The Space of Culture – the Place of Nature in Estonia and Beyond

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People have used fire to shape landscapes according to their needs for thousands of years. Fire cultivation, with all the effects characteristic to it, was one of the means by which human-induced fire was present in Estonian landscapes. Fire clears and opens up land, harms some species and gives advantages to others. Plants and animals adapt to particular patterns of fire according to frequency and intensity (Pyne 2001). Thus fire cultivation has had an impact on the environment and the landscape. Knowledge and experience of handling fire in the environment was one of the components of culture. The long tradition of fire cultivation has left its traces in language and in numerous toponyms.

The general term ‘fire cultivation’ includes different land-use techniques. For swidden cultivation \(\text{ale, sõõrd}\) an area was cleared of trees and burned, the ash serving as fertiliser. After some years of cultivation the plot was abandoned and vegetation left to regenerate. Slightly different swidden techniques were used in old-growth forest and in young, secondary, forest. There were also differences in preparing the area for winter and summer cereals. For burn-beating \(\text{kütis}\) — another fire cultivation method — young trees were cut and tied into bundles. The bundles were placed in rows and covered with sods. The heaps of wood and turf were burned and the mixture of ash and burnt soil spread over the surrounding area.

It is difficult to determine from the historical sources which fire cultivation technique was used in any particular case because the terms swidden and burn-beating were sometimes used synonymously. Overviews of agrarian history often discuss swidden cultivation as an oddity unrelated to the permanent arable, as a primitive mode of land use, the persistence of which appeared inappropriate in the agricultural

systems of (early) modern society. Fire cultivation has remained a research topic of minor importance in comparison to permanent arable in Estonia. Very little in-depth research has been conducted on this topic. The situation is different in Finland where fire cultivation has drawn ample attention since the study of agrarian history began (Raumolin 1987). Historian Herbert Ligi (1963) was an exception among Estonian researchers, having produced a chapter on bushland and fire cultivation in his treatise on agrarian land-use methods in the sixteenth and seventeenth centuries that has remained the most thorough analysis on fire cultivation in Estonia. Archaeologist Tanel Moora has also contributed to the study of fire cultivation, focusing mainly on the experimental approach (Moora 1966; 1971; 1974; 1976).

The term bushland (Buschland in the Baltic-German sources, võsamaa in Estonian) has been described in the eighteenth century sources (e.g. Hupel 1774) as an area covered by young trees and bushes where small plots were regularly chosen for fire cultivation. The parts of bushland neighbouring the permanent arable could be used as a land reserve, cultivating parts of it temporarily. Other more important uses of bushland were grazing and the collection of timber for fuel. Thus, bushland was a multifunctional and extensively used category of land.

The aim of this paper is to discuss the role of fire cultivation in Estonian land-use history and its impact on the environment. We will analyse the reasons for its perseverance and disappearance and move towards formulating the function of fire cultivation in the larger agricultural system in Estonia in the light of recent research. We will map the problems that have arisen so far and put forward future research questions.

Fire Cultivation in Historical Perspective

Indirect data are often used to infer the fire cultivation practices of the prehistoric period. Information on land-use practices is provided by pollen and charcoal particles found in sediments, the settlement pattern and comparison with later periods. An additional method for gaining knowledge on this subject is to conduct an experiment by creating a test field imitating the land-use practices of the past.

Neolithic farming spread across Europe from the Middle East between 7000 and 3500 BC (Roberts 2004). According to the evolutionary scheme, the development of land-use systems was linear from primitive and extensive techniques such as slash-and-burn cultivation, to more complex and intensive systems (Boserup 1965). Today such interpretation has been called into question (Thorpe 1999; Bogaard 2004).
There is no consensus on the type of land-use of these first farmers. In-depth local case studies imply that different land-use methods, chosen to suit local environmental circumstances, were simultaneously in use in Europe. For example, it has been assumed that in the permanent settlement region of fertile alluvial and loess soils in Central Europe, the first land-use method was intensive garden cultivation of long-established fixed plots (Bogucki & Grygiel 1993; Bogaard 2004). Swidden cultivation played an important role in the economy of northern Scandinavia and large parts of the Finnish inland during the Late Iron Age and the entire historical period (Alenius et al 2009). Researchers have not agreed on early land-use methods in southern Scandinavia (Thorpe 1999) since very little direct data on the matter is available and the evidence there is can be interpreted in different ways. On the other hand, we cannot exclude the possibility that complex agricultural models, combining intensive and extensive cultivation techniques, were already in use in the ancient period.

Cereal cultivation was introduced into Estonia, as into southern Sweden, in ca 4000 BC, more than 1000 years earlier than into Finland. Cultivation started in the coastal zone and spread inland (Poska et al 2004). Early Bronze Age settlement sites were small and used for short periods. The populations probably consisted of single households. The subsistence economy befitting this settlement pattern is dispersed cultivation — a type of limited and mobile slash-and-burn agriculture (Lang 2007). The earliest preserved fossil field systems in Estonia are the block-shaped fields at Saha-Loo near Tallinn. According to radiocarbon dates from charcoal, these fields date back to the Middle Bronze Age, 1300–1000 BC (Lang 2007). The charcoal found during archaeological excavations under clearance cairns and baulks is the primary and often the only evidence of fire cultivation in these fields. Whether the charcoal originates from repeated rotating swidden cultivation, or a single burn used for clearing the forest for permanent arable, remains unknown. There are relatively large systems of permanent arable surrounded with stone borders dated as being from the Late Bronze Age. All the presently known early fields in Estonia have been discovered on the thin rendzina soils found on the limestone bedrock of coastal Estonia and missing in the inland regions (Lang 2007). Pollen analyses support the view of fire cultivation prevailing in south Estonia during the same period (Laul & Kihno 1999). Relying on the archaeological research conducted on the Karula Upland, it has been assumed that in the single-household settlement type of the Upland, the land appropriate for swidden cultivation had been divided among the settlement units and that rotating swidden cultivation was used, meaning that the plots
for swidden agriculture were chosen in a circular configuration around the households and that the cultivators did not need to move their households [Konsa 2005].

During the Middle Ages and Early Modern period the open-field system was the prevalent agricultural system in large parts of Europe. The classic features of the open-field system were individually owned strips of arable in large village fields and commonly owned multi-functional lands used for grazing, gathering wood and other purposes. The open-field system has varied from location to location depending on the landscape, physical conditions and other variables [Dahlman 2008]. In Estonia, there is evidence of the open-field system being used since the tenth century. Some evidence has been found that it was already used in the seventh to tenth centuries [Lang 2003]. The open-field system with its characteristic strip fields, stayed in use until the enclosure of the mid-nineteenth century. In the Estonian context, the bushland was one of the land categories held as common land. Fire cultivation in bushland can thus be discussed as a regional characteristic within the open-field system model. It would be misleading to classify bushland as uncultivated land — it was an important part of the land-use system, although cropped less frequently than the arable. The large wooded areas in the region probably preconditioned such an arrangement.

Some archaeological evidence of swidden fields in the Middle Ages has also been found. In central Estonia, a three-hectare site with clearance cairn fields was inspected near Jalase village that was probably used for swidden cultivation. According to charcoal analysis, the area had been in use between the fourteenth and seventeenth centuries [Lang 1995]. Clearance cairn fields have been found in other locations in Estonia, some of them dating back to the Bronze Age. It is possible that some of the earlier clearance cairn fields can be associated with swidden cultivation [Kaldre 2007] but these systems have not yet been examined.

Fire cultivation was used widely in south Estonia until at least the seventeenth century, not only as a means of expanding the arable but also as an independent land-use technique in its own right [Ligi 1963]. It has been claimed [Meikar & Uri 2000] that the bushland formed at least one quarter of all land in agricultural use in the nineteenth century in south Estonia and hence was widespread at the time. By the early twentieth century it had virtually ceased to exist. We lack exact data about the end of swidden cultivation in the bushland, although it seems that researchers have sooner under- than over-estimated the persistence of fire cultivation. Ethnographic reports include a number of fire culti-
vation cases in different parts of Estonia, above all south Estonia, from the 1890s to 1940s (EA 22; KV 53; KV 74).

It is obvious that the role of fire cultivation has not been uniform at all times and in all regions: there is a clear difference between inland and coastal areas. It has also been suggested that in both Estonia and Finland the inland soil type was more suitable for swidden cultivation; the fire cultivation land use methods were first replaced by permanent fields in the coastal areas (Moora 1966; Vuorela 1986). In Estonia the woodland regenerates slowly on the thin alvar soil of the coastal areas, where the cycle of fire cultivation was too long and thus impractical.

**Traces of Fire Cultivation in the Environment**

The impact of fire cultivation depends on the previous conditions of the site and the burning process itself. According to an example from eastern Finland (the Koli National Park), intensive fire caused high reduction of the thickness of the humus layer, so the quantity and concentration of organic matter after fire was lower than before. In contrast to this, only weak increases of pH and nutrient content were registered in another site with a low amount of burned wood in a rainy year (Matas 2004). Thus, only a certain amount of burned biomass and intensity of fire has an effect on the quantity of available nutrients, organic matter contents and pH of the humus layer. According to several authors (Viro 1974; Matas 2004), the average increase in pH immediately after burning is about two units. Later the pH value decreases, with a faster decrease in the first seven years after the burn. After 30 years, the pH values become similar to those before the burn (Viro 1974). Burning the field surface produces gases in the soil, which expand and loosen the topsoil. Therefore the burnt soil does not need ploughing, the seeds can be simply raked into the soil (Moora 1974).

Burning results in changed light conditions and increased pedological variation. When wood is burnt, high quantities of nutrients go into the topsoil from where new vegetation can take it up. At the same time, after burning, nutrient loss through leaching into the deeper soil layers begins. These factors may affect regeneration of the vegetation.

Palynological analyses of bog and lake sediments give us palyno-spectra that are widely used to obtain data about vegetation and its changes in the past. As swiddening has played an important role in land use and considerably changed the vegetation, it ought to be reflected in fossil pollen assemblages. This kind of disturbances has been detected in pollen diagrams from the Haanja Upland, southeastern Estonia (Laul & Kihno 1999; Niinemets 2008).
According to pollen diagrams, the most prominent changes are those in tree pollen composition: A decline in *Picea* (spruce) often coincides with a spike in heliophilous *Betula* (birch) pollen. Depending on the ecological conditions, *Alnus incana* (grey alder) or *Pinus sylvestris* (pine) reforests burnt land. The brief decrease of spruce pollen together with high charcoal concentration values is often the only clear indicator of forest clearance. Later on, the shortened rotation periods harmed the regeneration of spruce, so its pollen curve is no longer informative. Frequencies of other tree pollen and the human activity indicator herb pollen became more important, for example *Rumex acetosa/acetosella* (sorrel), which appears abundantly for a short period after harvesting (Huttunen 1980; Vuorela 1986; Kihno & Mäemets 2007).

There are no proper pollen indicators of swidden cultivation, as all the plants belong to native flora, although the periodicity in tree pollen succession, finds of cereals and other anthropogenic pollen types combined with layers of microscopic charcoal in the sediment profiles, may reflect the practice of swidden (Vuorela 1986; Lageras 1996). In addition, an increasing erosion of mineral soil from the areas with destroyed vegetation cover can imply fluctuations in agricultural activity (Vuorela 1989).

The indicative value of species or groups of species may be evaluated by means of studies of the pollen–vegetation relationship in modern analogues of past human-made vegetation types (Gaillard 2007). Palynological tests to study the yearly variation in pollen spectra across the different phases of the fire cultivation cycle were conducted during the experiment in south-eastern Estonia (Kihno et al 2008). Modified Tauber traps (Hicks et al 1996) were used to record pollen deposition at different distances from the field in the years of the experiment. The results of pollen trapping were expected to provide a basis for the recognition of the historical swidden practice in pollen records from peat and lake sediments and mineral soil. Preliminary results for the flowering 2008 season were interesting: Percentages of deposition of allogamous rye pollen in the vicinity of experimental field I were quite low (Kihno 2009). In the present stage of research it is early for conclusions and more thoroughgoing analyses are needed. As the interpretation of pollen data is often based on *Cerealia* pollen curves, it is necessary to study the sedimentation of rye pollen in more detail in the future.
Experimental Research on the Productivity of Fire Cultivation

A number of fire cultivation experiments have been conducted in Europe since the 1950s (Iversen 1956; Reinold 1977; Steensberg 1979; Engelmark 1995; Soto et al. 1995; Tvengsberg 1995; Rösch et al. 2002; Lovén & Äänismaa 2006; Eckmeier et al. 2007) with the objective of gaining knowledge on the techniques of fire cultivation, its impact on the environment, and crop yield. In Estonia, the first experimental swidden field was founded by Tanel Moora in an old-growth forest site in eastern Estonia in 1969 (Moora 1971). In the 1980s, several plots in northern Estonia were re-burned (personal communication with Tanel Moora).

Drawing on his experiments, Moora has stressed the relationship between fire cultivation and relief: A field established in the old-growth forest has to be well exposed, otherwise part of the crop remains in shadow and ripens unevenly (Moora 1974; 1976).

The undulating landscape of the region is highlighted by the tree-line in the background

Figure 1. Experimental swidden field in the Karula National Park. Photograph: Marge Konsa, 2007.
We initiated another experiment in south-east Estonia (the territory of the Karula National Park) in 2007. Two experimental sites were burned, one in 2007 and the other in 2009. On both sites, a 20 to 25-year-old, mainly deciduous, copse was cut, dried and burned and a multi-stemmed landrace winter rye was sown in two consecutive years on the first field; in the second field, the second year of cultivation is underway (Figure 1).

Preliminary results from these experimental fields display similar dynamics to those described in historical sources: The first crop of winter rye from a swidden plot gave ten seeds to one; the second crop from the plot was considerably lower. The first year crop had approximately six stems with ears per plant (max 22 ears); in the second crop from the same field most of the plants had only one stem.

Another small-scale experiment was conducted with the same landrace of winter rye in 2006 in south Estonia near Tartu, where approximately 45 seeds were planted one by one in a burnt-land bed of 1.5 x 3 metres. The seeds were planted straight into the ash to a depth of one centimetre. This experiment produced 28 plants, approximately 40 stems with ears per plant (max 83) and approximately 40 grains per ear, thus amounting to an average productivity of 1600 seeds to one plant (Figure 2).

Figure 2. Multi-stemmed landrace of winter rye used in the experiment. Photographs: Mari Laane, 2006.
The productivity of this small-scale planted bed experiment probably cannot be extrapolated to the conditions of larger-scale swidden fields, although its success opens up the discussion to the merits and profitability of small-scale intensive production. The results of other experiments support its findings. For example, a small-scale experiment with landrace winter rye in Norway conducted in 1990, produced seven plants, the biggest with 162 ears, each containing, on average, 75 grains (amounting to 12 150 seeds in total) (Tvengsberg 1995). A swidden experiment with an old strain of winter wheat (*Triticum aestivum*) produced 20- to 25-fold crop yield (Rösch et al 2002).

**The Persistence and Decline of Fire Cultivation**

Any given land-use method is not a rigid complex of elements but a flexible system, always adapting to the changing natural and social situation (Raintree 1991). This holds true for fire cultivation techniques in nineteenth-century Estonia. Fire cultivation did not stop abruptly. Rather, a long process with a change in function and simplification of the work occurred.

A number of factors supported sustaining the perseverance of fire cultivation techniques. Firstly, there were the high yields. A landrace of rye grown on the burnt land differed from the one grown on permanent fields. It was characterised by exceptionally numerous stems: One plant could produce between 30 and 40 (Manninen 1922). At the time prior to agricultural modernisation, the yields of a permanent, manured field were four-fold. The average productivity of the swidden field was reportedly ten- to twenty-fold (Ligi 1963), although the yield was that high only during the first year of cultivation. The yield in the second and the third years was much lower, closer to the productivity of the permanent arable. Together with the termination of swidden cultivation, this landrace variety has disappeared in Estonia.

Secondly, the reason for the persistence of fire cultivation was, paradoxically, the agricultural modernisation process, which gained full speed in Estonia in the middle of the nineteenth century with the process of enclosure. Formerly collectively owned village territory and village arable was parcelled up into privately owned farmland. Change in ownership patterns during enclosure accompanied by the relocation of the farms and the need to clear new permanent arable created conditions for swidden practices to persist (Lõugas 1980). In these new circumstances, fire cultivation gained importance mainly as the quickest and most convenient technique for clearing woodland for new arable, gradually losing its significance as an independent land-use method.
Thirdly, fire cultivation survived side by side with permanent arable cultivation for centuries due to the fact that these two land-use methods complemented each other, enabling people to reduce the risk of crop failure. The productivity of swidden fields could be high but the permanent arable tended to produce a more stable yield, being less vulnerable to drought and rain. The crop of the swidden fields was usually harvested slightly earlier than that of the permanent field, allowing the workload to be spread over an extended period. With rainy weather being a constant threat to the ripening crop, having two fields with different harvest times enabled farmers to react flexibly and reduce the risk of rain damage. The swidden fields thus made production from additional arable possible without increasing the need for manure. This was constantly in short supply, and thus the main factor in limiting the extension of permanent arable. The opportunity of enlarging the overall cultivated surface by using swidden plots fertilised with ash was welcome, especially on the acidic soils of south Estonia.

It has been suggested (Dahlman 2008; Neeson 1993) that the open field system functioning together with commonly held lands lost its significance as the market’s demand for agricultural produce increased. Fire cultivation ultimately lost its economic significance when the crop yield in permanent arable reached the same level as in the swidden fields (Öpik 1992). Among the factors contributing to the decline of fire cultivation was the rapid decrease of woodland in the eighteenth and nineteenth centuries. Shortage of forest and timber was severe in some areas in south Estonia and some authors have linked the problem to extensive fire cultivation (Friebe 1794; Kelch 2004). Some attempts to control the exploitation of woodland were made through legislation in the seventeenth century. Restrictions were set for rotating swidden, especially in the old-growth forest. An interval of 24 years was determined as the frequency of cropping in bushland with no more than three consecutive crops allowed (EAA.1406.1.2; Lihwlandi... 1820). The developments were similar in Finland (Vuorela 1981). Legislation on the matter of bushland and fire cultivation in the early nineteenth century shows that these topics kept their relevance, demanding attention at government level.

In the early nineteenth century, the price of timber started a steep climb owing to growing population numbers; there was a constant demand for fuel and building material. Spirit distilleries, saw-mills, tar, brick, and lime production facilities, were numerous, although usually not very large (Ibius 1977; Rosenberg 2010). Therefore the interest in rearranging the management of bushland and investment in forestry grew gradually throughout the nineteenth century (Meikar & Uri 2000).
In the agricultural intensification process, bushland was divided between permanent arable and forest. For instance in Karula, south-east Estonia, seventy percent of the farmers’ bushland was turned into arable and about twenty percent became forest (Tomson 2007). With expanded permanent arable, improved agricultural equipment and an intensified land-use system, combined with high prices for timber, keeping permanent arable or forest was more profitable than periodically cultivating extensive bushland.

**Conclusion**

The relationships between extensive fire cultivation methods and permanent arable are probably more complex than a straightforward development from one (more primitive) to the other (more advanced). Rather, they ought to be understood in terms of making the best use of natural resources (relief, woodland and soil type) and the labour force available. The techniques for fire cultivation have not formed a rigid set through time. Owing to differences in physical conditions, population numbers, settlement types and subsistence methods, fire cultivation was adapted according to need, being dominant in certain places and periods and subordinate in others.

We suggest that fire cultivation remained an important integral part of the open-field system in Estonia at least up to the seventeenth and eighteenth centuries. The final phase of fire cultivation in Estonia in the nineteenth and early twentieth centuries remains yet to be studied in detail; according to ethnographic data this land-use method was in use longer than so far assumed.

In order to open up a more thoroughgoing discussion of the role and impact of fire cultivation in Estonian cultural landscapes, additional research is required from the humanities as well as the natural sciences. As indicated above, much information can be obtained about fire cultivation by studying its traces in the environment, for example aspects relating to changes in vegetation type, light conditions and soil nutrients.

Further work on a method to distinguish between the sites of natural forest fire and the sites of ancient swidden fields is necessary. Analysis of the charcoal particles and soil profiles may give insights into how to define the differences between natural and agricultural burns. Having a method with which to determine the locations of agricultural land-use can aid analysis of the development of south Estonian landscapes. In examining ancient fire cultivation practices it is also important to determine the tree species of the charcoal from the fossil fields. Access to resources is another significant issue for analysis:
Which social groups had the right to use the various fire cultivation methods, to what extent, and how did these conditions change over time?

Fire cultivation has shaped the cultural landscape in Estonia. Its characteristic features were not only the smoking swidden fields but also the mosaic landscape they produced. Traces of these are barely noticeable in contemporary landscapes, although the history can be traced through pollen surviving in sediments, pieces of charcoal in the soil and records in written sources.

Notes

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