Between nature and society: the interpretation of an early nineteenth-century Swedish farmer's diary

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Abstract

Pre-industrial agriculture was largely based on local natural resources, which needed to be handled together with a variety of societal factors. In this study we use an unusually detailed Swedish farming priest's diary to show interactions between ecology and society at the micro-level, and how they influenced the decisions and actions made by the household. The diary is analysed by using the conceptual framework of social-ecological systems (SES). We focus on years in the 1810s, when extreme weather conditions made the weaknesses and potentials of the agrarian system particularly visible through their impact on the production of hay and pasture.

The working of pre-industrial agriculture was the result of the interaction of different drivers, related to ecosystems, economy, society, and culture. As these interactions changed, so did agriculture itself. Pre-industrial agriculture gradually vanished as a result of the 'agrarian revolution' in Scandinavia between 1750–1850. New agricultural systems, crops, and techniques were introduced.[1] This process has mainly been analysed from a local or regional perspective, in studies addressing, for example, the spread of new technology, the implications of population pressure, reactions to changing market conditions and the adoption of imposed institutional changes in the form of enclosure legislation, falling rents, the spread of new crops and rotations, improved livestock and livestock feeding, and land reclamation.[2] Regional and

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[1] Carl-Johan Gadd, 'The agricultural revolution in Sweden 1700–1870', in J. Myrdal and M. Morell (eds), *The agrarian history of Sweden* (2011), pp. 118–64.

[2] See e.g. Maths Isacson, *Ekonomisk tillväxt och social differentiering, 1680–1860. Bondeklassen i By socken, Kopparbergs län* [*Economic growth and social differentiation 1680–1860 among the farmers' class by parish, Kopparberg County*] (Uppsala Studies in Economic Hist., 18, 1979); Carl-Johan Gadd, *Järn och potatis. Jordbruk, teknik och social omvandling i Skaraborgs län 1750–1860* [*Iron and potatoes: agriculture, technique and social change in the province of Skaraborg 1750–1860*], (Reports from the Dept. of Economic Hist., Univ. of Gothenburg, 53, 1983); id., 'Jordbruksteknisk förändring i Sverige under 1700- och 1800-talen – regionala aspekter' ['Regional aspects of agrarian technical change in Sweden during the eighteenth and nineteenth centuries'], in L. Andersson Palm, C. J. Gadd and L. Nyström (eds), *Ett föränderligt agrarsamhälle, Västsverige i jämförande belysning* (1998); Pablo Wiking Faria, *Freden,*

local studies have laid the ground for syntheses at the national level, of which several have recently been produced.[3] There are, however, considerably fewer studies focusing on the actions and decisions of individual farmers, for example at the household level, or how they coped with local, regional, and national changes.

In addition to the studies mentioned before, some larger Swedish projects have used multidisciplinary approaches to explain the spatio-temporal change of the agriculture in a certain region, for example the Ystad project in southern Sweden, the Barknåre project in central Sweden, and the Ängersjö project in the north.[4] These studies demonstrate the advantages of using interdisciplinary methods for understanding historical agriculture. They also show that there are few methods available for simultaneously studying and integrating multiple variables, of a biophysical and socio-economic nature, which together provided the arena for historical agrarian households.[5]

In this study we make an addition to the small number of studies at the micro-level of the complexity of a pre-industrial farmer's arena. Our approach has been to apply a social-ecological framework to an early nineteenth-century Swedish agrarian household in order to analyse its actions and decisions, and ascertain their causes and effects.[6] We view the agrarian household as being part of a *dynamic social-ecological system* (SES), in which the household needs to manage a number of factors influencing the daily livelihood: ecological, economic, cultural, social and so on. In SES theory, such aspects are denoted *domains*. The SES approach emphasizes the links and interactions between domains, in particular between ecological and

Note 2 *continued*
friköpen och järnplogarna – drivkrafter och förändringsprocesser under den agrara revolutionen i Halland, 1700–1900 [*Peace, freeholding and iron ploughs: Drivers and processes of change during the agricultural revolution in Halland, 1700–1900*] (Department of History, Gothenburg University, 2009); Magnus Bohman, *Bonden, bygden och bördigheten – Produktionsmönster och utvecklingsvägar under jordbruksomvandlingen i Skåne ca 1700–1870* [*Peasants, production patters and paths of development during the agricultural transformation in Scania, Southern Sweden, c.1700–1870*] (Lund Studies in Economic History 52, Lund University, 2009); Aadel Vestbö-Franzén, *Research on rye: Food, humans and structural changes in the agrarian landscape of northern Småland, 1550–1700* (Dept. of Cultural Geography, University of Stockholm, 132, 2004); Anna Dahlström, *Betesmarker, djurantal och betestryck 1620–1850. Naturvårdsaspekter på historisk beteshävd i Syd- och Mellansverige* [*Pastures, livestock numbers and grazing pressure 1620–1850. Ecological aspects of grazing history in Sweden*] (Uppsala, Swedish Biodiversity Centre publications, 13, 2006).

[3] Gadd, 'Agricultural revolution'; Mats Morell, 'Property rights and growth in Swedish agriculture in the late eighteenth and early nineteenth centuries', in G. Beáur, P. R. Schofield, J.-M. Chevet and M.-T. Pérez-Picaso (eds), *Property rights, land markets and economic growth in the European countryside (thirteenth-twentieth centuries)* (2013), pp. 495–514; Mats Morell, 'Ecological constraints and property rights in Swedish agriculture, *c.*1750–1850', in B. van Bavel and E. Thoen (eds), *Rural societies and environments at risk: Ecology, property rights and social organisation in fragile areas (Middle Ages-twentieth century)* (2013), pp. 41–84.

[4] Björn E. Berglund (ed.), 'The cultural landscape during 6000 years in southern Sweden: the Ystad project', *Ecological Bulletins* 41 (1991); Ella Johansson, *Periferins landskap: historiska spår och nutida blickfält i svensk glesbygd* [*Landscape of the periphery: historical traces and present views in a Swedish rural region*] (2002).

[5] E.g. Introduction and Chapter 1 in U. Jansson and E. Mårald (eds), *Bruka, odla, hävda. Odlingssystem och uthålligt jordbruk under 400 år* [*Cultivation systemas and agriculture sustainability during 400 years*] (2005).

[6] Fikret Berkes and Carl Folke, 'Linking social and ecological systems for resilience and sustainability', in F. Berkes and C. Folke (eds), *Linking social and ecological systems* (1998), pp. 1–25; F. Berkes, J. Colding and C. Folke (eds), *Navigating social-ecological systems. Building resilience for complexity and change* (2003), pp. 1–29.

social aspects of subsistence. A historical agrarian SES at the household scale is based on local ecological conditions, traditional knowledge about how to use the ecosystems, and on the social, economic, and cultural properties of the underlying society. Social-ecological theory is often used to analyse how societies deal with ecological or socio-economic change, and how societies can build capacity to adapt to change or to shape change for sustainability. It can be used to analyse how problems and deficits in one domain can be compensated or buffered for by other domains, or, conversely, how problems in one domain can worsen problems in other domains, the latter often referred to as the cascade effect.[7]

We base the study on a detailed diary kept by the vicar and farmer, Johan Fredrik Muncktell (1764–1848).[8] In almost 1500 pages Muncktell describes, among other things, how an agrarian subsistence system worked, how it changed, and how it was perceived by a single household between 1814 and 1829. Through the information it contains we can come close to understanding the decisions and actions taken by an actual land-user. We get an inside perspective on the possibilities and problems encountered by a pre-industrial farmer, and we can see how the preconditions for agriculture *per se* relates to the vicar's economy and social status.

In order to identify the potentials and constraints of the household's agriculture and the constraints placed on it, and to understand the decisions and actions taken, we focus on a number of years in the 1810s, during which the weather was particularly harsh and severely impaired Muncktell's production of hay and pasture.[9] These problems triggered a variety of responses by which the household handled the problems, spanning over several domains in the household SES. Our assumption is that it is unusual or even extreme conditions which make the structure and function of the agrarian SES particularly visible, including its weaknesses, potentials, and capacity for change.

Specifically, we address the following questions:

(i) Which ecological, economic, social, and cultural preconditions were most important for Muncktell's agrarian household, that is, which were the main social-ecological domains of the subsistence system?

(ii) How did the household utilize different social-ecological domains in order to overcome the resource problems that were caused by bad harvest years?

(iii) Were the problems posed by a bad harvest mitigated or worsened by the economic, social, and cultural preconditions of the household, for example its social status?

(iv) Can we, through a social-ecological analysis of the diary, identify areas that were in deficit and unbalanced, or other circumstances that may have been microeconomic drivers for the changes of agriculture that occurred during the agrarian revolution?

[7] A. P. Kinzig, P. Ryan, M. Etienne, H. Allison, T. Elmqvist and B. H. Walker, 'Resilience and regime shifts: Assessing cascading effects', *Ecology and Society* 11 (2006), pp. 1–20.

[8] M. Hellquist (ed.) *Prosten Muncktells dagbok* [Vicar Muncktell's diary] (3 vols, 1979–1995), I, Kärrbo, II, Sevalla, Västerås.

[9] Gustav Utterström, *Jordbrukets arbetare. Levnadsvillkor och arbetsliv på landsbygden från frihetstiden till mitten av 1800-talet* [Rural living and labour conditions, *c.*1720–1850] (2 vols, 1957), I, pp. 199–200.

I

The Muncktell family consisted of himself, his wife Christina Charlotta Nohrborg (1773–1846), four daughters (born 1797–1808) and one son (born in 1805). In addition, the household included a number of maids and farmhands, and one of the tasks of this project has been to quantify them and the other labour resources available to Muncktell.

Muncktell decided to start writing a diary on the day of his fiftieth birthday, 26 September 1814. By then, he was employed as a curate in Kärrbo parish, which was annexed to the neighbouring parish of Kungsåra. In June 1816 he moved to Sevalla vicarage where he was offered a vicar's benefice. Although the position was much coveted by Muncktell, he went through considerable agonies over leaving Kärrbo, conscious that he would lose the fruits of 20 years of improvement of the fields, pastures and meadows of the priest's farm. He stayed in Sevalla until May 1821 when he obtained the benefice of a third, even more attractive parish in the same region, Irsta. This study concentrates on Munkell's time in Kärrbo and Sevalla, 1814–21. Although Kärrbo represents the shortest period in the diary, Muncktell had arrived there in 1795. The diary's description of Kärrbo thus describes Muncktell's longest continuous period of farming activities in its mature phase, and therefore we pay special attention to Kärrbo when describing the dynamics of his farming in the following discussion.

Both parishes are situated in the county of Västmanland in central Sweden (Figure 1). At the time of our study the region in which both parishes were situated was characterized by its proximity to a number of urban centres. There was strong social polarization with both large mansions and an increasingly landless population. The supply of labour was very similar in the two parishes. In both, around 55 per cent of the working population were landless and 30 per cent were farmhands and farm-boys.[10] The agriculture, both Muncktell's and in general, was orientated towards grain production. The landscape was therefore dominated by arable land, with important elements of hay meadows and forest/outland for pasture.[11]

This economy was common to both Kärrbo and Sevalla, but there were also some differences between them. Kärrbo was dominated by large noble estates to a greater degree than Sevalla, which had a larger proportion of freeholder peasants. Sevalla had a larger proportion of forest in its landscape and thus, in theory, a greater potential for pasture. As we shall see, however, Muncktell's concern in both parishes was not so much the area of forest pasture *per se* as its quality and accessibility, in terms of clearing and fencing.

(a) Interpretation of the diary

The income of Swedish rural clergy was based on a mixture of tithes from the parish and the profits of their own agriculture. The priests' farms were managed in the same way as other farms. Although priests rarely performed manual work themselves, they usually planned and led the work. Muncktell spent much of his time in the fields, constantly developing his farms,

[10] Per-Göran Ersson, 'Kulturgeografiska förhållanden i Irsta, Kärrbo och Sevalla under 1810- och 1820-talen' ['Cultural geographic conditions in Irsta, Kärrbo, and Sevalla 1810–1830'], in Hellquist (ed.), *Prosten Muncktells dagbok*, II, pp. xii.

[11] Gadd, 'Jordbruksteknisk förändring'.

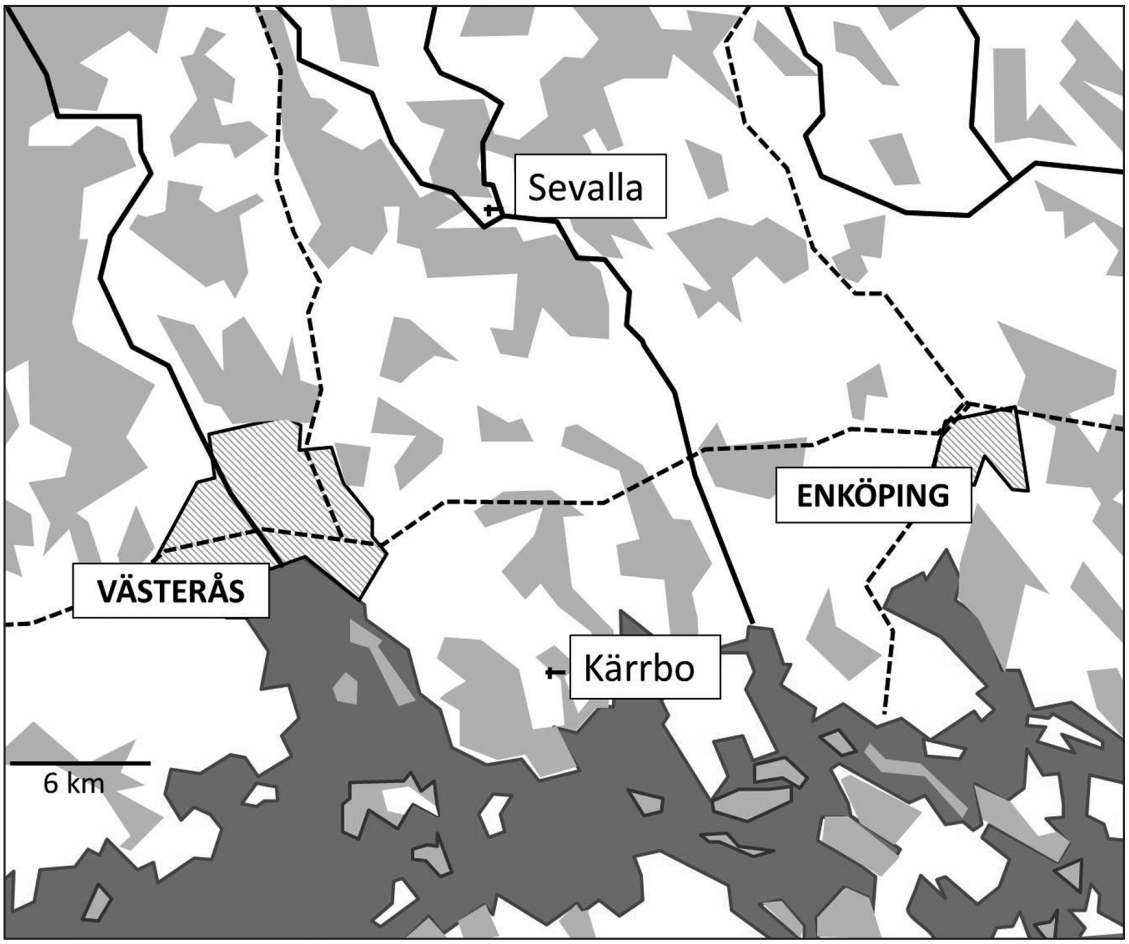


FIGURE 1: Map of the current region around Kärrbo and Sevalla.

Dark grey: Lake Mälaren; Light grey: forest; White: arable land; Solid lines: larger rivers; Dashed lines: main roads. The two towns of Västerås and Enköping are shown. The road passing them both is the highway between Stockholm and Oslo.

both by trying novel techniques invented elsewhere and by experimenting with new methods for shaping, maintaining, and harvesting his resources.

In this study we focus on those diary entries which described the management of the hay and pastures, both of which are strongly weather-dependent. Muncktell wrote about short- and long-term conditions for his farming, about daily activities, and, to some extent, the results of the activities. This enables interpretation of the entries in terms of cause, action, and effect. The entries were also interpreted in terms of which parts of the social-ecological system they related to, for example ecosystem resources and productivity, labour, technique, cost and market, his benefice, his social network, social conditions in the parish, gender relations, property rights, and so on. All these parts of Muncktell's area were listed as potential domains of the social-ecological system.

These tasks required the different disciplines to interpret the entries from their own perspectives. Furthermore, questions were repeatedly asked across the disciplines, and results were fed back into the interpretation process, using a hermeneutic interdisciplinary approach.[12] The interpretation process included shifting between the general and the specific, in which individual entries confirm the whole, and vice versa.[13]

When interpreting the diary we needed to be aware that we apply different perspectives when reading it to those employed by Muncktell when he was writing. For example, the diary provides a day-by-day description which is conditioned by an inherited system, largely lost to us, of social structures, experiences, and beliefs, as well as of inherited ecosystems which were largely formed by earlier generations of farmers. On the other hand, we can read Muncktell's diary entries knowing about the changes of agriculture and society that were to follow, but of which Muncktell was unaware. His diary's perspectives are those of in his world and everyday life, comprising a fine-meshed fabric of social-ecological details. Although his diary is exceptionally rich in reflexions and explanations, we can, 200 years later, only partly understand his world. On the other hand, we can retrospectively place Muncktell's world in a larger context, national and international, societal and economic, more accurately than he was able to do.

(b) Other sources and analytical tools

The evidence of the diary, as well as our interpretations of it, needs to be complemented with other sources of knowledge.

(i) Ecology of ecosystem resources

Muncktell's production system relied on three main types of ecosystem: summer pastures, meadows for the production of winter fodder (hay), and arable land, the last mainly for the production of cereals, vegetables, and flax, but sometimes for fodder production. A large proportion of the diary's entries which concern farming activities describe ecosystem resources and Muncktell's reflections on them. Knowledge of the relations between land-use activities and ecosystem processes and dynamics is necessary for interpreting the diary in an ecosystem resource perspective. Today, Muncktell's arable land and a great deal of his hay-meadows are entirely changed by subsequent cultivation. Most of his pastures, by contrast, can still be studied in the field since they are situated on till ridges in the landscape, which have escaped modern cultivation. We have estimated the productivity and drought-sensitivity of the ground vegetation based on classification of vegetation types.[14]

(ii) Cultural geography of Muncktell's farms

The geography of Muncktell's arena is shown by different types of cadastral maps. There are, however, no maps showing all types of land during the exact period when Muncktell was farming and the areas of his farms can only be approximately estimated by combining maps

[12] Per-Johan Ödman, *Tolkning, förståelse, vetande. Hermeneutik i teori och praktik* [Hermeneutics in theory and practice] (2007).

[13] Ibid., p. 67.

[14] Lars Påhlsson, *Nordic vegetation types* (1994).

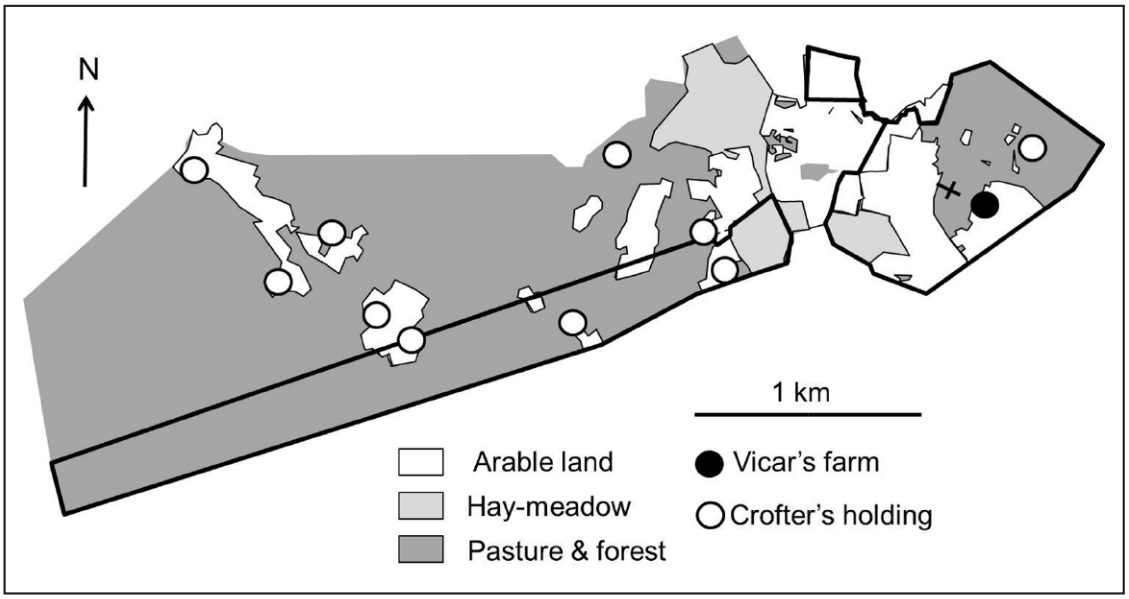


FIGURE 2: Land used by Muncktell at Kärrbo.

Areas delimited by bold lines were entirely the property of Muncktell; of the other areas he had a half share. Of the ten crofter's holdings, six belonged to Muncktell's farms.
Sources: Cadastral maps of Täby, 1728, 1788, Kärrbo 1848.

from different years. The first map covering the vicarage at Kärrbo was made in 1848 as part of the Swedish enclosure process, 35 years after Muncktell left the farm. The adjacent farm of Täby, which he partly used, was mapped somewhat earlier: a forest partition is shown on a map of 1728 while the infields were divided in 1788, at the time of Muncktell's arrival at Kärrbo. In addition, Kärrbo was included in a national initiative to map and describe entire parishes in 1852. In his second benefice, Sevalla, the situation is similar. The forest was mapped in 1741 and all land was mapped during, although not all included in, the enclosure act in 1858. Both processes concerned land division between the vicarage and the neighbouring village, Bro. Two small-scale maps show land-use and ownership structure of both parishes, one from 1905–11 and the other, which is based on an aerial photo, from 1959. Figure 2 shows the land Muncktell used in Kärrbo.

Different maps were made for different purposes, which largely determine how cadastral documents can be used as a source. Cautiously interpreted, cadastral maps provide a spatial background against which the main features of the agriculture, cadastral conditions, activities noted in the diary, social relations, and labour can be understood. The area of different land-use is given, and the productivity is indicated by notes made by the surveyor. Sometimes grain yields (yield to seed ratios), production of hay (number of hay carts), and pasture (number of livestock) are given in text.

We connected people mentioned in the diary to specific locations in the landscape, and estimated the size of the available labour force, by combining maps with the registers of

households maintained by the clergy. The combination of diary notes and place names in the maps enabled us to see where different activities were performed.[15]

(iii) Market and monetary economy

The diary contains numerous entries about selling and buying, prices and markets. We attempted to gather these in order to describe the monetary aspect of Muncktell's subsistence system, both the supply and the demand. This overall view is related to annual market and production conditions in larger geographical and organizational scales, in the parish, county, and nation.[16] Some particularly important sources of data are market prices and governors' reports from the county administration boards.[17]

II

As mentioned, in this paper we use the ecosystem resources of hay and pasture as an entry into Muncktell's farming system and the analysis of it in a social-ecological perspective. The diary provides a wealth of explicit information about activities and conditions more or less directly related to these resources, including both land-use and socio-economic aspects of ecosystem resources. More information of this kind could be implicitly derived from the diary when entries are interpreted in their social-ecological context with the aid of other sources. Individual entries could thereby be readily assigned to different domains and scales in a social-ecological system which gradually became better defined the more we processed the diary.

Initially we identified seven domains which occurred frequently in the diary's accounts of the handling of hay and pasture: (1) 'social relations', (2) ''market and monetary economy', (3) 'labour and technique', (4) 'ecosystems', (5) the benefice, (6) 'culture/local society'. The seventh, 'legislation', appears in the form of entries about the duty of road maintenance and difficulty of travel, and as well as the payment of state taxes. These entries are, however, rare and not linked by Muncktell to problematic weather conditions, and we therefore excluded this domain from the further analyse. The domains 'social relations' and 'culture/local society' appeared closely related and could be merged into one domain: culture and social relations. The benefice proved to be part of two other domains, namely 'culture/social relations' regarding Muncktell's position in the local communities, and 'ecosystem resources' regarding his tithe.

The remaining four domains are described below, followed by some examples of causality chains and relationships in Muncktell's farming, illustrating interactions between domains.

[15] The historical maps can be found at www.lantmateriet.se/Kartor-och-geografisk-information/Historiska-kartor/.

[16] E.g. Kärrbo parish archive, deposited in the Swedish National archive, Uppsala. Statistical tables, G1, ULA. Lennart Jörberg, *A history of prices in Sweden 1732–1914* (2 vols, 1972); id., 'Harvest assessments in Utterström', *Jordbrukets arbetare*, pp. 437–41.

[17] Jörberg, *History of prices*. Kongl. Maj:ts befallningshafvandes femårsberättelser [Governors' five year reports], Bidrag till Sveriges officiella statistik [Sweden's official statistics, BiSOS], Series H.

(a) Social-ecological domains and scales

(i) Ecosystem resources

During period under consideration, 1814–21, Muncktell's household was repeatedly affected by deficits of different ecosystem resources, in particular hay and pasture. In his diary, Muncktell reflected on the causes of his problems. He described various measures for solving the immediate problems as well as for increasing and improving the resources in a longer perspective, to avoid similar situations in the future. These crisis-related entries appear in the diary alongside detailed descriptions of the recurrent and periodic, everyday activities performed in the house as well as in fields, meadows, and pastures.

In both parishes, Muncktell's ecosystem resource was divided between his own land, containing meadows, arable fields and some pastures, and the village territory, containing the common pastures. The land belonging to priest's farm in Kärrbo constituted about 30 ha. of arable land, 20 ha. of hay meadow, and 100 ha. of forest and pasture. In addition, he rented a farm in the adjacent village of Täby which gave him access to another 12 ha. of arable land, eight of meadow, four hectares of unspecified crofters' land, and 70 ha. of forest and pasture. The farm in Sevalla (crofters' holdings included) had about 17 ha. of arable land, 15 ha. of hay meadow, and 30 ha. of forest and pasture.[18] On 8 March 1817 Muncktell bought an additional three ha. of forest from a neighbour, mainly for its timber and fencing wood, but also for its firewood.

In Sevalla, the vicar's benefice was entitled to collect tithe from the parish. If we interpret tithe from an ecosystem resource perspective, it can be regarded as an expansion of Muncktell's 'ecosystem territory' to the entire parish. The tithe, however, varied synchronously with Muncktell's own harvest. Not surprisingly, therefore, the diary shows no signs of parish tithe making up for shortfalls in weather-induced deficits of Muncktell's own production. The making up of shortfalls was instead, as will be described in the following sections, achieved by borrowing and buying cereals and hay cheaply within his social network, mainly consisting of neighbours and acquaintances belonging to the local elite. The social network spanned a larger geographical area than the parish, as well as over more levels of the society. The geographical and social extensions of the network seem to have generated a certain asynchronicity among the network members regarding the effects of biophysical variation. Some of the network members did better than the parish's farmers during the harsh years, and could therefore provide some of the commodities that Muncktell lacked.

We see that Muncktell used four main types of land-use activities to provide the household with the needed ecosystem resources, namely measures for *shaping, transforming, maintaining*, and *sowing/harvesting* the resources. Using this palette of land-use tools, he tried to optimize the type, amount, and stability of supply of various products. Production was however strongly affected by conditions out of the farmer's control, such as weather and soil. Measures of the first three types were used to improve the resources in the medium or longer term, while day-to-day problems were solved using the fourth type, by adapting the harvest methods. As will be described later in this article, the activities for manipulating the ecosystem resources

[18] Arable land from Ersson, 'Kulturgeografiska förhållanden'; meadow, pasture, and forest by combining the forest delineation of 1741 and the enclosure act of 1858.

were constantly combined with activities in the socio-economic domains of Muncktell's subsistence system.

Much of the resource used by pre-industrial agrarian societies was extracted from semi-natural ecosystems shaped by agriculture informed by locally adapted knowledge about ecological and socio-economic conditions.[19] At the time of the diary, most ecosystem resources in Muncktell's region had been created by earlier generations of farmers, but some *shaping* of new pasture resources seems to still have been possible. In Kärrbo, on 15 June 1815, during a severe deficit of summer pasture following a dry autumn, Muncktell decided to clear the forest in order to shape new semi-natural pastures: 'I walked in the forest between Starbo, Tistebo, Munkbo etc. and designated new areas for enclosing pastures for next year, which I will let old Jäderholm clear and cut this summer'. In October 1815 his initiative was rewarded: 'I saw with delight how the cut forest, through fencing and clearing, easily can become a good pasture'. In order to further improve the new pastures, Muncktell experimented with leaving some of the litter from the clearing on the ground, hoping that the nutrients in bark, leaves, and twigs would fertilize the grass.

By using cadastral maps in combination with place-names given in the diary, it is possible to locate Muncktell's pastures in today's landscape. Some of the old forest pasture is still grazed, but most is now ungrazed mixed forest or clearings made for forestry purposes. Field comparisons of currently cut and uncut forest in Kärrbo confirmed that the ground vegetation responds rapidly to the increased light influx following cutting, and, hence, that Muncktell's measures could increase the pasture supply considerably in good years. Field observation also showed that much of the forest was rich in boulders and rocks, with vegetation types characterized by recurrent drought. This indicates that clearing of the forest would have increased the pasture resources in rainy summers but very little so in dry years. A fluctuating resource must be occasionally deficient, unless the demand is based on the bad years.[20] It is possible that Muncktell would still have experienced the 1814 shortage of pasture even if he had had a larger pasture area, since the grass might have been killed by drought before it had time to become feed for the cattle.

Apart from the making of pasture from forest, very little new fodder-producing land was created during the period of the diary. The area of arable land was increased somewhat through the cultivation of hay-meadows, in particular on peaty soils.[21] This represents a *transformation* of one resource into another, and not an increase of the resource in total. Transformation of resources was a dynamic and mostly reversible process in Muncktell's agriculture, used both in shorter and longer time perspectives for adjusting the supply of resources. Some measures could be used with immediate effect, such as letting poorer hay-meadows for pasture. Other measures took longer to influence the resource, for example transformation of cereal fields into hay-meadow or pasture.

Muncktell used his labour to *maintain* ecosystem resources. On his arrival in Sevalla, he

[19] E.g., Fikret Berkes, Carl Folke and Madhav Gadgil, *Traditional ecological knowledge, biodiversity, resilience and sustainability* (Beijer discussion paper series, 31, 1993).

[20] Dahlström, *Pastures*.

[21] Swedish Land Survey Office [Lantmäteriet], Cadastral map T13:81, Forest partition Täby, and *Prosten Muncktells dagbok*, Kärrbo, e.g. pp. 118, 143, 150, 201.

found many of the pastures on his new land were overgrown by juniper and other shrubs. On 10 June 1818 he complained about the unsatisfactory previous management:

> Yesterday I began the clearing of the so-called Hästhagen, to the right of the road by the river. It is a both large and beautiful area, which would have been highly valuable if not being so neglected and overgrown. … It will take 50 days of work at the least, which, at a cost of 32 shilling and a dram per day, will cost me at least 35 riksdaler and 22 shilling.

The diary shows how a farmer could control some aspects of the *harvest* of ecosystem resources, where other aspects were in the hands of environmental factors out of his control. The yield of meadow hay was determined by summer growth and the success of harvest, i.e. of mowing and drying. Muncktell could only influence the harvest, which he attempted to optimize by utilizing the days with good weather if possible, and by procuring equipment for easier drying of the hay during rainy summers. The pasture resource, in contrast, can be assumed to be independent of the harvest success since the grazing animals can acquire the available fodder. Muncktell attempted to improve the summer growth by delaying the onset of grazing in some pastures.

(ii) Market and monetary economy

Muncktell's household was involved in a monetary economy at different levels, mainly for consumption and salaries. Although his own production provided a subsistence base in terms of cereals, potatoes, vegetables, dairy products, meat, alcohol, and textile fibres, the household's social position created a need for purchased products, some of them produced far away from the farm and parish. The household normally purchased one or two oxen for meat, pigs, poultry, meat products, fish, butter, cheese, syrup, sugar, salt, lemons, raisins, prunes, coffee, tea, red wine, hops, snuff, and tobacco. The household's labour was paid in both cash and kind, so its costs varied with the market-dependent salaries.

Muncktell's main source of income was rye, which he sold into a cereal market that he followed carefully to secure the best prices, and which was already internationally integrated. This implies that the ecosystem resource, i.e. the growth and supply of rye at the small scale, on Muncktell's farm, did not necessarily match the demand and prices at markets at larger scales. For example, in the two bad years of 1814 and 1815 Muncktell's harvest was poor, as was the local rye output in general in the parish of Kärrbo, with output as low as five harvested grains per sown seed.[22] However, neither the average Swedish harvest assessments, nor the price records indicate crop failure in a wider region.[23] Instead, rye prices at the northern European market were relatively low, and Muncktell thus suffered both from low production and low market prices.

Muncktell frequently complained about his inadequate hay supply, caused both by poor harvests and by the highly volatile price of hay. Since hay could not be transported long distances at a fair cost, the hay market was poorly integrated. For example, the price variation

[22] Kärrbo Parish archive, Statistical tables G1, ULA. Even worse harvests were to come 1818 and 1820.

[23] Harvest assessments: Utterström, *Jordbrukets arbetare*, pp. 437–41. Prices: Jörberg, *History of prices*, p. 142.

coefficient for the province of Västmanland 1803–20 was 42.7 for hay, compared to 29.6 for rye.[24] Therefore, shortages of hay were mainly solved by reducing the number of animals and via the 'semi-monetary' social network, as described in the previous section, rather than by purchasing more hay. Reduction of the number of animals was a simple and logical solution to the hay problem from an ecosystem perspective, but more complicated from an economic point of view. Muncktell was often forced to sell animals in the winter (when prices were low) and buy again in the spring (when prices were higher). Sometimes the high prices on hay coincided with low prices on Muncktell's cash crops. For example, when the price on potatoes was low in the autumn of 1815, Muncktell sold only six barrels of potatoes to Stockholm, compared to around 30 barrels a normal year. Instead, he considered feeding the pigs and cattle with potatoes and even thought about buying in potatoes for the animals.

The pasture resource, which, similar to the hay, was often in deficit for Muncktell, but there was no local market in pasture.

(iii) Labour and technique

The Kärrbo part of the diary provides details of the number of day-works available to Muncktell and their cost. At the priest's farm in Kärrbo, the permanent labour force consisted of three maids, two farmhands and one boy, all of whom were paid in kind. Then there were six crofters (tenants on very small plots of untaxed land) with their wives on the farm's land. Each of the crofters had to undertake two days of work per week, except for the inhabitants of the tenant croft Trångan, who worked a single day. Each crofter's family was annually paid 12 barrels of cereals, two carts of hay, and 6 pounds of meat by Muncktell. In addition, the crofters worked additional days for Muncktell, which he paid for in cash. From September 1814 to September 1815, the five male crofters together were employed for 350 extra day-works, and so about 920 days were worked in total by the crofters.

In Sevalla, the diary shows that Muncktell employed four maids and three farmhands, at least during his first years when there was much work to do improving the land, buildings and garden at the new farm. Three crofts belonged to the priest's farm, but the Sevalla part of the diary does not allow analysis of the number of day-works by them.

Beside this permanent labour staff, Muncktell hired extra labour when needed, both men and women, and often drawn from amongst 'the poor'. For example, on 30 January 1819 he noted: 'By the end of the week I let some poor clear for pasture in my home forest, and gave them 24 shillings in cereals a day'.

In general, Muncktell's farming was based on extensive manual labour with a low level of expertise. He experimented with some technical developments, but often discovered their disadvantages in the consumption of time or ecosystem resources. One example is his attempt to replace manual threshing using flails with ox-driven machine threshing. On 30 September 1814 he observed: 'Through the machine threshing more hay is needed for the oxen, which yet grow thin by the doubled work'. And further on 31 January 1815:

In general I have had little gain of the threshing machine. In all, each barrel of rye threshed

[24] Jörberg, *History of prices*, pp. 142, 206.

using machine this winter has cost me 2 riksdaler. Even worse, the straw becomes too damaged to be useful as roofing material. As I need much roof-straw I will now thresh one barn of rye manually, which I think will cost no more than 1.5 riksdaler.

(iv) Social relations

Muncktell was a man of the church, and also one of the larger farmers in his parish. In Kärrbo the priest's farm was larger, 150 ha., than any of the peasant farms, but smaller than the nobles' (200–800 ha.).[25] Like the manorial domains, his farm included several crofters' holdings, of which he had six where the peasant farms had no more than three.[26] Unlike the manors, he had no permanent staff but relied on a few maids and farmhands, crofters and casual day-workers. He was a considerable employer of labour from the lower social strata. The social stratification in the region created a supply of cheap labour, which was, conversely, a prerequisite for much of Muncktell's agricultural activities. Muncktell explicitly noted on 15 June 1819 that his extensive clearing of forest for pasture in Sevalla had only been possible because of the surprisingly low cost of labour, 30 days for one barrel of rye.

The tight connection between social stratification and Muncktell's need for labour is also shown by his handling of the vicar's social duties towards the poor. He tried to find arrangements for taking care of single mothers in ways that fitted into his own agricultural activities, for example on 13 October 1815:

> I finally finished the cottage of Wooden-legged Stina for Nettle-Anna and her children, in which I built double floor and mended the stove etc., so that neither vapour from the soil, nor draught, gas from the stove etc., that ended the previous poor woman, may harm this now hard-working maid and her little children. She is now living well, to earn herself with caring for my oxen, having her boy in school, and as a maid earn some further support etc., which pleases me in my heart since it cost me more than 25 labour days.

At a larger scale, Muncktell's social network, particularly among the higher classes in the parish, fellow vicars and relatives, was vast. The network functioned as a safety net that gave him access to loans, provided him with produce below the market price and other solutions to temporary problems, as on 2 May 1816:

> At Lindö Manor I also met Baron Cronstedt who yesterday had written to invite me and Mother [his wife] to Geddeholm … After lamenting over my hay which is all used up I was soon promised to send for a small cart of hay from Geddeholm.

The network, however, was not free. As Muncktell was expected to assist in return, the network made him part of a reciprocal system of favours. Furthermore, maintaining his network and social status was costly in terms of both money and ecosystem resources. Membership required the purchase of a variety of luxury foodstuffs, which was an important reason for the household's need for cash and cash-crop production. Pork or ox steak was served on the

[25] Kärrbo parish map 1853, Swedish land survey office.
[26] Ibid.

banquets. The cost of keeping pigs concerned Muncktell since they required more resources than the grazing livestock:

> Neither can the distillation in the summer be enough to sufficiently feed them with draff, nor can they be let in the pastures as the grass is tiny and in deficit. … in the summer the fallows become too dry and scanty for their living.[27]

In general, Muncktell describes his duties of being a good host to people from his own social stratum as an economic burden. A typical diary entry was made on 27 August 1817:

> At lunch Nohrforsson's girls arrived and Mother [his wife] had to cook her last chicken. Even more, in the afternoon Mrs Prinzensköld came with her two daughters, using Capt. Leijonflyckt's horses; all of which needed to be treated. The horses were let to nibble in a pasture and brought their ladies home by the evening – poor Mother who frequently must host guests in this meagre time of the year.

At the smallest organizational scale, the agrarian household of Munktell had, for its time, a typical division into male and female working spheres. In simplified terms grain production and use of land for fodder, grazing, and forest were responsibilities of the men, while milk production and food processing were the women's responsibilities.[28] Women took care of the animals except for the horses and oxen, control of which fell within the male sphere. A certain competition for resources between the spheres can be assumed, as well as some diverging choices and priorities, but the diary rarely mentions this. One implicit example is when Muncktell and his wife, Christina, came to different conclusions regarding the rationale of producing flax. Christina questioned the profitability, but Muncktell could change the equation by lending 12 days' of 'his' labour to Christina for the processing of flax. He found the cost of this work to be low since it could be performed at a time of the year (November) when the workers had few other duties.[29]

The differences between the male and female spheres present a methodological problem since the diary often mentions only half of the problems and solutions. For example, the motive Muncktell gives for improving the pastures was the lack of hay for oxen and horses whereas any corresponding problem for the cows and sheep is never mentioned. The lack of any female perspective may on the one hand make the household look more homogenous than it was, but may on the other hand hide a degree of interconnection between the two spheres. Although not mentioned in the diary, the drought was naturally a problem also for the cows and his wife's milk production, and, conversely, Muncktell's actions to overcome the deficit of pasture and hay also benefited 'his wife's' dairy cows.

(b) Interactions between social-ecological domains and scales

Muncktell's detailed diary provides several examples of how different domains of the household's social-ecological arena interacted. Below we describe two examples starting from the harsh weather's effects on the supply of pasture and hay. The background to both examples

[27] 15 June 1819.

[28] Martine Segalen, *Love and power in the peasant family: rural France in the nineteenth century* (1983).

[29] *Prosten Muncktells dagbok*, I, pp. 188, 196.

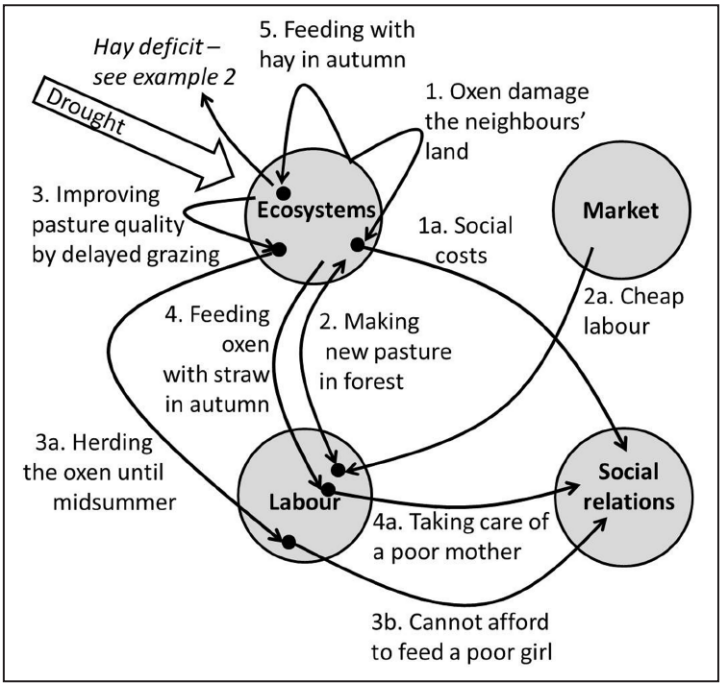


FIGURE 3: Some activities, and their effects, performed by Muncktell's household in order to handle the pasture deficit in dry years during the period 1814–1821.

The grey circles represent domains in a social-ecological system, see the text for explanation. Black dots represent nodes at which one domain is linked to an activity or effect in another domain.

is the social-ecological system surrounding Muncktell's extensive cultivation of cash crops, in particularly rye. This SES can be described as follows. The cultivation of rye was motivated by the household's high costs for labour and consumption, the latter in turn largely necessary for the household's social status. The rye cultivation required many oxen and horses for traction power. Muncktell had as many as 12 oxen and 4 or 5 horses, with which he cultivated *c.*50 ha. of arable land per year. The animals required large quantities of hay and large areas of pasture, but the rye cultivation decreased the supply of hay since rye was favoured on arable land at the expense of hay production. In all, the system had become vulnerable to years with low grass production.

(i) Pasture deficit

In Sevalla, the forests did not provide enough pasture for Muncktell's oxen, which therefore tended to break through fences to graze on the meadows and fields of other villagers (1 in Figure 3). The pasture deficit is an ecosystem issue and so is the oxen's behaviour in the pasture, hence an arrow entirely within the ecosystem domain. Muncktell's oxen caused problems for the neighbours and thus for Muncktell's relations to them (1a). In this case, a problem in the ecosystem domain gave rise to a problem in the social relations domain, which is illustrated with an arrow from ecosystems to social relations in Figure 3. Muncktell tried several ways to overcome the pasture deficit. He created new pastures in the forest (2), which was possible because of the cheapness of labour (2a). The supply of labour (as previously described in the section 'Labour and technique') was used to improve the ecosystem resource, shown by the arrow from labour to ecosystem. But Muncktell's hiring of labour for clearing the forest pasture can, conversely, be assumed to have been a significant

part of the local labour market, hence an arrow from ecosystem to labour. The amount of labour which Muncktell could afford was increased by the low wages (arrow from market to labour). Muncktell also experimented with delayed grazing and other means to increase the grass production in the new pastures (3). Delayed grazing required herding of the cattle in the forest until the new fenced pastures were ready, and to do this job he employed a herder (3a). The diary shows an unexpected social effect of this measure. Muncktell sometimes took care of poor children: he hosted them and sent them to school, but when he took on a herder he could no longer afford to care for the poor girl he had at the moment (3b). On 25 May 1819 he notes that 'she will regrettably be back in the pack of beggars'. We interpret this sequence of events as follows: that a measure within the ecosystem domain (delayed grazing) affected the social domain (Muncktell had to give up one of his social commitments), via the labour domain (employing a herder). When the pasture became scarce in the autumn, the oxen were fed with supplementary straw at night (4). For this task, Muncktell employed the poor mother Nettle-Anna for whom he had refurbished a cottage (4a). As an emergency measure in Kärrbo, Muncktell even used hay in the autumn (5), which enhanced the deficit of hay, see the next example.

(ii) Hay shortages

Muncktell seems to have regularly suffered from a shortage of hay in the late winter, a problem that was particularly pronounced in years of drought (poor growth) or rain (difficult harvest). He combined different measures to solve the problem. One was to use arable land for hay production (1, Figure 4), either by sowing clover or timothy or by allowing natural grass growth. This is a transformation of ecosystem resources, as illustrated by an arrow within the ecosystem domain. This measure reduced the area available for production of rye and thus the production of rye for sale (1a). Thus, the arrow indicates that the ecosystem measure had an effect on the market domain. Another possibility was to sell a horse in the autumn, and buy one back in the spring, however usually at a higher price (2). The most important measure was to borrow or buy hay from friends and neighbours within his social network (3). This created social debts (3a) and Muncktell was expected to give favours in return, for example to provide cheap (below market price) rye when requested (3b). When the hay prices were high and prices on cereals low, Muncktell chose to feed the animals with cereals (4), which reduced the amount he could sell (4b). Finally, Muncktell used the boys he was catechising as labour for collecting leaf fodder to supplement the hay (5).

(iii) Further activities related to deficit of pasture and hay

Both examples above show five chains of interactions between activities, causes, and effects. In this way we identified all activities trigged by the shortfall in hay or pasture during 1814–21, and traced them through the diary to identify chains of interactions. All identified activities and chains of interactions we found in the diary are illustrated in Figure 5.

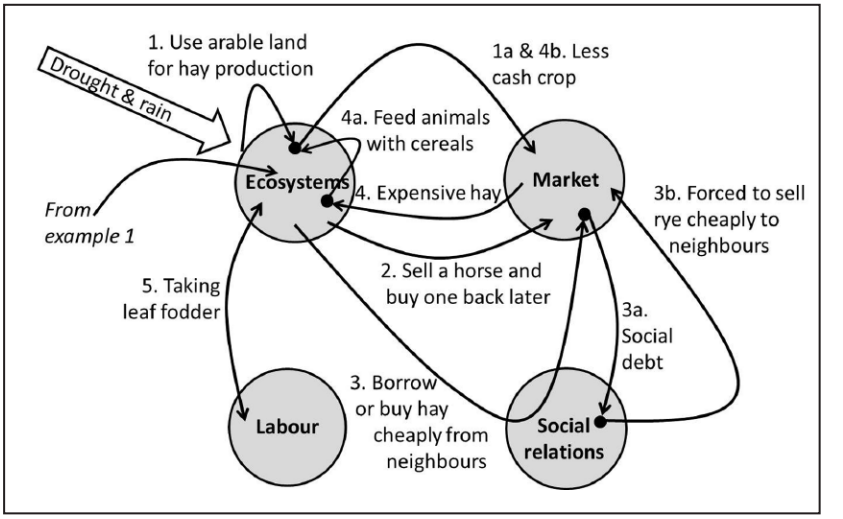
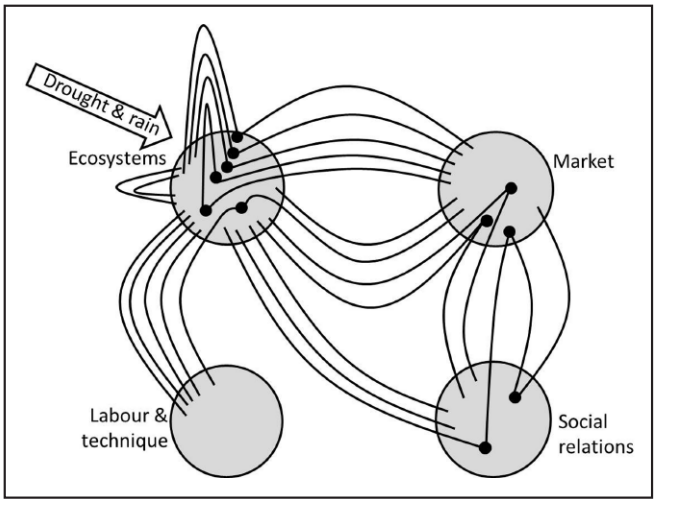


FIGURE 4: Some activities, and their effects, performed by Muncktell's household related to hay deficit during the period 1814–1821, see the text for explanation.

The grey circles represent domains in a social-ecological system, see the text for explanation. Black dots represent nodes at which one domain is linked to an activity or effect in another domain.



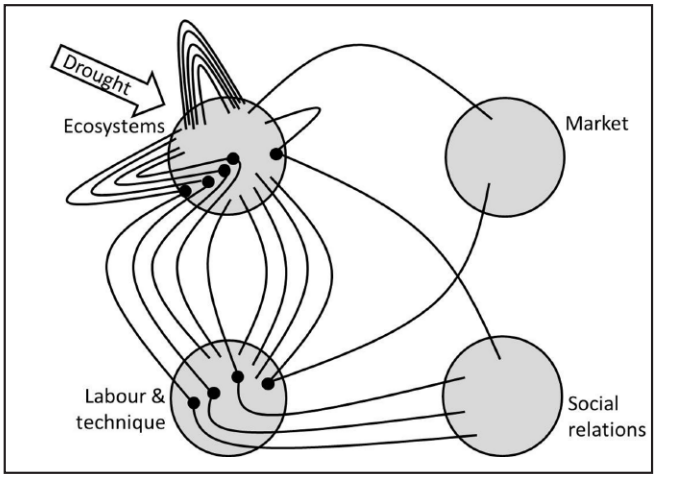


FIGURE 5: Graphic representation of all activities, and their effects, performed by Muncktell's household for handling the deficit of pasture (above) and hay (right) 1814–21. The graphs are made as described in the examples in the text and Figures 3 and 4. For simplicity, the lines show only the interactions between domains, not the direction of the interactions.

III

Muncktell's diary is considerably richer in detail than most Swedish farmers' diaries, particularly in his observations and reflections. Although farming activities were not systematically noted, the wealth of information about other aspects of the household and society makes it a rich source for our knowledge of pre-industrial agriculture, in many aspects richer than archival records bearing directly on farming such as accounts.[30] The social-ecological framework has proved to be a useful tool for sorting and analysing the immense amount of information provided by Muncktell's diary, and, in particular, for understanding how a pre-industrial agrarian household depended on interactions between the socio-economic and biophysical environments.

Most of Muncktell's diary entries describe *conditions*, good and bad, for the household, the *activities* performed to handle the conditions, some *effects* of the activities, and his *reflections* about all this, including on short-term and long-term needs, expected effects of conditions and activities, and potential problems and possibilities. When interpreting the diary from a social-ecological perspective, a general methodological conclusion can be made: it is obvious that the entries in the diary about conditions largely describe the *state of the domains* of the system, including variation and change. The activities, in contrast, appear to constitute *interactions between domains*, and can thus be seen as the glue that keeps the domains together.

We would not have been able to draw this conclusion without Muncktell's own thoughts, which provide a necessary micro-economic background and explain the activities in terms of causes, mechanisms, and effects. Other Swedish farmer's diaries usually describe the activities performed, but rarely other conditions than the weather. Perhaps, our contextualizing of Muncktell's rich additional information can be a tool for interpreting other, more taciturn, farmer's diaries.

(a) The household arena: the scale of social-ecological domains

When categorizing the information, a majority of the diary entries could be assigned to one or other of the four domains (ecosystem resources, labour, market, or social/cultural relations). When interpreting the entries in order to understand problems, constraints, and possibilities of importance for Muncktell's subsistence system, the four domains together provide a very useful blueprint of the household's social-ecological arena. They are explicitly mentioned by Muncktell throughout the diary, and could also be implicitly discerned in our interpretation of his diary.

The range of scales at which the household manoeuvred differed between the domains. The *ecosystem resource domain* was mainly restricted to Muncktell's own farms, with some spatial extensions to the village through common pastures, to the larger neighbourhood via borrowing or purchasing products from neighbours, and the entire parish in Sevalla through the tithe. The *labour and technique domain* was based on labour for help in the house, crofters inhabiting the crofts at Muncktell's farms, and casual labour, mainly poor people from the

[30] Cf. R. W. Hoyle, 'Farmer, nonconformist minister and diarist: the world of Peter Walkden of Thornley in Lancashire, 1733–34', *Northern Hist.*, 48 (2011), p. 294. Hoyle came to a similar conclusion regarding accounts.

parish. In the *social and cultural relations domain*, the household's social network spanned from the internal household relations to a geographically spread network of relatives, clerical colleagues, and upper-class acquaintances. Most of the household's social relations, however, occurred within the parish or its close neighbourhood, either with persons of Muncktell's own social status, or with the poor, who laboured on his farm. The *market and monetary economy domain*, finally, ranged from trade of products and labour within the parish, to sale of crops into northern European markets.

(b) The household's activities: interactions between social-ecological domains

In some years during the study period, bad weather and poor harvest caused resource problems, which Muncktell frequently described in terms of crises. For example on 25 February 1815: 'I have now farmed this land for 19 years, and this is the worst failure of crops I have experienced. … How I will be able to manage this year passes my comprehension'. The direct problem, thus emerging in the ecosystem domain as deficit of resources, can be analysed in the context of other domains, both regarding its causes and how it was handled.

The analysis shows interesting differences between how the pasture deficit and the hay deficit was handled. As seen in Figures 3 and 5, the *pasture deficit* initiated labour-intense actions that were possible because of the availability of cheap labour, which arose as a result of the social stratification in the society and of Muncktell's relations to the lowest social groups in the parish. Most of the actions were aimed at extending and improving the farm's own pasture, i.e. at *increasing* the resource, both to overcome the immediate problem and for reducing the risk of future pasture deficit. Other options for overcoming temporary deficits of pasture were few and really restricted to making more use of the common pastures by herding. Here we see strong social-ecological interactions between the pasture resource, labour, and social stratification, and that fluctuations of the pasture resource could hardly be compensated for.

The *deficit of hay* was, in contrast, handled mainly through Muncktell's relations to the higher social groups, from whom he could borrow or cheaply buy hay (Figures 4 and 5). Muncktell's actions were thus mainly aimed at accommodating shortfalls of the hay supply, rather than to increasing his own supply. Some measures were taken for improving the drying of hay, i.e. for reducing the fluctuations, but hardly any significant actions were taken to increase the total hay resource.

The relationship between the labour for agriculture and social stratification has been studied at regional and national levels.[31] The analysis of Muncktell's diary illustrates this relationship at a micro-level. Labour was needed as result of ecological pressure, either for larger works such as clearing of forest for pasture, or for special tasks such as herding of oxen. In some cases, poor people were employed on a casual basis, but to a considerable extent Muncktell obtained labour by providing socio-economic positions for landless persons, in return for accommodation, i.e. cottages and crofts. Many different tasks on Muncktell's farm conferred some social and economic security, not the least shelter for the winter.

The analysis also suggests an interesting link between the social organization of agrarian labour and the utilization of ecosystem resources. Information about the geography of

[31] E.g. Utterström, *Jordbrukets arbetare*.

Muncktell's crofts and cottages can be used to study the old croft sites in the field in order to estimate their resource potential. In both Kärrbo and Sevalla, the croft-holders were located on small, fragmented, low-productive, usually distant, pockets of meadow and arable land. It is likely that these factors would have made it difficult for the main farm to utilize this marginal and distant land without help from crofters settled there. Conversely, payment to the crofters in kind or cash was a necessary complement to the crofters' subsistence. The crofter's system may therefore be regarded as an expansion of the total ecosystem to areas and resources which otherwise would probably have remained unused. It is significant that most of the crofters' land is now abandoned.

Problems in one domain may exacerbate problems in other domains. Such so-called cascade effects[32] were not found by our analysis of Muncktell's agrarian household, apart from a negative feedback loop connecting rye cultivation, winter fodder, and monetary loss, which is discussed in the next section.

(c) Occasional catastrophe or unbalanced agriculture?

In this study, we have in particular looked for effects of the bad weather years in the early nineteenth century. Drought, frost, and rain forced Muncktell to take drastic actions, often in ways that caused him new problems later. He sold horses in the autumn only to buy new ones in the spring. On 3 October 1814, he had to begin feeding his oxen with hay before the end of the grazing season: 'Now all the pasture is consumed. … I had no other way out than to use the spring barn, which, thus, in the spring will need to be filled with purchased hay'. Measures like these may have served as emergency solutions to problems. They may have caused new and temporary problems later, but without affecting the subsistence in the long run. There are, however, signs of more permanent, or at least regular, imbalance between supply and demand. Muncktell complained about a constant hay shortage, as on 4 March 1816: 'The usual problem with hay deficit, also this year seems to fall to me'. Also there seems to have been a recurrent shortage of pasture, triggered by even relatively moderate drought. It appears that for both hay and pasture, stock numbers had reached a critical maximum threshold, with little margin for years with lower fodder production – years that would inevitably come.

Muncktell's heavy demand for fodder was a result of his large stock of oxen, which was necessary for working the large rye fields. From a social-ecological perspective, Muncktell's extensive rye cultivation had generated a feedback loop that leaked nutrients and monetary resources in every turn. Large areas of rye reduced the area for hay and pasture and required many oxen to work the fields. The oxen needed hay (even in the summer because of pasture deficit), which partly had to be bought with money from the selling of rye. Increased costs of hay required a greater cultivation of rye.

Muncktell sometimes tried new strategies in order to break out of this loop, for example by feeding the animals directly with potatoes and cereals instead of selling them and buying hay. Such actions, however, carried costs in the market and ecosystem domains of the SES: it reduced Muncktell's income and it reduced the nutrient status of the fields because the manure-producing livestock were fed with crops produced on manure-fertilized fields.

[32] Kinzig *et al.*, 'Resilience'.

The negative feedback loop illustrates, at the micro-level, the so-called dilemma of reclamation, describing how increasing the area of cultivated arable land leads to an imbalance in the proportions of arable fields, hay-meadow, and pasture in the production system.[33] Interestingly, Muncktell's diary shows that he could well have chosen a more balanced proportion of the fields for production of hay and pasture instead of rye, and that the transformation of meadows and pastures to arable fields was thus not irreversible. He cultivated small quantities of hay – for example, timothy – and in emergency situations he could convert arable land to pasture. On 19 June 1815 Muncktell:

> decided to transform both fields at Tistebo to pastures. … As I don't have manure at Tistebo, and the fields at home need all the manure that can be gathered, I find this measure wise, especially since there is now so unusually little pasture.

We can therefore conclude that Muncktell's problems with the fodder supply was mainly a question of too high a demand, not too little production capacity on his farms, and that the reasons for his unbalanced field-meadow-pasture ratio were socio-economic rather than ecological. Probably, Muncktell's expensive social status also forced or tempted him to cultivate cash crops on land he would have been better using for production of fodder. Muncktell seems to be approaching a monetized agriculture, but based on natural resources that were still largely in the hands of variable weather and ecological processes, which were out of his control. We don't know whether this situation was specific to Muncktell or whether it applied to other representatives of the local elite too, as well as to the peasants. As mentioned in the introduction, however, the agriculture of the whole region had a strong focus on the production of rye for sale, driven by a strong demand from the towns and the iron-producing industrial regions to the north. We might therefore suspect that the signs of an unbalanced agriculture which we can discern in Muncktell's diary, represent a more general regional trend.

No doubt the negative loop described above, together with the focus on one major crop, would have increased the sensitivity of the system to both environmental and socio-economic perturbation. Seen from a social-ecological perspective, Muncktell's diary becomes a description of a household's struggle to reconcile a changing society with an uncompromising natural environment.

[33] Gadd, 'Agricultural revolution', p. 235.