Farmer experiments, agro-environmental policies and practice change

Suvi Huttunen

Finnish Environment Institute, SYKE, Helsinki

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Abstract
More sustainable farming practices need to be developed and adopted. Current agro-environmental policies struggle in efficiently promoting sustainable agriculture. On the other hand, many farmers experiment constantly in order to improve their practices, but the created knowledge is rarely acknowledged by formal agricultural research or extension, nor is it systematically collected to provide general lessons. Farmer experiments can be seen as a part of the creation of farmers' local knowledge as opposed to more scientific and bureaucratic knowledge that forms the basis of policy formulation. This paper explores the role of farmer experiments in the building of their expertise and the relationships between experiments, agro-environmental policies and changing farming practices. Findings from thematic interviews of 31 Finnish farmers are provided. Farmer experiments were identified important in translating innovative technologies and practices promoted by policies to the local circumstances. To encourage experimentation, policies need to leave sufficient room for local adaptation while encouraging practice change. If collected in a systematic manner, farmer experiments could be an important source for improving the policies as well as facilitating the spreading of environmentally friendly practices.

1. Introduction

Farming is always site specific. It is performed at a unique setting regarding fields, crops, weather and farmer's purposes. Generic rules or technologies developed in agricultural science are rarely directly applicable in the local context without being translated to the particular circumstances. Without translation and modification, they can easily be rejected as unfitting to the current practices, and the purposes of the farming system (e.g. Noe et al., 2015). Similarly, the making of environmental policies and regulations often ignores the local specificities. This can result in failures in agro-environmental policies (e.g. Morris, 2006; Riley, 2008; Bartel, 2014).

Farmers have valuable knowledge built experientially over the years and previous generations (Millar and Curtis, 1999; Baars, 2011), but their knowledge is informal in comparison to more explicit scientific or bureaucratic knowledge. This local knowledge goes under many slightly differing terms such as tacit, implicit, vernacular, indigenous or traditional knowledge (Raymond et al., 2010; Bartel, 2014). The divisions between different knowledge types are somewhat arbitrary, since a person's knowledge is always hybrid, combining different ways of knowing. The cross distinction between scientific knowledge constructed using scientific methods, bureaucratic knowledge constructed in policy making and implementation processes, and local knowledge production types is however useful in pointing out the varying ways of knowledge production and legitimization (Morris, 2006; Raymond, et al., 2010). Scientific knowledge is based on scientific rules and processes, farmers' knowledge is constructed via their own knowledge systems and policies are based on bureaucratic knowledge system (Morris, 2006). These discrepancies in the knowledge systems make policies seem distant and unreliable from farmer's perspective (and sometimes from scientists' perspective as well). Riley (2008) has suggested that understanding farmers' ways of knowing and how these affect farmers' perceptions on practices promoted by agro-environmental policies can facilitate policy design and implementation. One way of increasing this understanding is to focus on the experimental nature of farming.

Farmer's experience with his/her fields is a result of ongoing experimenting and following learning in order to improve livelihood. Especially in the developing country context, it has been noted that many farmers experiment constantly to improve their farming practices (e.g. Bentley, 2006). Following Sumberg and Okali (1997), I argue that experimenting is a central process for the creation of local knowledge among farmers. By focusing on their experimentation process, it is possible to scrutinize knowledge creation and assess the knowledge discrepancies causing policy failures. The role of experiments in creating local knowledge and mediating policies has not been explored previously. Analyzing Finnish farmers' arable farming practices, the following research questions are asked: How do farmers build new knowledge via experimenting? What is the role of policies in the experimentation processes? And, could building on farmer experiments be a way to improve the policies?

In line with Kummer et al. (2012) I define farmer experiments loosely as a process, where something totally or partially new is introduced at the farm and the feasibility of this introduction is evaluated. In the analysis, experimentation refers to both planned and non-planned situations, where lessons are learned from observing the initial situation, making treatments and observing and monitoring the results (Hoffmann et al., 2007; Kummer et al., 2012).

2. Farmer experiments mediating knowledge asymmetries

2.1 Farmer experiments as livelihood experiments

Farmer experiments differ from more formal scientific or more applied innovation experiments, focused on developing pre-determined solutions in an organized manner (Huttunen and Zavestoski, 2016). These so-called local livelihood experiments or folk experiments (Bentley, 2006), i.e. experiments that are performed in everyday life to improve one's livelihood are (re)gaining attention in farming systems studies (Maat, 2011). Farmer experiments have been approached via the call for participatory research, acknowledgement of farmers' local knowledge and the need to co-create innovations rather than disseminate information from science to farmers (e.g. Hoffman et al., 2007; Baars, 2011). Especially in the developing country context, farmer experiments have gained interest as a method of developing and spreading agricultural innovations (e.g. Bentley, 2006). In a more developed country context, farmer experiments are related to the development of unorthodox methods, which have initially not been promoted by the extension services. Typically, these include organic farming and no-till, which were developed via farmer experiments and exchange of knowledge via farmer networks, as no information was available apart from other practicing farmers (Ingram, 2010; Goulet, 2013). In fact, all agricultural research has its roots in farmer experiments; only the increasing complexity and methodological organization of agricultural science have distanced research from farmers working on their fields (Maat, 2010).

Farmers have different styles for experimenting and the degree of experimentation varies among them (e.g. Lyon, 1996; Bentley, 2006; Vogl et al., 2015). Livelihood improving experiments need not be encouraged by advisors or scientists, but many farmers conduct them as a part of normal farming activities (Bentley, 2006; Munya and Stillwell, 2013). The experiments can be accurate, resembling scientific style in their design and management or they can be accidental implying that the experimenting farmer was not initially aware of conducting an experiment (Kummer et al., 2012). The experiments can be directed to solving a single, even incremental problem or towards wider transformative development of the farming system (Bentley, 2006). In the latter case, several consecutive experiments are conducted over a longer time-period to reach the development target via trial-and-error adjustment (Ingram, 2010).

Farmers evaluate the results of their experiments taking into account diverse observed factors and drawing from their local knowledge developed over the years of farming experience encompassing previous generations and neighboring farmers (Lyon, 1996; Vogl et al., 2015; Baars, 2011). The results are discussed in farmer networks, leading to co-creation of new (local) knowledge (Goulet, 2013; Dolinska and d'Aquino, 2016) facilitated by farmers' readiness to trust information obtained from other farmers (Hoffmann et al., 2007). The holistic evaluation style and implicit sharing of results suggest two major advantages in farmer experiments compared to top-down policy steering and extension: The knowledge created experimentally is adapted to the local circumstances and it easily spreads in existing farmer networks facilitating its adoption.

2.2 Experimentation and environmental policy

Farmers perceive agro-environmental policies from the perspective of their local, practical knowledge (Riley, 2008). As new policy measures are introduced, farmers need to decide whether and how to implement them. The policies can appear far-fetched from the farmers' perspective if the policies rely strongly on other knowledge systems. Famers can find their knowledge superior to that of the government because it is more practical, evidence-based and effective (Bartel, 2014). They possess their own systems for the legitimation and production of knowledge (Morris, 2006; Goulet, 2013). In comparison, the knowledge systems used in making policies or science are unfamiliar to farmers making the knowledge produced seem non-transparent and invalid in the local context. This can lead to direct rejection of introduced policy measures and farming practices they promote.

The discrepancies between the different knowledge systems have been approached by bringing the scientific knowledge production closer to the production of local knowledge. Participatory and transdisciplinary research projects have managed to combine the different knowledge making processes and create new hybridized knowledge (e.g. Misiko, 2009; Nguyen, et al., 2014) and the ideas of co-creating knowledge and increasing dialogue and knowledge brokerage have been adopted in extension and innovation (e.g. Millar and Curtis, 1999; Klerkx and Leeuwis, 2008). From policy perspective, the discrepancy has been approached by pleas to better incorporate farmers' perspectives in the policy-making processes and to make the policies more fitting to farmers' practices and purposes (Riley, 2008; Burton and Schwarz, 2013). In addition, attention has been made to facilitate the internalization of the policies by farmers via enhanced education and co-learning processes (Lobley et al., 2013; Stobbelaar et al., 2009), which connects the issue back to increasing participation in agricultural science (Nguyen et al., 2014). Experimentation provides a new angle to the debate by providing a broad arena for the social learning to occur (c.f. Nguyen et al., 2014). Farmers mix the knowledge systems via experimentation drawing ideas and discussing results in their networks (Munya and Stillwell, 2013).

Thus, if the agro-environmental policies are mandatory or if they despite the far-fetchedness seem lucrative, due to monetary compensations for example, a process of implementation starts. This can be seen as an experimentation process. When farmers start experimentally implementing the policies by adopting the promoted farming practices, they incorporate the knowledge the policies provide to the creation of their own locally based knowledge. This way experimentation functions as a process of knowledge integration, where farmers incorporate the knowledge implied in the agro-environmental measures into their own knowledge system finally resulting in modified or new performed farming practices (Fig. 1).

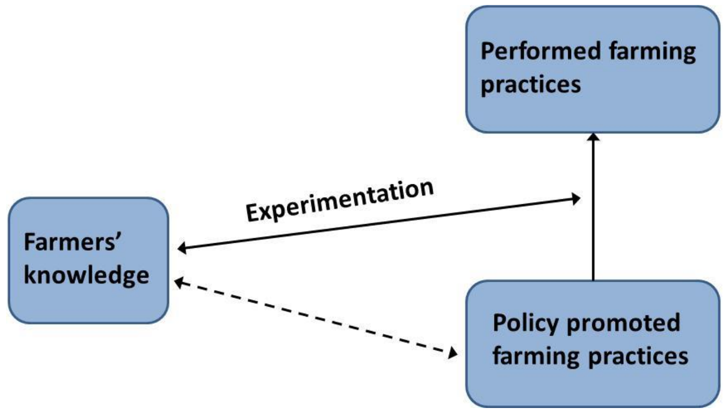

Figure 1. Framework for analyzing the role of experimentation in the adoption of policies at the local level.

I use this framework to analyze the role of experimentation in Finnish farmer's farming practices and implementation of both voluntary and non-voluntary agro-environmental measures applied in the country via rural development programmes between 1995 and 2014.

3. Data and analysis

The analysis is based on 31 qualitative interviews of Finnish farmers, representing different locations, farm sizes and production lines. A detailed description of the data is available in the article by Huttunen and Oosterveer (2016), see also Table 1. The interviews were conducted during fall 2014 and they lasted from one to three hours. The thematic interviews focused on farmers' arable farming practices, their changes during the past 20 years and the role of agro-environmental policies in these changes. Experimentation and learning emerged as an important category discussed with the farmers and the analysis derives mainly from this part of the interviews. In the analysis, the issues the farmers themselves identified as experiments were considered as experiments.

The analysis followed content analytical methodology (Mayring, 2004). The interviews were analyzed qualitatively in two phases with a small quantitative element of calculating the different experiments described (Table 1). In the first phase, the transcribed interviews were read through while searching for specific experiments. These experiments were then scrutinized to identify their motivation, source of idea, design, innovativeness and results. These were classified under categories developed based on the identified issues and existing literature on farmer experiments (e.g. Vogl et al., 2015) (Table 2). In the second phase, the focus was reverted to the whole interviews to enable a deeper understanding of the farmer's learning and relationship between policies and experimentation. Following questions were posed to the interviews: how does the farmer build his or her knowledge? and what is the relationship between experimenting, learning, practice change and policies? (Fig. 1). The analysis was made with the help of an excel-sheet facilitating the collection of the relevant information from each of the interviews into shorter descriptions and enabling categorization and comparison.

4. Farmer experiments in Finland

Experimenting was quite common: in total 18 out of the 31 interviewed farmers told about having experimented and 43 experiments were described at varying levels (Tables 1 and 2). The majority of the farmers told about one or two experiments, but up to six experiments were touched upon in an interview. The number of experiments discussed does not provide accurate number of the experiments actually performed at the farms as it was unlikely that the farmers remembered or found it necessary to describe all their experiments.

Table 1. Experiments at different farms and (socio-economic) characteristics of the farms studied.

		Experimenting farmers (18)	Total farmers (31)
Number of experiments in a farm	*minimum*	1	0
	median	2	1
	maximum	6	6
Farms by area	*Uusimaa*	5	11
	Southwest Finland	5	11
	Ostrobothnia	7	9
Farms by production line	*Cereal, ley or vegetable*	7	16
	Dairy	7	8
	Other animal husbandry	4	7
Farms by field area (ha)	*minimum*	13	12
	median	70	70
	maximum	161	214
Farmer's age (years)	*minimum*	29	29
	median	47	49
	maximum	66	66
Gender of the interviewee	*Male*	11	21
	Female	2	2
	Farmer couple	5	8

In general, the identified experiments were about improving the farming system by either searching for solutions to particular problems, or finding new ways to make agricultural production more efficient. This reflected in the motivations behind the experiments, which usually related to a desire to improve the economic result of the farm (Table 2). However, not all experiments aimed simply at economic benefit. Curiosity towards new issues was an important motivation often connected to other motivations, and especially the farmers who experimented considerably regarded it important to always try out new things and apply them at the farm level to see if they really work in practice. The motivations could also involve a desire to improve the environment, the soil or help other farmers. Policy-measures had directly motivated the experimenting in five cases, but they had indirect effects to many other experiments (Section 5.1).

Table 2. Diversity of the 43 identified experiments summarized.

What was the experiment about?	New crop/ crop mix	30% (13)
	Fertilization	21% (9)
	No-till/ reduced tilling	12% (5)
	Green manure	9% (4)
	Adding organic/inorganic matter to the soil	7% (3)
	Plant protection	5% (2)
	Other (e.g. separating manure, calculating nutrient balance, microbial additive to seeds)	16% (7)
Motivation (multiple reasons apply)	Directly improving the economic result:	
	Saving capital	37% (16)
	Improving yield	26% (11)
	Curiosity	33% (14)
	Improve fields/ soil	21% (9)
	Saving labour	16% (7)
	Available subsidy	12% (5)
	Other (environmental change, improve the environment/reduce emissions, help someone else)	7% (3)
Where did the idea come from? (multiple sources apply, in some cases no source was identified)	Promoted/suggested by another farmer (incl. contractors)	23% (10)
	Agricultural advisor, or project	19% (8)
	Read about it from a magazine	16% (7)
	Own idea	12% (5)
	Policy recommendation/ option	12% (5)
	Commercial agent	12% (5)
	Agricultural Education	5% (2)
	Other (visit abroad, previous work experience, suitable machinery)	7% (3)
Design	Direct application at a small area	49% (21)
	Direct application at large area	16% (7)
	Serial experiments with modification	21% (9)
	Comparison on parallel fields	7% (3)
	Accidental	5% (2)
Innovative scale of experiment	Adopting new technology/crop/practice at the farm	56% (24)
	Adopting new rare technology/crop/practice at their farm	37% (16)
	Creating a completely new or significantly modifying a technology/crop/practice	7% (3)
Result	New technology/changed way of doing	49% (21)
	No clear result/ more experimenting required	33% (14)
	Failure	19% (8)

The experiments mainly involved adoption of existing technologies, crops or practices not previously used at the farm. The experimented issue could be quite common among other farmers, or it could be rare, such as applying a recently developed product or no- and reduced tillage in their early development phases. In these cases, the experimenting involved finding out whether the issue fits the conditions at the farm and making the required modifications to improve the compatibility. In three cases, farmers developed a new issue or made a new kind of application for an old method. These were about fertilization and preventing water pollution.

Farmers designed their experiments to varying levels. Most common method was simply to try out on a small parcel of land or in a way that the potential failure would not mean significant financial loss or other problems severely hampering the functioning of the farm. In some cases, farmers directly employed a larger land area, but then they were quite certain of the success of the experiment beforehand based on the experiences of other farmers. Farmers could also design the experiments to resemble formal trials comparing parallel fields for example. If the first experiment provided successful results, the farmers often expanded the experiment and developed it further potentially leading to full adoption of the new practice. In two cases, the experiment was initiated by accident and resulted in a discovery of a suitable practice.

Farmers evaluated their experiments based on their own observations on the growth of the fields, soil structure, the level of yield and the amount of weeds, depending on the subject of the experiment. Many discussed and exchanged results with neighboring farmers and recommended good practices to others. Hence, farmers did not experiment in isolation, but they benefitted from the knowledge of neighboring farmers or other farmer-friends. Farmers also discussed the results with agricultural advisors and retailers, but their knowledge was perceived in relation to their practical experience as farmers (c.f. Hoffman et al., 2007). Experimentation was a co-learning process, where new knowledge was produced discursively comparing experiences and practices between different farms. The discussions with other farmers have been suggested to create space for the generation of new knowledge via the generation and reinforcement of new discourses (Dolinska and d'Aquino, 2016).

The described characteristics of the experiments are well in line with farmer experiments described elsewhere, including both developed and developing countries (e.g. Vogl et al., 2015). The particular role of policies as motivation and source of ideas, however, is rarely scrutinized in previous literature.

5. How experiments translate policies into practices?

The interviewed farmers emphasized learning by doing. Knowledge was built over the years by observing fields under different weather conditions, while cultivating different plants and using different farming techniques. This also made the created knowledge manifestly local and applicable only at the particular farm or in its proximity. The creation of experiential knowledge was slow and the farmers emphasized that one is never fully learned. As described by Hoffman et al. (2007), farming is a life-long case study or a continuous experimenting process, where results are composed holistically in relation to time and space. Many farmers did not connect their experimenting directly to policies, but were highly motivated to develop their farming and saw policies more as hampering their endeavors than facilitating or promoting them. However, policies clearly had induced experimenting; they were translated into local practices and knowledge via experimentation in the various settings.

5.1 Policies inducing experiments

The interviewed farmers considered new issues in relation to their local knowledge. Introduced policy measures did not easily shift the understanding of proper and functioning ways of farming and hence, there was reluctance and feeling of misfit regarding the policy measures as reported in previous studies (Morris, 2006; Riley, 2008; Bartel, 2014). However, policies provided a motivation via subsidies and requirements, and induced experimentation to test the possible ways to implement the policy demands. The interviewed farmers described many areas, where experimentation with new practices related to changes in policies. Common examples are no-till related to the requirement to increase plant cover during winter and reducing fertilization. A young farmer explains how the plant cover demand induced them to experiment with winter crops:

> We started cultivating winter grain due to the environmental support, one reason was the high price of rye and the other was the requirement for plant cover in winter. And we wanted to experiment with them, because we had never tried them before, to see how they succeed. (B1)

Usually the policy induced experimentation resulted in the adoption of the promoted farming practices, but also more ambitious development of new farming systems, like no-till. Not all the experiments were successful and some farmers rejected the new methods as unadoptable at their farms.

The policies could also support experimentation and development work in subjects not directly related to the particular policy measure. For example, one farmer was continuously experimenting related to different means to improve the structure of soil at his fields. He benefitted from the subsidies to establish a wetland and utilized the topsoil removed during the establishment of the wetland to improve his clay fields. In similar vein, farmers selected optional policy measures based on their predicted fit to the existing farming system. This limited the potential scope of policies to induce experimentation on new issues. As was evident related to the evaluation of experiments, farmers consider their farm holistically, and the changes need to work well in relation to the multiple interconnected farming practices. An older vegetable farmer describes his decision-making related to optional environmental measures:

> Largely we have taken the actions, which won't require any radical modifications to our practices. That they wouldn't make it impossible to do some important cultivation measure. This means that we have looked at what we can do and then tried to improve it and fit it to the environmental measures. (A2)

The knowledge building initialized by policies can also be hampered, if the regulations are too tight and leave no room for experimentation, or if new technologies cannot be adopted in the first place because of the regulations.

> There were these requirements related to how deep you can till, it was something like 13 centimeters, nobody can measure it, and there is no machine that can do it precisely the way the requirements demanded. These kinds of ridiculous requirements should not exist. (B2)

The fear for new restrictions and their change can also just keep farmers from committing to the means, but they may still experiment on related issues.

5.2 Policies mediating knowledge

Experimentation provided means to slowly build new knowledge via combining local and scientific knowledge. A farmer growing vegetables describes the development of his fertilization activities with respect to the policy demands to reduce fertilization:

> I have continuously questioned it (fertilization reductions demanded by agro-environmental policy), that does it really work. We developed the system via fertilizing the crops several times, which helps in getting the right nutrient to the right place at the right time. This way the reduction of fertilization begun. Then we used soil fertility analyzes to monitor the remaining amount of phosphorous. The figures were wild; in principle we would not have needed to utilize phosphorous at all. Then we tried it at a couple of small fields, that we did not use phosphorous at all. But we had to revert to giving part of the plant's phosphorous

> need at each fertilization time to make the plant feel well, so that it can utilize the phosphorous in the soil. (A2)

The farmer had high motivation for reducing the environmental impacts of his farming practices. He had internalized the need to reduce fertilizers, prevent pollution and connected these to his motivation to reduce cultivation costs. He tested the knowledge on the functioning of reduced fertilization promoted by policy. In doing this, he used scientific knowledge provided by the soil fertility measurements and his own observations on plant growth and modified his practices accordingly resulting in a new fertilization system, which demonstrated increased knowledge on the nutrient need of the plant.

The farmer evaluated the fertilization system foremost against the purpose to produce healthy plants. Also, the success of the experimenting with different new systems, such as green manure, reduced tilling or manure injection were evaluated and modified based on the improvement of the farm economics and overall improvement of the farming system, not in relation to the environmental benefits. Hence, successful experiments performed in order to accommodate policies do not necessarily mediate scientific knowledge related to environmental impacts of farming, but they can also simply translate the policy measures into local knowledge (c.f. Nguyen et al., 2014). This is the case especially if the reasons or scientific understanding behind the promoted measures are not made explicit to the farmers or if the farmers do not understand them. The search for (economic) farming system benefits resulted even in disappointments related to the policy measures and questioning their appropriateness. A cattle farmer explains his selection of the measure on specifying nitrogen fertilization:

> Farmer: we have selected the measure on precise nitrogen fertilization.
>
> Interviewer: Do you remember why you selected it?
>
> F: The idea was to select everything, which even in theory can reduce fertilization costs, but as we have the tools for the measurements and we have made the analyses, it feels a bit frustrating. We have not found any high values indicating that we should drop the fertilization level. (C3)

The farmer felt the measurement as useless waste of time, because it induced no further development with potential savings in fertilization costs. The knowledge itself was not important to him.

Higher education helped some farmers in understanding what lies behind the policies instead of mere mechanical implementation. Higher education provided farmers with tools to develop their farming; enhanced experimentation style, measurements to support their observations and increased openness and boldness in testing and searching for new ideas. A cattle farmer with considerable crop production also emphasized that education was important in helping him to understand policy requirements:

> I think the university education has affected in a way that I don’t have any threshold to try anything, not as big threshold as my parents had. It has somehow widened my worldview, given abilities to experiment and so that the initial reaction is not rejection… It has probably given the so-called scientific worldview, so that I believe research results and let them influence on what I do. It also means that when there are all these instructions and regulations in the environmental support system, I have a better change to understand the background and reasons for their existence. (B8)

The relationship between understanding and embracing the purposes of the policy measures and the experimental farming style appears crucial in improving environmental policies (see also Stobbelaar et al., 2009). Currently, the policies do not promote experimentation and innovation to better reach the policy aims, but merely to fit the policies to the farming systems. The potential learning effects to merge scientific knowledge with local knowledge via policy-induced experiments do occur, but policies could benefit from farmers' experiential learning and innovation potential much more widely.

5.3 Policies to enable experimentation

The results suggest two improvements for the policies: 1) focus on facilitating the understanding of the policy aims and their internalization and 2) enabling experimentation to reach the policy aims. A farmer couple discussed the role of motivation and understanding in implementing agro-environmental policies:

> Farmer 1: I believe that a better way is that the person who actually is taking the actions, that he has a motivation and an own goal. And that it can be influenced. For example if you think about the environmental issues, that we would want to care for the environment. It does not happen by handing 10 orders, that you need to do this and this and this. That only results in opposition, especially here in Finland.
>
> Interviewer: You mean that you would need to understand why you are doing the things, and that there is a concrete purpose?
>
> F1: Yes, exactly
>
> F2: That would work better here, I'm sure of it.
>
> F1: These are related to the fact that currently the understanding is not facilitated, only orders are delivered: draw a line to the wall at this date.
>
> F2: You don't need to know anything, just do these things. This is the attitude related to subsidies. It is none of your business, just do the actions. The spreading of information is second-rate. (A4)

The importance of farmers' understanding on why certain environmental measures are required and motivating farmers to take environmental actions are widely acknowledged (e.g. Stobbelaar et al., 2009; Burton and Schwarz, 2013; Nguyen et al., 2014). Farmers' experimental development of their farming systems brings about a new dimension for its importance. Experimentation is mainly done in order to improve the farming system, hence the motivation and understanding is crucial. Selecting the policy measures which were the most natural from the point of view of the farm, which would be done anyways, or which would imply the least harm have not necessarily encouraged innovation or thoughtful implementation. However, the cases where the aims of the environmental support system were internalized demonstrated how new innovative systems can be developed going beyond the mere adoption of a required action.

The understanding and adoption of the policy aims is not sufficient, if the policy measures enable implementation only in a strictly defined manner. A cattle farmer explains:

> I think that we should create opportunities for action, so that the system would steer the opportunities in a way that it would pay off to do certain things… So that a farmer could make supported choices to develop his farm holistically. (C3)

There should be an incentive to actively develop farming instead of restrictions and punishments in the subsidies. The experiments related to policies were not very innovative, but often related to application of quite common methods. This is partially due to the small room for development available in the fixed policy measures.

If going beyond mere adaptation of the suggested technologies, the key issue is either the internalization of the aims promoted by the policies or the openness of the policies themselves to allow for the development of the systems. Recent studies have pointed out how agro-environmental schemes can eventually lead to internalizing at least some of the environmentally beneficial aims (e.g. Huttunen and Peltomaa, 2016). The development of the so-called result-oriented agro-environmental measures can provide a means for further opening space for experimentation within the policy measures. These measures subsidize farmers for the measured amount of environmental benefits they produce, not merely for performing a certain pre-defined action (Burton and Schwarz, 2013). Hence, they leave room for farmers to invent ways to produce the benefits, while also contributing to the internalization of the understandings and motivations related to the environmental benefits. For experimentation to occur, an emphasis on enabling resources rather than strict guidelines is important.

6. Conclusions

Farmers learn by accumulating experience and experimentation is a central process used for this learning. The interviewed Finnish farmers experimented in different ways and at varying extent. Experimentation provides a means to accommodate new knowledge and practices promoted by policies and policies provide inspiration for experimentation. This efficiently domesticates new practices and can result in the creation of new innovative practices. Experimentation provides a means to distribute innovations at the ground level and develop them further to meet the requirements at different kinds of farms. Thus, building on farmer experiments provides an interesting way to improve agri-environmental policies.

The results highlight the importance of farmers' motivation on the environmental improvements and understanding of the reasons and scientific mechanisms behind the policies, resulting in experimenting incorporating scientific knowledge and a better functioning of the policies. Without proper attention on the creation of understanding on the environmental aims and mechanisms behind the policies, the experimental implementation by farmers risks losing its potential in creating new environmentally beneficial practices. Rather, the experimentation merely accommodates the policy measures (not the aims) to the local knowledge.

Experiments can also lead to new innovations which should be taken into account in policy-making. It would be important to collect experiences from farmer experiments and applications of existing technologies at different kinds of farms. This could be combined to advisory services and development projects aiming at advising and changing farmers' practices. The collection of experiments would be valuable especially as the resources for agricultural research are diminishing, but also because the translated knowledge can be more useful for farmers than results from scientific research. In the future agro-environmental policies would benefit from promoting experimenting for the implementation of policy aims and take into account experimental innovations in policy design.

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