Supporting community governance in boreal forests by introducing participatory GIS through Action Research*

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We use the case of Vilhelmina Upper Forest Common (VUFC) in northern Sweden to test whether the introduction of a Participatory Geographic Information System (PGIS) can increase shareholder engagement. We take an *Action Research* approach to introduce a PGIS as a tool to help with forest management plans, and as a tool for communication between management and the shareholders. We found that the board and shareholders were initially resistant to adopting PGIS. However, continued collaboration and engagement seem to have encouraged the board to be more pro-active in their communication with the shareholders, and also more transparent regarding the management/governance of VUFC. We also find increasing interest among previously passive shareholders to engage in their forest common's management.

Key words: community forestry, Sweden, technology adoption, forest governance, participatory GIS

* Acknowledgements

We would like to thank the Swedish Research Council Formas through the PLURAL project, and the EU Baltic Sea Region Programme through the Baltic Landscapes Project, for funding our work with this manuscript.

International Journal of Action Research, 11(3), 2015, 236-264 DOI 10.1688/IJAR-2015-03-Poudyal
ISSN 1861-1303 (print), ISSN 1861-9916 (internet)

1. Introduction

Participatory governance of natural resources, especially forests, has received a great deal of attention worldwide in recent years: highlighted by studies in Japan (McKean, 1992a); South Asia (Adhikari, 2005; Adhikari & Lovett, 2006; Agrawal & Ostrom, 2001); and Western Europe (Bravo & Moor, 2008; Holmgren, Keskitalo, & Lidestav, 2010) to name a few. The increasing interest and importance of this area of study has also been underscored by the economics Nobel Prize to Elinor Ostrom in 2009 "for her analysis of economic governance, especially the commons".[1] Notwithstanding the difficulties associated with the governance of the commons, particularly due to the subtractability of the resources such as forests and fisheries, and high cost of exclusion of non-members (Becker & Ostrom, 1995; McKean, 1998), studies worldwide have shown that many of the locally and traditionally managed commons can perform as good as or even better than public and private resource management institutions under certain conditions. These conditions have been promulgated as the "design principles" for successful and long-enduring commons (Becker & Ostrom, 1995; McKean, 1992b, 1998; Ostrom, 1990). A more recent meta-analysis pointed out many of the same characteristics for successful community-managed forests around the world (Pagdee, Kim, & Daugherty, 2006). More importantly, commons share more characteristics with 'private property' than often assumed. McKean and Ostrom (1995) make this explicit when they state: "It is crucial to recognise that common property is *shared private property* and should be considered alongside business partnerships, joint-stock corporations and cooperatives" (emphasis original). This 'private property' characteristic is more nuanced in the case of modern forest commons in Sweden, as they are constituted from part of the private estates to which the shares are tied and cannot be owned or sold in isolation (see below).

While the institutions such as forest commons should be participatory by definition, they often exclude large sections of their stakeholders in governance and in benefits sharing. These very stakeholders are, on paper, members

[1] Nobelprize.org (http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/press.html), accessed on 2 January 2014.

of those institutions, a phenomenon Agarwal (2001) terms 'participatory exclusions'. She presents a 'typology of participation' where most of the marginalised sections' participation is limited to 'nominal' or 'passive' participation (ibid., pp. 1624-1625). Although the case of Swedish forest commons is rather different from many of these cases from developing countries, as we shall see later, the issue related to participation (or lack thereof) in the governance and decision-making, is rather similar, where the overwhelming proportion of shareholders' participation is limited to 'nominal' or 'passive' participation.

Although participation in community-based forest governance in itself does not guarantee success of such institutions (Agarwal, 2001), active and dynamic participation of the members in the management, governance and decision-making has been linked to the success of forest commons (Agrawal & Chhatre, 2006). However, previous studies of some of the Swedish forest commons have not only pointed out the diminishing role of shareholders in terms of governance (i.e. "decision-making rights") of their commons (Stenman, 2009), but they have also pointed to the fact that the shareholders in Swedish forest commons do not bear costs proportional to the benefits they obtain (Carlsson, 1997). Moreover, a more recent study has highlighted that although the resident shareholders seem to be generally satisfied in the way their forest commons is governed/managed, the participation in management, governance and decision-making is rather low among the shareholders (Lidestav, Poudyal, Holmgren, & Keskitalo, 2013). Overall, previous research indicates a need to stimulate participation among the existing shareholders in these forest commons, in order to make them truly participatory forest governance institutions.

In this paper, we present the case of Vilhelmina Upper Forest Common (VUFC) in the County of Västerbotten in Northern Sweden where we introduce and evaluate a Participatory Geographic Information System (PGIS) as a tool for forestland management, as well as for internal communication about the management of the common. By taking an 'Action Research' approach to understand the issues inherent in VUFC, we attempt to improve shareholder engagement in management and decision-making in the common by introducing PGIS, conducting workshops and trainings, and holding

regular dialogues with the board and shareholders of this forest common. VUFC is one of the major forest commons in Sweden in terms of size of forestland involved (56,500 ha), as well as the number of shareholders (393 shareholder properties with 906 individual owners) (VUFC, 2014). However, it is also one such common where participation among the shareholders, particularly in the governance and decision-making (through general assembly held twice a year) is very low. As such, this common presents a good case to study the shareholder passivity in governance/management, and to explore whether tools such as PGIS could be used to increase shareholders' interest in the management of their common forest, as well as for better communication between the board and shareholders, and among the shareholders themselves.

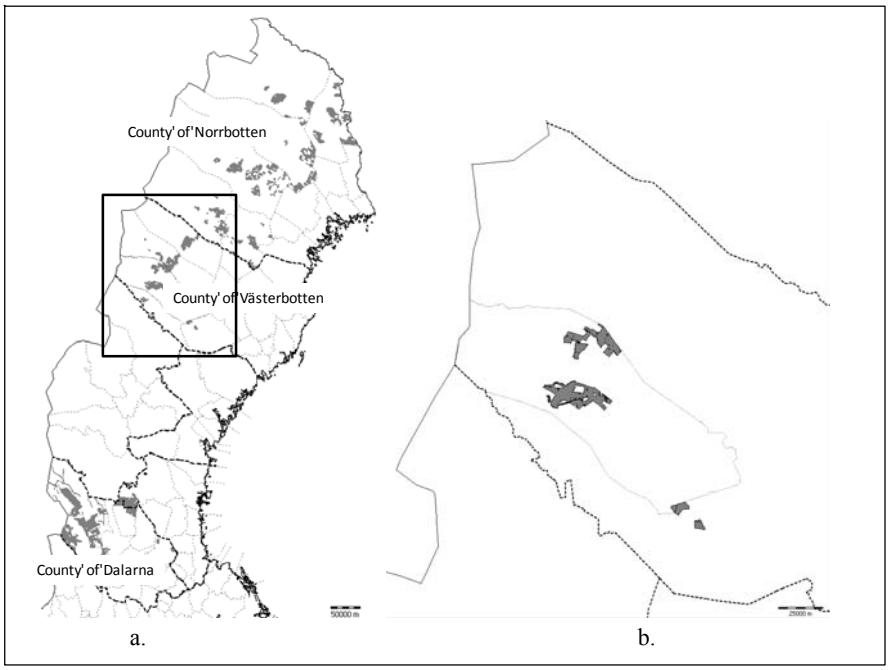
For the introduction of PGIS we draw upon the experiences of our research group's work with Sami reindeer herding communities: yet another kind of common, with whom the original PGIS communication tool was co-produced (Sandström, Granqvist Pahlén, Edenius, Tømmervik, Hagner, Hemberg, & Egberth, 2003; Sandström, Sandström, Svensson, Jougda, & Baer, 2012; Herrmann, Sandström, Granqvist, D'Astous, Vannar, Asselin, & Cuciurean, 2014; Sandström, 2015). In this work, we found an increased level of engagement, not only among Sami reindeer herders, but also among other land users, as a consequence of better communication of existing but not publicly available spatial information. The co-produced communication platform offered by our PGIS seems to have served as an appropriate arena for sharing of knowledge among land users, as well as a tool to support the actual ongoing dialogue among the participants (Herrmann et al., 2014; Vestman, 2014; Sandström, 2015). This paper presents and analyses our efforts at introducing a purpose-built PGIS to Vilhelmina Upper Forest Common, and how this effort affected the level of engagement among various stakeholders.

2. Forest commons in Sweden

In Sweden there are two types of forest ownership where participatory governance can be considered to be of particular interest and importance: forest commons and municipal forest land. Our interest in this paper relates to the

former, which are private forest holdings owned in common through "shares" and jointly managed by an elected board and a professional manager (employee). The shares in a common are tied with the private landholding (farm/forest) and thus cannot be owned in isolation but transferred or sold along with the associated private holdings. Moreover, shareholders in the Swedish forest commons could be individuals, as well as companies, church or State so long as they own the property linked to the share in the commons (Carlsson, 1997). These forest commons were established at the time when the forest industry expanded into the extensive and previously unexploited forests in the interior of northern Sweden. A total of 33 forest commons were established through this process. These commons cover 540 000 hectares of forest land and thereby represent the largest type of private forest holdings owned in common (Figure 1), by some 25 000 shareholders (Carlsson, 1999).

Figure 1: a. Swedish forest commons (in grey) and municipality boundaries, and three key counties with forest commons.
b. Vilhelmina Upper Forest Common in Vilhelmina municipality



2.1 Modern forest commons in Sweden: A historic analysis

The establishment of the Swedish forest commons was a process that lasted from 1861 to 1918 (Liljenäs, 1982). During this long period of establishment, many of the laws and regulations affecting the process changed. The individual commons have thus been established under slightly different conditions. At the same time, the forest industry underwent a period of economic and industrial development, which meant that the land allocation process (and thus the establishment of the forest commons) was constantly adapting to counter-act the market forces (Ministry of Agriculture, 1983). In the County of Dalarna where the process began, the villages were old and well organised. Further north in the counties of Västerbotten and Norrbotten, the villages were a result of a new colonisation process that was still on-going (Arell, 1979; Figure 1a). No property boundaries were recognised between the State-owned land and the individual villages/settlements (Stenman, 2009). While the majority of the landowners agreed to the establishment of the commons in the Counties of Dalarna and Norrbotten, in the County of Västerbotten the majority (largely supported by the forest companies) did not support the establishment of the commons (Liljenäs, 1982).

One of the main incentives for creating forest commons was to prevent forest companies from purchasing farmer-owned forests. The commons were also supposed to serve as a management model to the farmers, and promote good forestry on their privately managed properties. Further, they were believed to give a sustainable income to the farmers and thereby promote local well-being, and support an independent class of farmers. However, the actual form and size of income from the commons to the shareholders varies significantly. In Västerbotten, the dividend is distributed to the shareholders as an annual cash payment; while in most of the other commons, the dividend is distributed as subsidies aimed at benefiting the shareholders' agriculture and forestry or the local community. Moreover, to make commons economically sustainable in the long run, it was stated that the management should be carried out in an orderly, planned, and scientifically-based manner by professional foresters (Lidestav et al., 2013).

Since the commons were originally formed, the number of shareholders has increased along with the number of shareholding properties (Troéng, 1995): due to the division of original properties and an increased number of joint ownership. At the same time, the number of non-resident shareholders has increased, due to the fact that a shareholder in a Swedish forest common does not have to live in the same area as the common itself to retain the rights to benefits from the common. In addition, and despite the original aim, a significant proportion of the commons belongs to forest companies (Holmgren, 2009, p. 28). Furthermore, the social and demographic landscape around the forest commons has changed dramatically since their establishment. A typical shareholder is no longer a farmer surviving off the property (subsistence hunting and fishing included), but using her/his properties mainly for recreational purposes (Lidestav et al., 2013).

Forest commons are under the jurisdiction of Swedish Forestry Act (SFS, 1979) which regulates all Swedish forestry, while their formal organisation activities are regulated by the Forest Commons Law (SFS, 1952). However, each forest common also has its own unique set of by-laws, which regulate the direct management of the common. Historically, the state-control and steering through regional authorities has varied, and according to Holmgren et al. (2010) the most extensive state-control occurred in Västerbotten. In the beginning, forest management was mainly the responsibility of Domänverket (the state's department for management of Crown forestland). In 1934, the supervision of the management of the forests was handed over to the County Forest Boards. Over time, the control of the commons was gradually handed over to the shareholders and with the introduction of the Forest Commons Law in 1952, they obtained the independence that they have today. Still, it is required to have a professional forester as manager, either directly employed by the common or as a commission to an external forestry organisation.

2.2 Recent studies on the Swedish forest commons

During the last five years, we have studied four major forest commons in Sweden: Jokkmokk, Tärna-Stensele, Vilhelmina and Älvdalen. We have conducted questionnaire surveys involving shareholders from these com-

mons. In Vilhelmina, a sample was drawn from all the shareholders, and in the other three commons the sample only included the resident shareholders. In all these commons, our survey data revealed a generally high level of satisfaction with the status quo, with regards to the way these forest commons are being governed/managed and the way the revenues from the forest commons are being shared/utilised (Lidestav et al., 2013; Poudyal & Lidestav, 2012; Poudyal, Sandström, Lidestav, & Berg Lejon, 2013). However, these studies also reveal that a majority of the shareholders' participation and actual and perceived benefits relate to the recreational use of these commons, while very few are engaged in the governance and decision-making in their commons (ibid.).

Table 1: Proportion (%) of respondent resident shareholders stating participation and use of their forest common

Participation/Benefits	Jokkmokk	TSA	Vilhelmina†	Älvdalen
Fish & do outdoor recreation on FC land/water	70	47	60	67
Receive cash payment from the FC	66	77	83	5
Hunt on the FC land	51	41	40	33
Take part in annual meetings/general assembly	43	19	27	35
Participate as elected representative	6	6	7	3
Total Cases (N)	115	145	147	153

† Both the resident and non-resident shareholders were surveyed in Vilhelmina, unlike three other commons where only the resident shareholders were included in the survey. To make the results comparable with the other commons, this table only includes the results from the respondent resident shareholders from Vilhelmina.

As highlighted in Table 1, all the commons had lower than 50% attendance in the annual general meetings among the resident shareholders, and results from Vilhelmina has shown the participation to be much lower among the non-resident shareholders, where 7% mentioned occasional participation, with none of them participating regularly. Furthermore, it has to be taken into account that the majority of the shareholders who participate in these meetings also seem to respond to our surveys. This suggests the actual proportion

of shareholders participating in the general assembly is likely to be lower than that reported in Table 1. This situation is very much akin to what Agarwal (2001) describes as 'participatory exclusions' where some community members participate only in name (nominal participation by virtue of being members of the commons) or are passive participants ('being informed of decisions *ex post facto*', or staying passive during the meetings without having a say in decision-making).

Analysing responses from both the resident and non-resident shareholders from Vilhelmina Upper Forest Common (VUFC) provided interesting insights regarding shareholders' participation in the governance of their forest common. While 93% (n=167) of the respondent non-resident shareholders had never participated in the general assembly, only six of them said they had 'no interest' in participation. For more than 50% of the non-resident respondents, the primary reason for not participating in general assemblies was that they lived too far from the meeting venue. When asked if anything could increase their interest in the FC meetings, two-thirds of the respondents: both resident (n=125) and non-resident (n=151), responded negatively, indicating the factors such as the distance to the meeting venue would always play a greater role in their decision. However, it is important to note that of the remaining one-third of the respondents, 25% said they would participate in the meeting if the agenda of those meetings 'reflected their interests', while 16% said a 'governance reform' would increase their interest in the FC meetings. Overall, survey results from Vilhelmina indicate a situation where very few shareholders participate in the governance of their commons, and even fewer shareholders make decisions regarding the management of the commons. A large majority are totally disengaged in the governance of their commons, a situation indicating highly uneven, and potentially exclusionary participatory and decision-making process (see Poudyal et al., 2013 for further details).

2.3 Swedish forest commons in the 21st century: Challenges and opportunities

While the forest commons in Sweden can be considered a success in general, as they have survived for over a century with more or less the same institutional and governance structures (Carlsson, 1999), it is increasingly apparent that they face some considerable challenges, particularly due to the demographic shift and the changes regarding the use and views about these forests. More specifically, many of the aims at establishment, such as 'being a role model for forest management' or 'help secure continued existence of independent class of farmers' appears out-dated for the modern-day realities where there is an increasing number of remote shareholders who are neither forest managers nor farmers (Lidestav et al., 2013). This demographic shift in recent years has been a challenge for the commons, particularly in terms of shareholders' participation in governance and management of these commons, especially that of the younger generation of forest owners. While the number of shareholders is increasing, primarily for the opportunities these forest commons provide in terms of hunting and fishing rights (Carlsson, 2001), the size of the commons have stayed the same. This creates additional challenges for the managers in these commons.

The challenges outlined above can also create opportunities for many of these commons however. Recent interest and increasing use of forest for non-extractive purpose provides opportunities for a shift in management priorities from timber production to recreational/service-oriented forestry. This is a good opportunity considering the stresses of modern city lives, and the increasing demand for recreational and health-related use of forests (Bell, Tyrväinen, Sievänen, Pröbstl, & Simpson, 2007; Vanhanen, Jonsson, Gerasimov, Krankina, & Messier, 2012). Furthermore, while new forest commons and other community-managed forests are increasingly being established and revived in many other countries in Europe (Lawrence & Ambrose-Oji, 2014), Sweden already has the commons established that could be better managed to serve the 21st century demands (i.e., for recreation, ecosystem services and so on). In addition, we believe Swedish forest com-

mons as well as the research community in Sweden can learn and benefit from participatory, and action research approaches in community forestry and other community-based conservation and development approaches elsewhere. For example, participatory action research with community-based organisations in South Asia and Latin America has reported success in terms of increased and inclusive participation of members, thereby bringing about a positive change in these organisations (Bacon, Mendez, & Brown, 2005; Paudel, Green, Ojha, & Barnes, 2007). Moreover, in Sweden, PGIS has been successful in increasing the engagement of Sami Reindeer herders in land use planning and in decision-making (Sandström et al., 2012).

There are different GIS methods in use where the purpose is to involve individuals in land use planning or management (Brown & Kyttä, 2014). PGIS is usually the preferred method from a bottom up perspective. We chose PGIS because it allows individual shareholders or groups of shareholders to independently create and share their own data with other shareholders or with the board. The board can influence data collection, but never control it. The quality of the data collected by shareholders is however dependent on the willingness of the board and/or the forest manager to share their data to all shareholders. When seeking to improve dialogue and inspiring participation, the compilation and visualisation of relevant geographic information is often a suitable approach as such effort can be supported through the use of GIS. The introduction of PGIS can further strengthen use and the level of engagement through deeper involvement of each stakeholder instead of a single GIS-expert.

Modern management and communication tools, such as PGIS could help meet some of the challenges faced by these forest commons and benefit from the opportunities in non-timber forestry, given the natural advantage of scale these forest commons have. Our experience with the use of PGIS among Sami reindeer herders indicated an overall increase in their involvement in the management process especially among women and the youth (Sandström et al., 2012). Furthermore, PGIS provided a platform for co-production of knowledge among reindeer herders, researchers and agency personnel (Sandström et al., 2003; Sandström, 2015). Having access to all the data on your computer can provide opportunities to learn, participate and contribute even

for remote shareholders. With the proportion of non-resident shareholders being 46% in the Swedish forest commons overall (Holmgren, 2009), and 57% in VUFC (Poudyal et al., 2013), tools like PGIS can provide unique opportunity to involve shareholders in their commons. Moreover, using a common tool, based on the same data for management discussions, can make it easier to understand and discuss different strategies. Finally, PGIS can be used to map and show alternative ways to use the common, for example regarding ecosystem services.

Our decision to take an action research approach stems from our experience of co-production of knowledge, collaborative research and learning with the reindeer herding communities as well as an expressed concern of the VUFC board regarding the lack of shareholder engagement and their motivation in finding the causes, which was later explored through a questionnaire survey conducted with the shareholders of VUFC (see Poudyal et al., 2013). As we will elaborate in the sections below, we, together with the VUFC board, identified a distinct need to understand the shareholders' perceptions regarding the management of their forest common and the benefit (or lack thereof) of being a shareholder. We especially wanted to understand the reasons for limited participation and even resistance among some shareholders against current governance and management. However, merely understanding the issues was not the ultimate goal for either party. VUFC board wanted to learn from the research findings and improve the shareholders' engagement, while we researchers wanted to both learn from and help bring positive change in VUFC management and governance.

3. Theoretical and analytical framework

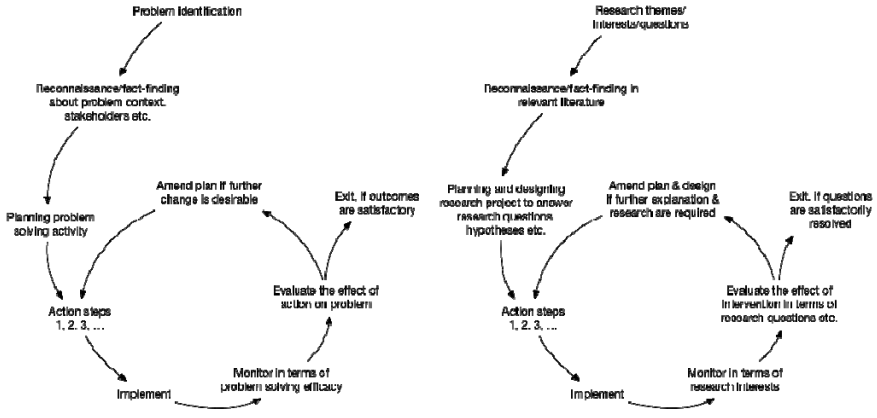
Following Levin and Martin (2007, p. 220), we take 'Action Research' not as a (single) method in this study, but more as "a strategic approach to knowledge production, integrating a broad array of methods and methodological approaches in specific ways to create new understanding for participants and researchers through solving practical and pertinent problems and supporting problem-owners' democratic control over their own situation." As such, our use of this approach had two key objectives: first, to better understand the

problems related to shareholder engagement in forest commons in Sweden, using VUFC as an appropriate example; and second, to help in the problem solving by introducing PGIS as a tool for communicating land management. We used Vilhelmina Upper Forest Common as 'action arena' for our study, which complies with principles of action research scholarship where researchers work with and for subjects of research (Charles & Ward, 2007).

The limited scope of this paper does not allow us to describe the history and roots of action research (see for example, Charles & Ward, 2007; Fals Borda, 2013); however, it is important to acknowledge that we are following a now well-established approach in social science research, particularly in the study of community-based natural resources. In terms of our understanding and use of action research in this study, we follow Reason and Bradbury (2001) to define action research as:

a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview… It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities. (2001, p. 1)

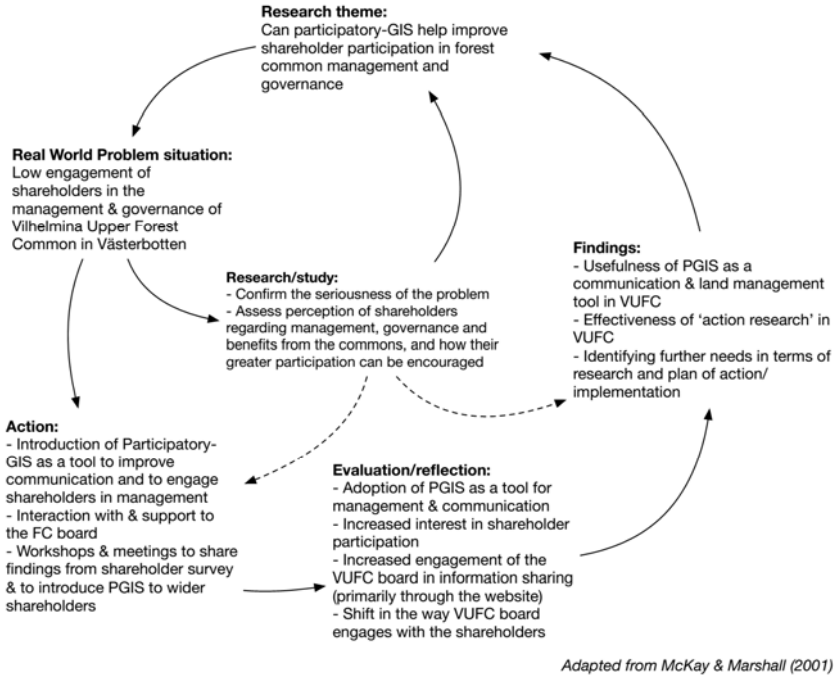
Figure 2: Problem-solving interest and research interest in action research (McKay & Marshall, 2001)



Source: *McKay & Marshall (2001)*

Hence, there is an inherent duality in the approach: which McKay and Marshall (2001) call 'dual imperatives of action research', that of research interest and of problem-solving interest (see Figure 2). Following McKay and Marshall (2001), we use a dual cycle action research framework adapted to our 'problem situation' (i.e., to Vilhelmina Upper Forest Common) (Figure 3).

Figure 3: Dual-cycle action research framework to study shareholders engagement in Vilhelmina Upper Forest Common



As described in Figure 3, we focus on six interlinked elements within the action research framework in this study: (1) Research theme; (2) Real World Problem situation; (3) Research/study; (4) Action; (5) Evaluation/reflection; and (6) Findings. We briefly describe each of these within the context of VUFC below.

(1) Research theme: this element highlights the core problem that we want to address in our project, both in research and in action: that of low and declining shareholder engagement in the management and governance of the forest common, and whether participatory-GIS can help improve the shareholder engagement.

(2) Real World Problem situation: the case of low engagement of shareholders in the management and governance of Vilhelmina Upper Forest Common is our 'Real World Problem' situation. This narrows our research theme to a specific problem situation, which also gives us an 'action arena' to conduct our action research. In traditional research, we would define this as our 'case study'.

(3) Research/study: One of the two elements that comes out of (2), this is used to confirm the seriousness of the identified problem (i.e., low shareholder engagement) and to better understand shareholders' perceptions regarding their commons. This element should enhance our understanding of the situation, as well as inform our action (4), and also contribute to the overall findings (6).

(4) Action: this element highlights our action and practical involvement in VUFC to try to solve the problems identified in (1) as well as more specific issues identified in (2). In VUFC, we had two action approaches; first, the introduction of PGIS as a tool for communicating land management decisions; and second, our regular engagement with some of the key actors within the forest common to share our research findings (from (3)) and to support and inform their decision making related to the identified problems.

(5) Evaluation/reflection: This is one of the most important elements in our framework. Here, we evaluate the effectiveness of our actions concerning the identified problem in VUFC. We assess the application and usefulness of PGIS, as well as the effect of our regular engagement and sharing of research findings with the key actors and shareholders within the forest common. For evaluation, we use relevant indicators from Herr and Anderson (2005, pp. 53-57). In particular, we use *Outcome Validity* to explore how action resolves the initial problem posed; *Process Validity* to investigate how the framing and solving of problems enable learning; *Democratic Validity* to investigate the extent of collaboration with stakeholders; and *Catalytic Validity* to ex-

plore how the research process affects the engagement of participants to better understand and transform their reality (Herr & Anderson, 2005).

(6) Findings: The final element in the framework follows (5) as well as (3), where we bring together our findings from research, as well as from action in order to make an overall assessment of our approach in VUFC; to identify further needs in terms of research and plan of action; and to inform and improve the initial understanding of the problem (1).

4. Participatory GIS: A useful/suitable tool for community forest governance?

To improve communication between Sami reindeer herders and other land users, we previously developed and implemented a system to produce reindeer husbandry plans together with Sami reindeer herding communities (Sandström et al., 2003; Sandström et al., 2012). A central component of this process was the co-production and use of a custom made PGIS, named RenGIS. As part of the work with reindeer herding communities, we evaluated the potential and limitations of PGIS as a tool for collaborative learning (Sandström et al., 2012). We concluded that by merging traditional and scientific knowledge in a PGIS, the process of spatial communication contributed to a more inclusive planning process and to an improved knowledge sharing. The process also contributed to a more efficient land use planning that focused on key areas while the solutions applied to the whole landscape. Good geographical information was central to making good geographically-based decisions. For the purpose of our work with forest commons, the introduced PGIS tool aimed to support an inclusive communication process and serve as a decision support tool.

Given the experiences of using PGIS in reindeer husbandry, we decided to introduce a specifically adapted PGIS from reindeer husbandry to the actors in VUFC. While the PGIS was introduced to address the problem of limited shareholder participation in the management of the common forest land, it could also be used as a communication platform, especially to help increase shareholders' engagement with the common by providing them with up-to-date information about the management of their common forestland visually

using GIS. In parallel with our on-going research on shareholder participation and perceptions in VUFC: which involved questionnaire survey and discussions with the board, we introduced the PGIS to the board as the first step. At this stage, the participation of general shareholders was limited to being respondents in our questionnaire survey about their engagement in their forest common and their perceptions of benefits from VUFC.

As often happens with the introduction and adoption of new technology, we found an initial resistance from the board and the forest manager to use the PGIS. However, over repeated attempts, these key actors started to show interest and were willing to try the tool. The forest manager in VUFC was among the first in this group to have PGIS installed in his computer, which was significant, since he is responsible for the day-to-day forestry operations within the common, and he has exclusive knowledge and access to digital maps and "his own" GIS information.

4.1 The 'action': experiences of introducing PGIS in Vilhelmina

Despite initial apprehension about the introduced PGIS, some of the board members were curious about its functioning, and were prepared to install and try it in their personal computers. Over a number of meetings and discussions with the board and some of the shareholders (between August 2012-October 2013), we demonstrated how the PGIS could act as a data collection and communication platform regarding land use within the common. We installed the PGIS for some board members' and for the forest manager. However, we have not yet received specific feedback regarding their use of the PGIS and whether they have found it a useful tool in their own land use planning and decision-making.

The board agreed to display VUFC's borders, walking trails, huts and shelters for outdoor activities. We made map layers available for download together with the PGIS-program on the Vilhelmina Model Forest website (http://www.modelforest.se/index.php/temaartiklar/vmf-gis). Furthermore, we organised demonstrations of PGIS during a general meeting with the shareholders in September 2013. However, the initial plan to include infor-

mation concerning forest conditions and management alternatives was considered too sensitive by the board to be spread electronically.

4.2 Some reflections on the attempts to introduce PGIS in VUFC

Our attempts to introduce PGIS in VUFC faced considerable challenges. We had hoped that VUFC would adopt PGIS with associated custom compiled data, to enable them to communicate forest management plans and engage previously passive shareholders about the management/governance. Regarding *outcome validity*, we cannot claim that our action has resolved the problem identified in VUFC. However, we identified and framed the problem in VUFC through our shareholders survey in such a way that the board, the forest manager and the concerned ordinary shareholders are both aware of and interested in resolving the problem. Although the problem inherent within the VUFC is not yet solved, we have clearly contributed to a *process* of ongoing learning and action.

Initial resistance to the adoption of new technology soon after its introduction is not a new phenomenon. Similar resistance to technology adoption has been observed in agriculture, business, and even within information and communication technology (ICT) such as GIS (Budić & Godschalk, 1994; Man & van den Toorn, 2002; Morris & Venkatesh, 2000; Parente & Prescott, 1994; Waddell & Sohal, 1998), as well as in our work with Sami reindeer herders (Sandström et al., 2012). Furthermore, there could be some genuine concerns in part of the VUFC board against adopting the introduced PGIS without proper scrutiny and tests. Based on our discussions with the board and forest manager of the VUFC, as well as past experiences with PGIS in reindeer husbandry, we broadly identify the following six important considerations for adoption of PGIS in VUFC.

First, in our experience in the case of reindeer husbandry, Sami reindeer herders came to us with a clearly identified problem. They felt they lacked tools to communicate the complex land use needs of reindeer husbandry in relation to other land use forms. This initiated the process to co-produce the appropriate tools with the researchers. In the case of VUFC, the Board identified the problem of low engagement among their stakeholders and wanted us

(the researchers) to conduct a traditional questionnaire survey to explore the causes and potential solutions. However, we proposed PGIS as a possible remedy, based on our experience with the Sami herders, and hoping that the Board would be more open to sharing information that they held regarding the management of VUFC. Through our experience from these two cases, we find that stakeholder engagement already at the initial stages of a process is of great importance for full implementation of tools such as PGIS.

Second, is the often-held belief that GIS is a 'difficult' technology to learn and use for non-experts. In our discussions with the VUFC board, it was clear that they viewed GIS as a specialist tool, and that it was not easy for a lay person to understand or to use it. A contributing factor could be that almost all of the board members were reliant on the young forest manager to 'do the GIS', not wanting to try the technology themselves, at least initially (Morris & Venkatesh, 2000). We can contrast this finding to our experience with Sami reindeer herders who had no initial "GIS-expert" to rely on, possibly encouraging them to take charge.

A third consideration is the short amount of time since the introduction of PGIS. We are only two years into the engagement and interactions with the VUFC board and stakeholders. It takes time to develop mutual trust and understanding, as well as for the VUFC board and the forest manager to learn about the tool and its potential use and evaluate its effectiveness. Though it is early for final evaluation of the adoption of the PGIS in VUFC, it is very important to evaluate the ongoing process (cf. Figure 3). The experiences with reindeer husbandry show that trust and understanding take time to build before a fully-functioning technological system can be put in place (Sandström et al., 2003; Sandström et al., 2012; Vestman, 2014). Furthermore, the progress of the work to develop reindeer husbandry plans and RenGIS included several partial evaluations to redirect the path of the overall process.

A fourth possible reason for the limited involvement of shareholders and the board was the condition that the management of a Swedish forest common has to be carried out by forest professionals. It became evident that in Vilhelmina, the board has an almost unconditional confidence in their employed forester and his ability to manage the forests. He has the tools of a

management plan with digital maps, and the expertise to use traditional GIS to satisfy his managerial needs. When required, he produces information and reports, such as proposals for annual harvesting, as a basis for decision by the board and the assembly. The board seemed to be satisfied with this state of order, and did not see any need for them or the shareholders to have access to more detailed information about forestry by using tools such as PGIS.

Fifth, the board and forest manager may have resisted adoption of PGIS, because there is some opposition to the extent of the board's decision-making authority, which we were only able to identify after our repeated engagement with the board and the shareholders. In particular, issues regarding hunting and fishing have been widely debated. There are even those who question the legitimacy of the common itself as a whole, which is partly related to how the VUFC was established almost a hundred years ago and partly related to the principles of private property (rights). Although these are minority sentiments, those in opposition seem outspoken and challenge the board at the assemblies, and more recently via blogs (http://vilhelminabloggen.com, accessed on 9 Nov 2013). The mutual distrust between the board and the opposition seems thus to be one additional reason for not sharing information about forest condition and different management options through PGIS with the shareholders. The tactic seems to be that it is best to have the manager make "informed" decisions. This also reflects the power-dynamics between the board managing the common and those in opposition who are ordinary shareholders and are in a minority without much influence to change the governance and decision-making structures within the common. By adopting tools like PGIS widely that are by definition participatory and not exclusionary, which sharply contrasts with how the VUFC governance has appeared thus far, it is likely that the board is worried about not only losing its relevance but also empowering the shareholders, particularly those in opposition.

Finally, our effort consisted of the introduction of new technology that was developed by "outsiders". This contrasts to the development of technology from within or in partnership with the subjects, as was the case with Sami reindeer herders (Sandström et al., 2003; Sandström et al., 2012; Sandström, 2015). This indicates that it is harder to engage users of an introduced technology that has already been developed than in the case of the co-produced

RenGIS. Being part of the development of tools appears to play an important role in inspiring the adoption and use, as well as an increased understanding.

As Waddell and Sohal (1998) state, people usually do not resist change *per se* but to the inherent uncertainties, and the members of VUFC board are likely to have a similar view regarding PGIS at this stage. Thus, as other studies have shown, introduction of technology like GIS are not always going to be a success, and the successes and failures are often dependent upon the organisational environment, available resource and commitment, as well as culture within the adopters, and the organisation involved (Budić & Godschalk, 1994; Man & van den Toorn, 2002).

In the case of VUFC, we can conclude that during the project period, the board's overall willingness to share information has increased substantially even though they did not fully adopt the PGIS strategy. Nowadays, important documents like by-laws and protocols from the general assembly are published on their web site (http://www.vilhelmina-allmanning.se/, accessed on 10 Nov. 2014). Furthermore, maps showing hiking trails, fishing and hunting are now made publicly available online. VUFC has also shared the final report of our shareholder survey online. Additional indications of increased transparency are the invitation to a public meeting in Vilhelmina 19 September 2013 and a video conference seminar in 31 January 2014 connecting the major villages in the area of the common (Vilhelmina, Saxnäs and Dikanäs). The board has also shown an interest in a continued collaboration with the project team on a survey of individually or jointly managed forestland in Vilhelmina. All these actions on the part of the board and the concerned shareholders indicate that our research project and our engagement with VUFC has energised the board to be more open and to better engage with the shareholders (*catalytic validity*). This was in large part assisted by our open engagement and collaboration with the board and the shareholders in terms of research and dissemination of our research findings.

4.3 Key findings

Despite the difficulties in getting the VUFC board to use PGIS as a management and communication platform, we believe this technology is and will be

useful in the long term. Our belief comes not only from the successful experiences with reindeer herders, but also from the shareholders' growing engagement in various aspects of VUFC since our involvement. We felt over the course of our engagement with the VUFC board and with shareholders through our surveys that shareholders' interest and engagement in their common is growing and that their participation in the common can be revitalised with policies that better recognise their contemporary interests and needs. However, the nominal and passive 'participation' and existing 'participatory exclusions' in VUFC have not been completely resolved yet. As our experience with Sami herders shows, it takes a continued long-term engagement with the stakeholders to bring about a change from the *status quo*, and particularly so for the diverse groups of stakeholders with differing interests such as those in the Vilhelmina forest common.

Conventional research would probably have made no difference in how VUFC was managed and governed. Lack of shareholder engagement in the management and governance in VUFC was already known among board members. With our approach, we were able to highlight particular issues, such as the reasons for extremely low engagement among non-resident shareholders, and shareholders' perceptions about the management and governance of VUFC more generally. However, merely studying perceptions and writing reports based on our surveys would probably not have revitalised shareholder engagement in the way that our attempts to introduce PGIS seem to have done. Indeed, this is not the first forest common we have studied and written about; but this is certainly the one where we have actually started a real dialogue about the future of the common.

Our research in VUFC will be ongoing in many respects. Based on our recent experience however, engaging the board and shareholders to improve and create the PGIS is critical. One of the main reasons for the low interest and adoption of PGIS in VUFC was likely that it was 'introduced' technology without input from the end users during the development phase. The tool itself is flexible and the users can modify the way they find it useful for their needs. So the logical next step in our action research would be to encourage the VUFC board and shareholders to adopt and modify the PGIS as they feel serves their purpose.

5. Conclusions

Although economic contribution of boreal forests to respective country's GDP is rather modest and generally in decline (Vanhanen et al., 2012), forests are still considered the backbone of the boreal region, due to their socio-cultural importance locally, and their environmental importance. In this study, we looked at the state of some of the major forest commons (community-managed forests) in boreal Sweden, particularly at the low and declining shareholder engagement in the management and governance of these commons. Through participatory action research we tried to test whether modern tools like participatory-GIS could be used as a management and communication platform to increase shareholders' engagement with the commons.

Using Vilhelmina Upper Forest Common in northern Sweden as a test case, a common with very low shareholder participation in its management and decision-making, we describe and introduce a relatively new tool, a PGIS, and analyse our efforts to engage shareholders in the management of their common forest. Given our earlier experiences in developing and introducing PGIS as a tool for land-use planning and communication among Sami reindeer herders within the same landscape, our aim was to understand whether similar tools can be used to revitalise shareholder engagement in the forest commons. Based on our experience of introducing PGIS in VUFC we draw the following overarching conclusions expressed in a general and broader context also applicable in other situations:

While, the introduction of PGIS to Sami reindeer herders is part of a 14-year long process where we have worked side by side in both the development and the use of PGIS, the case of VUFC is quite different in that we were simply introducing an already developed tool, ready to be used. Looking at these two cases, we can identify the importance of participants being part of the development of the tool such as PGIS for a successful later adoption of the tool. Co-production and sharing of knowledge among the forest common shareholders and between the researchers and the common, as was the case with reindeer herders and researchers, could potentially have been more successful. Being part of the development of the tool as well as the produc-

tion of best available knowledge also ensures the maintenance of the specific quality and functionality of the tool for its specific purpose.

In our previous experience, the Sami reindeer herders asked to participate in order to meet their needs and to resolve some of their problems. In contrast, VUFC was invited and encouraged to participate as a test to see if they might need PGIS. It is important to note that the VUFC did not participate based on their own identified needs, but instead as an opportunity. Our anticipation was that they would realise the advantages of using a PGIS and adapt it to their own needs.

While the prior computer experience was probably lower among Sami reindeer herders than among VUFC users, the need to use the tool for the former group seem to have expedited the process of learning, adoption and engagement. Furthermore, among Sami reindeer herders there was a need to use PGIS both within the group and among other land users. VUFC has so far only used PGIS within the group.

Finally, the process of learning to use PGIS and to realise its advantages takes time. PGIS is now well established as a communication tool in reindeer husbandry in addition to it being a tool for land-use management, but it is not yet in real use in VUFC. Through the long-term process of development and adoption, PGIS has empowered the reindeer husbandry communities with access to common information leading them to a more democratic decision-making process. While we hoped this would be the case for VUFC as well, and that the early signs are positive and encouraging, it is too early to assess the adoption rate, and too early to understand the impact PGIS might have on the management and decision-making in VUFC.

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