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Local protein sources in animal feed - Perceptions among arctic sheep farmers

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ABSTRACT

Structural change and efficacy measurements have made Norwegian livestock farming dependent on imported protein-rich components in feed concentrate. The increasing global demand and competition for stable protein sources has spurred a new debate on food security and utilization of local resources. Certain local species have been identified as promising alternatives to imported sources because of their high level of proteins, such as legumes and seaweed. In Norway, the use of seaweed as both food and feed has historical roots reaching back to the Viking age. To replace or reintroduce local protein sources requires substantial and long-term investments in both competence, technology and market mechanisms. At the same time, the unstable situation in global markets for protein rich feed components, makes the vision of sustainable local protein sources difficult to refuse. Little is known, however, about large scale and sustainable manufacturing and distribution of concentrate based on these local resources, nor of farmers' willingness or ability to make use of these resources. This paper seeks to identify and explain sheep farmer's perceptions towards the vision of increasing the use of local protein sources in arctic sheep farming. Based on in-depth interviews with active and retired sheep farmers in coastal and inland Northern Norway, we have explored the dynamic relationship between biophysical and political conditions for farming, and the farmers' willingness and capacity to adapt to new and alternative sustainable practises. Through narrative analyses of farmers' storylines four archetypes were co-constructed, that each explain critical dimensions to farmers' perceptions towards increased use of local protein sources. Building upon insights from adaptive capacity literature and social embeddedness theory, the study shows how farmers' meet these limiting conditions through proactive or reactive responses. The archetypes can inform the wider debate on sustainable feeding regimes at various scales, by revealing context-dependent and endogenous factors that shape farmers responses to change.

1. The need to change

To gain sufficient animal feed is a growing challenge for global food security and production, both marine and terrestrial (Verbeke et al 2015). Costs on protein and fat acids are expected to increase substantially on the global market, because of the limited availability of conventional feed resources such as soymeal and fishmeal, ongoing climatic changes and food–feed–fuel competition (Makkar et al., 2014). European meat production is increasingly dependent on imported protein sources for concentrate feed, such as soya from Brazil (Leonardus et al., 2014; Mølstre, 2016). As a response to this, a renewed interest in locally produced feedstuff has emerged. In Norway, several rationales for increasing locally produced feed exist. One rationale is nationally framed as a need for strengthening Norway's food security, food sovereignty and self-sufficiency by securing its potential to produce more food using domestic resources (Bjørkhaug et al., 2012; Vinge, 2015). Globally connected rationales such as climate change and unsettled financial global markets (Brobakk and Almås, 2012) and socio-ecological sustainability at the local level (Marsden, 2012) have also been raised as reasons to change practices. At the same time, novel proteins require the development of new value chains, which leads the attention to issues such as production costs, scalability and consumer acceptance (Henchion et al., 2017)..

To be able to facilitate changes in farmers' feeding regime and practices, the policy makers need to understand which factors that influence the farmers' perception and response to change. People's perceptions and local contexts have the potential of determining their behaviour toward carrying out adaptation. These factors are therefore critical in planning phases and the implementation of adaptation measures that are suitable for the farming communities at the local level (Pyhälä et al., 2016). This paper seeks to inform this debate by exploring how farmers in Norwegian arctic communities perceive and respond to ideas of replacing imported soya with locally produced protein sources. Farmers' perceptions, attitudes and practices are

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embedded both in the biophysical and social worlds (Feola et al., 2015; Ahnström et al 2009), including access to pastures and cultivated land, farming practices, cognition and networks, both in present time and across generations (Erickson, 1988). With a focus on farmers' adaptive capacity to change, we seek to understand their perceptions as derived from both their ability and willingness to change, that is from both etic and emic perspectives.

The results build upon qualitative interviews with sheep farmers in four arctic communities in Northern Norway; two in coastal areas and two in inland areas. Farmers living in the coastal areas have traditionally fed their animals with seaweeds, especially during lean feed seasons, and there are stories dating all the way back to the Viking age about using seaweed as food and feed. Free-range ruminants have been observed to willingly graze on beach-cast seaweeds. Legumes also used to be more commonly used on farms, both in the coastal and mountain areas, in combination with grass production.

In the following section, the potential for using local-produced seaweeds and legumes as alternative protein-sources is presented, before the methodological approach is outlined. Then we present our narrative methodologic approach and four co-constructed archetypes reflecting the farmers' perceptions as derived from their feeding regime and practices. Finally, conclusions and implications for further research are outlined.

1.1. The potential of legumes and seaweed

An increasing interest in locally produced feedstuff for ruminants is the background for the project *"Legumes and seaweed as alternative protein sources for sheep"* that was launched in 2014. This project is carried out by researchers from Norway, Denmark, Switzerland, and Spain, and the main goal of the project is to identify locally produced legumes and seaweed that can replace imported soya. This study is a result of one part of the project, that aimed to increase the understanding of farmers' attitudes related to using local protein sources.

After the foot and mouth disease, the animal feed industry is constantly looking for new sources of high quality protein, in order to reduce imports and ensure sustainable and environmentally-friendly animal production systems. Current feeding regimes are closely interlinked with global trade regimes, Norwegian regulation, and Brazilian management regimes regarding GMOs and exports. Norway does not allow for GMOs in feed or food and presently has agreements with non-GMO soya growers in Brazil and Canada. Concentrate feed is blended by Norwegian feed suppliers who buy the ingredients from both domestic production (mainly grains and rapeseed) and foreign suppliers (both sources of carbohydrates and proteins). According to *Felleskjøpet*,[1] proteins from soya make up about ten percent of the concentrate blend to livestock feed.

Legumes and seaweed may prove to be a viable alternative for locally-sourced protein (Stévant et al., 2017). Protein is the most critical component contributing to the nutritional value of the feed. Generally, the crude protein concentration is high in red and green seaweed (10–47% of the dry weight) compared to that of brown seaweed (3–15% of the dry weight) (Arasaki and Arasaki, 1983; Tayyab et al., 2016). Forage legumes such as white clover (*Trifolium repens*) and red clover (*Trifolium pratense*), lucerne (*Medicago sativa*) and birdsfoot trefoil (*Lotus corniculatus*) can give relatively high yields of crude protein (Wilkins and Jones, 2000). These forage crops are characterized by inducing high feed intake (Fraser et al., 1999), and Harris et al. (1997) demonstrated higher intakes and milk yields for silage made from white clover, red clover and lucerne than from grass silage (Dewhurst et al 2003). There are major differences between these forage crops. On the one hand, white clover and lucerne may have many of the disadvantages of grass silage with low concentrations of water soluble carbohydrates and extensive proteolysis resulting in feed with low levels of true protein (Wilkins and Jones, 2000). On the other hand, silage made from red clover and lotus may also contain high levels of true protein.

While protein levels have been proved high in both legumes and seaweed, varying with species and seasons, multiple challenges remain to be solved to achieve efficient and economically viable processing of these proteins into digestible feed. These challenges need to be solved if these local species are to become substitutes for imported protein sources. Changing a key component, like protein sources, in feeding regimes may influence sheep farming in multiple ways, such as economics, animal welfare and growth, and vulnerability of protein supply. It is therefore necessary to see farmers' ability and willingness to adapt, as an interaction among different drivers of change.

2. Investigating farmer's response to change

This study has a theoretical point of departure in the literature that position farmers' perceptions and practices as deeply embedded in both their biophysical and social relations (Lerner et al., 2015). While part of the literature to explain farmers' behaviour assume models of rational action drawn from economic theory, their critics claim that such reductionist behavioural models tend to result in a "technical fix" approach when translated into policy, involving informational, technological or economic measures only (Lerner et al. 2015). In this study we position farmers, their actions and perceptions as embedded in agricultural systems. Social-ecological systems and resilience theory see such agricultural systems as subject to continuous change and fluctuation (Aldunce et al., 2016; Cambell et al 2012). For example, are climate change and predator populations fundamental structures in mountainous social-ecological systems, including sheep farming (Risvoll, 2015). Also, changing agricultural policies and subsidy regimes represent structures towards which Norwegian farmers operate within. Together, these interacting processes shape farmers' livelihood, practices, access to resources, social organizations, settlements as well as preferences, perceptions and priorities (Nelson et al., 2008).

A second point of departure in this article is the perspectives demonstrating how farming requires adaptive or even transformative responses (Folke et al., 2010; Risvoll, 2015; Rybråten and Hovelsrud, 2010) to ongoing processes of change. Adaptive capacity literature is valuable for understanding the dynamics and interactions of intertwined human relations with nature, and mechanisms that support responses to change (Lockwood et al., 2015; Plummer and Armitage, 2010). This encompasses studies on farmers' ability to succeed while facing changing conditions and uncertainties (Dannevig et al., 2015; Kvalvik et al., 2011; Patt and Weber, 2014). Determinants of adaptive capacity represent the multiple assets that are available to actors of northern communities and nature based industries; for instance, natural, social, human, cultural, financial capital, as well as infrastructure (Kofinas et al., 2013). Natural capital of sheep farmers refers to biophysical conditions, for instance pastures with palatable grasses and herbs, and access to land. Social, human and cultural capital reflects the network, cognition and practices through which shared understandings and perceptions also evolve. This resonate with social embeddedness theory and how the perceptions of one individual are connected to the perceptions of others through social networks. Farmers are embedded in structures and relationships within farming communities of northern Norway, reflected in common norms, trust and reciprocity (Dacin et al., 1999). There are expectations on conformity to ethics of "good farming" (e.g. Burton, 2004) in shared expectations. This also means that the concentrate feed regime represents a structure within which practices and perceptions are embedded. Granovetter (1985:504) states that *"most behaviour is closely embedded in networks of interpersonal relations"*. Such embeddedness can take form as relational (trust, reciprocity, and common norms) (Simsek et al., 2003; Uzzi, 1997), structural (closure, density, connectivity and hierarchy) or cognitive/cultural embeddedness (symbolic representations, frameworks of meaning and shared understandings among actors) (Dacin et al., 1999).

[1] The major farmer owned feed supply company and farm input cooperative.