main concerns was how to get rid of the unprofitable barley as a companion crop in establishing the leys<sup>4</sup>. A separate rotation without potato or chinese cabbage was planned for some rocky, hilly or remote fields. The crop rotation planning was continued in another telephone conversation on February 2, 1998. On May 18, when I visited the farm, Antti's plan was ready. The new innovation was to establish the ley to rye, without barley as a companion crop. The outcome, the five-year crop rotation, was:

1. Fallow and sowing of rye and grass
2. Rye and sowing of clover
3. Ley
4. Ley and chinese cabbage
5. Potato

## **6. The dynamics of object construction in planning crop rotations**

Later, part of the data were analyzed paying special attention in the discussions to ideas in resource use and customer-orientedness. On the Kola farm, this was done starting from the first part of the planning meeting all the way through until the final crop rotation model was ready. On the Alanen farm, this was done of a one hour and 40 min long telephone discussion between myself and Antti, on January 28, 1998.

The farmers' ideas brought up in the conversations showing customer-orientedness or resource use are represented as arrows in figures 2 and 3. In this way, the arrows show the dynamics in the object construction of the farmers. The arrows are numbered in the temporal sequence the ideas appeared in the discussion. Because there are so many ideas and arrows, in this paper I shall describe and discuss only the ideas that are most interesting from the activity-theoretical point of view. These are the ideas that were moving the object to opposing directions of the same dimension, and therefore, they show the contradictory nature of the object. On the Kola farm, the interesting dimension is the sustainability in resource use (arrows 1, 2, 4, 5 and 7 in figure 2). On the Alanen farm, it was the dimension of entrepreneurship and customer orientedness (arrows 3, 4, 7, 8, 9 and 10 in figure 3).

The Kola farm

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<sup>4</sup> Ley here means perennial green manure, the yield of which is sometimes exchanged to farmyard manure with cattle farmers, but is mainly used for fertilization and soil improvement purposes.

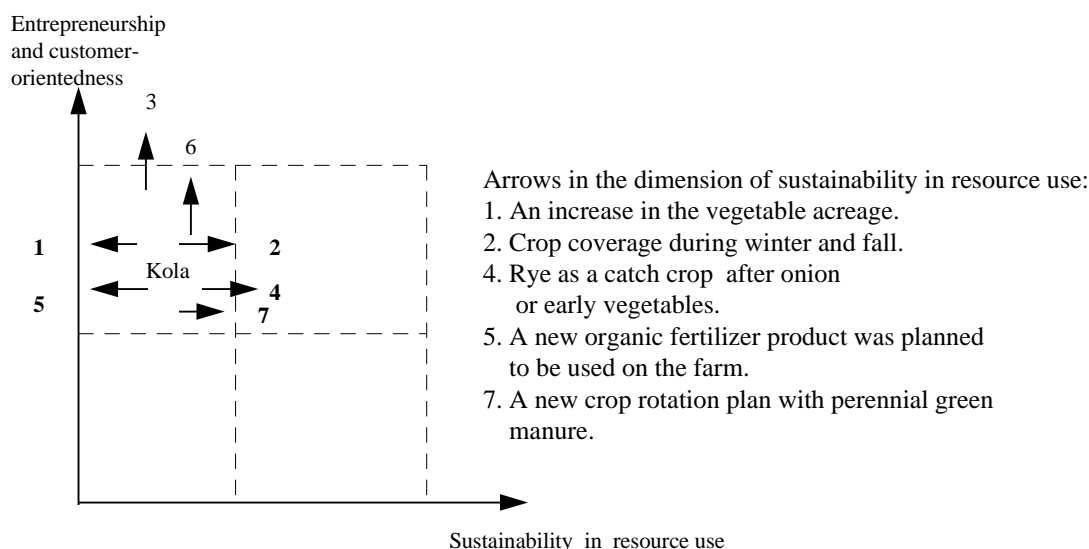


Fig. 2. Dynamics of object construction in planning the crop rotation on the Kola farm.

Maria and Kai Kola took into consideration the customers' demand in their crop rotation planning. They wanted to increase the vegetable acreage of the farm. Because vegetables are mainly crops requiring a lot of nutrients and labor, an increase in the vegetable fields means intensification in the resource use, and thus a move towards left in the framework (arrow 1, figure 2). The advisor was more cautious of increasing the vegetable acreage:

Advisor: Then if you increase [vegetable] land, it would be in the long run quite an exhausting rotation.

Maria: Yes I know that, and therefore I want us to ponder whether it is of any use to do it.

(27.3.1998)

Rather, the advisor thought it was important to have enough green manures in the crop rotation. She suggested rotations with perennial green manures, while Maria preferred annual ones:

Maria: And I see it at least so that, the experiences I have now from this vegetable farming, I would do it so, I don't know what you think, but just as we talked that even though it would be perennial, so, so, [cultivating it] as annual green fallow so that it would be ploughed in the fall, or done something to it that in the following [year] a new one, even though you would have the [extra] seed costs, but anyway we would then get more biomass and nitrogen fixed there.

(Maria Kola 27.3.1998)

The question whether to use annual or perennial green manures was acute in the planning discussion. The two types of green manure partly serve different functions in the field. Roughly, annual green manures have a quicker fertilization effect, while perennial green manures contribute to the nutrient supply during a longer period of time, and are also more effective in improving the soil structure. In the planning discussion, the dilemma was partly solved by including both a two-year perennial ley and an annual green manure in the crop rotation plan made. In this sense, the new crop rotation plan with perennial green manure was a move to the right in the dimension of sustainability in resource use (arrow 7, figure 2).

The main argument of the advisor for the perennial green manures was to keep the field covered with vegetation. The farmers took seriously and joined the advisor's concern about the crop coverage requirement<sup>5</sup>, and the meaning of perennial green manures in it (arrow 2, fig. 2). Crop coverage is meant to reduce the nutrient load on water courses and to use efficiently the nutrients within the farming system. Besides perennial crops or green manures,

<sup>5</sup> According to the Finnish General Agricultural Environment Protection Scheme, in Southern Finland, there must be a 30% crop coverage, or reduced tillage must be applied outside the growing season (Sirén 1999,67).



the crop coverage can also be obtained by using so-called catch crops<sup>6</sup>. The Kolas aim at producing early vegetables, after which it is relatively easy to sow rye as a catch crop. That way, the rye as a catch crop does not diminish the acreage within vegetable production (arrow 4, fig.2). Therefore, I have interpreted it as an initiative to the integrated type of object (fig.1).

One of the main ideas behind organic and sustainable farming is the efficient and sustained use of local resources. Earlier the Kolas had complemented the nutrient supply of their crops by farm-manure composts, the material of which was bought from local farmers. In the planning discussion, Maria and Kai Kola asked for an advice about the use a new fertilizer product manufactured from residues of food industry and imported to Finland from abroad. This is not an idea towards the normal conception of sustainable resource use and, therefore, it represents an arrow (5) to the left in figure 2. Altieri and Rosset (1995) distinguish between system redesign as a key principle in sustainable agriculture, and using inputs used in conventional farming. In the planning of crop rotation for the Kola farm, both of these opposing strategies were present.

### The Alanen farm

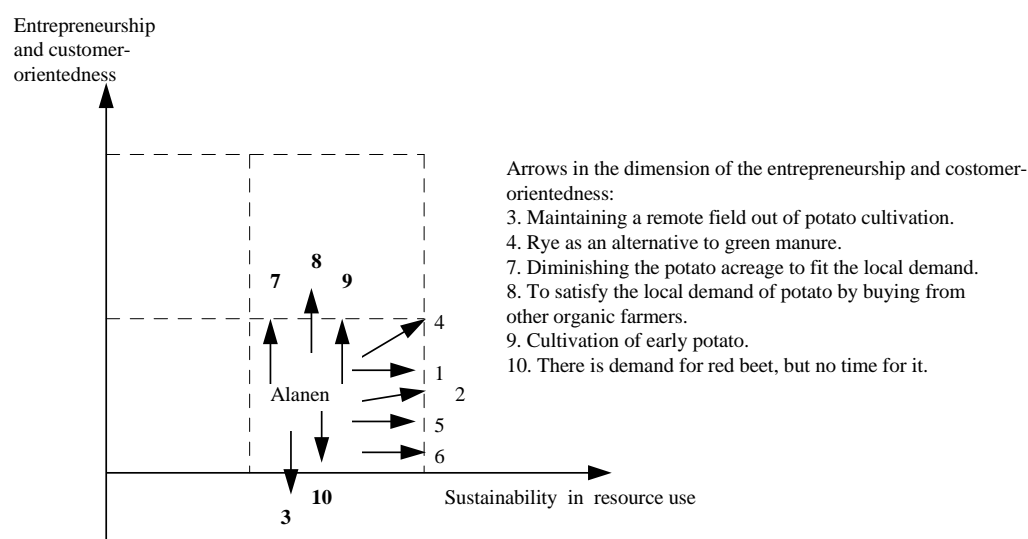


Fig. 3. Dynamics of object construction in planning the crop rotation for the Alanen farm.

At the moment of planning the crop rotation for the Alanen farm, there was demand for organic vegetables, and the local marketing company was encouraging the members to produce more vegetables. However, in the planning discussion, Antti repeatedly turned to rye cultivation instead of increasing his vegetable acreage. Rye seemed to be Antti's intermediate alternative to solve the contradiction between profitable, soil-consuming vegetables, and non-profitable, soil-improving green manures (arrow 4, fig. 3).

With the stony fields of the Alanen farm, Antti felt he could not compete in price with farmers of better regions, and therefore he thought of diminishing the potato acreage to fit the local demand. In this sense, he was oriented towards customers (arrow 7, fig. 3). Antti's idea of buying cheaper potato from other regions for his local customers is so customer-oriented

<sup>6</sup> A catch crop means that some crops, like grasses or cereals, are sown in late summer only in order to collect nutrients, that otherwise would run the risk of being leached to the water courses.

that I have interpreted it to cross the border to another type of object (arrow 8, fig.3). The cultivation of early potato was also a market-oriented initiative (arrow 9, fig.3).

There are two initiatives in another direction. In the first one, Antti opposed the idea of cultivating red beet, although it had a good demand (fig.3, arrow 10).

Antti: Yes, the red beet obviously (laughter) is in demand, but no, no, there is not enough time for that. (Antti Alanen 28.1.1998).

Antti did not want to have a remote field plot in potato cultivation (arrow 3, fig. 3), although the plot would have suited the purpose very well. The reason was that he wanted to preserve a stopgap for the survival of the family.

Antti: (...) potato would surely grow there [in the remote field, LS] very well, there has not been, what was it, between fifties and sixties potato has been grown there. But, it would be there as some kind of stopgap then, if there will be some problems here [on home fields, LS], so you could get at least a small acreage of potato, for not to die of hunger yourself. (Antti Alanen 28.1.1998)

This is oriented towards the old and fundamental self-sufficiency in agriculture, which contradicts entrepreneurship and customer-orientedness. Therefore, it crosses the border out of the framework of the study.

## 7. Conclusions

The ideas presented in crop rotation planning discussions show the potential alternatives in which directions the object of farming of the Kola and the Alanen farmers may be moving. At the time of crop rotation planning, the Kolas were facing remarkable changes in their farming. After the greenhouses were taken down, Maria and Kai wanted to extend their vegetable production. Not only were they facing the challenge of learning a more mechanized and large-scale organic vegetable farming, but also they had to learn to manage the new rented, unknown fields. The history of the farm having been in horticultural greenhouse production, the basic idea of crop rotation and green manures were also learning challenges for Maria and Kai. The planning of crop rotation helped the Kolas in this learning.

The Alanen farm did not face such radical changes during winter and spring 1998. Antti Alanen was not planning to extend the vegetable production, although the demand for organic vegetables was good. This could be presented as a third arrow downwards in the figure 3. The comparison of the results from the Kola and the Alanen farms show the heterogeneity of object construction in organic vegetable production. The continuation of the learning processes during spring and summer 1998 of the Kola and Alanen farmers will be analyzed further in the study.

The analysis of the ideas in crop rotation planning discussions shows that farmers are pondering on multiple and contradictory choices in constructing their object. This views learning as creation rather than adoption. The Kola farmers, representing the horticultural historical path to organic vegetable farming, were pondering on ideas which represent contradictory directions within the dimension of sustainability in resource use. On the Alanen farm, with its history in conventional milk production, the dimension of the entrepreneurship and customer-orientedness was the contradictory one. These results suggest, that farmers with different histories have different learning challenges in organic vegetable farming.

The contradictions in the object of farming activity are of interest from the point of farmers' learning. Contradictions by definition have to be solved in one way or another and, therefore, farmers actively work and put energy in solving them. This energy can be translated into change efforts by realizing that the object of farming activity is partly constructed by farmers themselves. The motive for change efforts arises from analyzing the contradictions and possibilities in the object and from projecting a new form of the object as a solution to contradictions (Engeström 1999, 66).

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