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Ecosystem Services in Climate Adaptation in Northern Sweden

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Abstract

Ecosystems provide humans with ecosystem services - benefits fundamental to human well-being. The Swedish government has set a milestone target to be reached by 2018, that the importance of biodiversity and values of ecosystem services should be commonly known and adopted in political and economic decisions. The use of ecosystem service assessments can be beneficial in local and regional planning and increase understanding of ecosystem services among decision-makers. Being of such importance it is of interest if, and how ecosystem services are integrated in planning and decision-making in the Norrbotten County. This study aims to give an overview of how far municipalities in Sweden has reached with the integration of ecosystem services. This was done by investigating explicit implementation, contribution to the milestone target and, if/how ecosystem services are used in local governance and especially regarding climate adaptation.

The results show that only four of the 14 municipalities have integrated ecosystem services, further that there is an absence of explicit use of ecosystem services in climate adaptation. This indicates that the level of knowledge about the ES concept is low and that implementation has not been successful in the county. Positively though, the county has a forerunner in the Arjeplog municipality, which can serve as role model for the rest of the county to achieve an implementation of ES in local governance.

Introduction

Ecosystem services (ES) are defined as benefits humans obtain from ecosystems, such as services and products which are fundamental to human well-being. These are divided into the four categories *provisioning services* e.g. food and timber, *regulating services* e.g. waste-water treatment, *cultural services* providing e.g. recreation and aesthetic values, and *supporting services* e.g. photosynthesis (MEA, 2005). As the functions of ecosystems are essential to human well-being, there was a need to increase the understanding that losses of ecosystem services are both social and economic losses, and should therefore be included in economic accounting as well as political decision-making (de Groot, 1987). The concept has its origin in a need to highlight the importance of ecosystems to human well-being to work against environmental degradation (Chaudhary, et al., 2015).

The concept of ES has both gained interest and been questioned, such as the appropriateness of monetary valuation, the anthropocentric view, and the commodification of nature. At the same time it is argued that the concept reveals societies' dependence of ecosystems, that there is a diversity in ways to highlight the value of ES and emphasizing that most ES are not linked to markets. (Schröter, et al., 2014)

Local and regional planning can benefit from the many perspectives becoming visible in ecosystem services assessments, as e.g. provide information on cross-scale trade-offs and for communication on environmental aspects to stakeholders (Albert, et al., 2014) (Galler, et al., 2016). Assessments of ES in local governance can provide a basis for strategies to avoid degraded ecosystems, strengthening ES provision, and avert economic risks as replacement costs for lost ES (Jorgensen, et al., 2016). The use of ecosystem service assessments has also shown to increase the understanding of ES among decision-makers (Posner, et al., 2016).

Barriers to integrate ES in local governance are limited knowledge of the concept and how to apply the knowledge in plans and projects (Schubert, et al., 2017). Challenges for implementation of ES in local governance are to raise the level of knowledge of the ES concept, to make decisions-makers understand the need for definitions of explicit and implicit use of ES and how to use monetary valuations of ES (Beery, et al., 2016). Schubert et al (2017) describe the definition of explicit and implicit implementation: "*explicit application or implementation* as indicating a conscious understanding of the ES concept and an *implicit application or implementation* as indicating a conceptual understanding of nature's services without associating this understanding with the ES concept itself". Their study shows that the understanding of the existing implicit use of ES in local governance can facilitate the explicit use.

In accordance with the Nagoya protocol (CBD, 2011), a milestone target was set in the environmental objective system by the Swedish government. This milestone target implies that, by 2018 the importance of biodiversity and values of ES should be commonly known and adopted in political and economic decisions (EPA, 2014). Achievement of this target is not legally binding. However, commitment among municipalities are considered as important in achieving the objectives by implementation in local politics (EPA, 2012). A recent survey with respondents from half of Sweden's municipalities showed that only 16 % of the municipalities use of the phrase ecosystem services in comprehensive plans (Hanson, et al., 2016).

Ecosystem-based adaptation (EbA), is another concept that is widely used within the field of environmental management. It is defined as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (CBD, 2009). While many adaptation strategies are reactive approaches, EbA is a systematic and proactive approach, addressing not only climate change but also loss of biodiversity and it contributes to human well-being e.g. by supporting ecosystems delivery of products and services (Roberts, o.a., Exploring ecosystem-based adaptation in Durban, South Africa: "learning-by-doing" at the local government coal face, 2012). Due to the degradation of earth's ecosystems, EbA cannot act as a panacea for the negative climate-related changes (Roberts, o.a., Exploring ecosystem-based adaptation in Durban, South Africa: "learning-by-doing" at the local government coal face, 2012) but still has a potential to act as a no-regret option, and provide benefits even though there are uncertainties of future changes (Sebesvari,

Rodrigues, & Renaud, Mainstreaming ecosystem-based climate change adaptation into integrated water resources management in the Mekong region, 2017).

Being of such importance it is of interest if and how ecosystem services are integrated in planning and decision-making at different political levels. Municipalities in Sweden have strong local governance. They receive tax revenue and are responsible for planning and decision-making on water and land use, which also include climate adaptation (SFS 2010:900).

The purpose of this study is 1) to investigate level of explicit implementation of ES among 14 municipalities in northern Sweden (i.e. is there a conscious use and understanding of the ES concept) 2) to get a deeper insight in what knowledge officials and politicians have of ES and, regarding municipalities' contribution in achieving the milestone target on biodiversity and ES, and 3) to analyse if and how ES is used in local governance and especially regarding climate adaptation.

The hypothesis of the study is that there are gaps in implementation and knowledge of ES.

Should this hypothesis be accurate, it highlights a need for education and capacity building in how to integrate ES in decision-making and political considerations (Schubert, et al., 2017).

Method

This study focuses on Norrbotten County, which is 25 % of the total area of Sweden, and it has 2.5 % of Sweden's 10.1 million inhabitants (Regionfakta, 2018). Important industries in the county are mining, forestry and pulp production. (County administration board of Norrbotten, u.d.)

Semi-structured interviews, with questions based on an earlier used questionnaire by the Swedish EPA (Jönsson, et al., 2017) were conducted with 13 officials and 10 politicians, working at the boards and administrations connected to environmental issues, in the 14 municipalities. Both officials and politicians were chosen as respondents to get an insight to what level ecosystem services have been integrated in municipal operations. Semi-structured interviews were chosen as method to be able to allow discussions with the respondents.

The use of semi-structured interviews provided an understanding of the respondents' knowledge, their views and priorities e.g. municipal priorities and reluctance to introduce new concepts such as ES. The method, also provided an opportunity to discuss the topic during the interview. In some cases the respondents showed insights during the interview e.g. on the importance of ecosystem services in their own municipality. The method thus proved to contribute with some increased knowledge of the concept to the respondents.

However, the choice of method also means that the interviews may differ e.g. in terms of the order of the questions, which may have impact on the answers given. Also that some answers cover more than one question. A higher certainty of the results would have been achieved with more interviews in each municipality. The differences between officials' professional role can contribute to different perceptions of the occurrence of ES.

Previous to the interviews the respondents were given a short written information on the definition of ES according to MEA (2005), the *Milestone target of biodiversity and ES*, possible benefits of EbA, and the purpose of the interview to investigate the presence of ES in the municipalities of the county. Thus, the respondents had the opportunity to seek their own knowledge of ES prior to the interview. Of the respondents, 6 of them mentioned that they had sought information before the interview. During the interviews, there were occasions when there was a need for further explanations of the concept. Access to interview questions was given upon request.

As the terms explicit and implicit use of ES is frequently used in this article the definition by Schubert et al (2017) is used to clarify this: "*explicit application or implementation* as indicating a conscious understanding of the ES concept and an *implicit application or implementation* as indicating a conceptual understanding of nature's services without associating this understanding with the ES concept itself" is consistent with the interpretation of respondents' answers.

In order to get a better understanding of the explicit use of ES, a search was done for the term *ekosystemtjänster* (in Eng. ecosystem services) in the comprehensive plans of the 14 municipalities.

Results

Knowledge and use of Ecosystem Services

A total of 23 respondents participated in the study (10 politicians and 13 officials), of these, 13 respondents of 23 (dominantly officials) had earlier had contact with the concept of ES, but only 3 of 23 had experience of explicit work with ES. The most common way of contact was through courses, conferences and education.

Only 3 respondents answered that there is an explicit use of ES, but 17 respondents could see an implicit use, not using the term *ecosystem services* but instead terms as *Green infrastructure* and *Green-Blue-White plans*¹. Of the respondents, 2 did not experience explicit use, and where not asked to provide answers on conceptual, strategic or instrumental use according to questionnaire.

Ecosystem Services in local governance - Conceptual use

Conceptual use in this study refers to if ES is used to increase society's understanding even though no direct measures has been taken (Johnson, et al., 2009). As example to describe how human well-being depends on ecosystems, or to describe risks for human well-being when ecosystem functions are degraded.

None of the respondents said that explicit work is done on a conceptual level, however 13 respondents said that there is an implicit use, not using the term *ecosystem services*. The search for the phrase *ecosystem service* in comprehensive plans shows a presence of some conceptual use in 4 municipalities. Examples of this were that definitions and examples of ES were included and, the importance of ES to adapt to a changing climate was mentioned (Arjeplogs kommun, 2017; Bodens kommun, 2017; Luleå Kommun, 2013; Piteå Kommun, 2016). A good example from these four municipalities is the municipality of Luleå that also include a local example of an important ES and its monetary value. The example was that of water purification through sand worth almost half a billion Swedish kronor (Luleå Kommun, 2013).

When asked about the conceptual use, 6 respondents answered that the focus is on risks with damaged ecosystems. One respondent said that the terms *environment* and *ecosystem* often are used in negative contexts, e.g. highlighting risks, and another respondent also commented that it is more common to talk about the risks than opportunities. Six of the respondents commented during the interviews that ES is a part of everyday life.

The interviews and analysis of comprehensive plans show that the conceptual use of ES can be found in plans but not in the operations of the municipalities. There is an awareness of risks with degraded ecosystems and an appreciation of the proximity to nature. An understanding of what nature contributes with is common, but this is not associated with the ES concept, which highlight the contribution to human well-being.

Ecosystem Services in local governance – Strategic use

The expression *strategic use*, in this study, has reference to whether ecosystem services are explicitly included in municipal plans and decisions.

The interviews, and the analysis of comprehensive plans showed that four municipalities have included INTES explicitly. An implicit use of ES, referring to green plans, was seen by 13 of the respondents at a strategic level.

The four municipalities that explicitly include ES in their comprehensive plans, expressed a conceptual use and the importance of ES to manage changes, (Arjeplogs kommun, 2017; Bodens kommun, 2017; Luleå Kommun, 2013; Piteå Kommun, 2016). The municipality of Piteå stressed the importance to include ES to achieve sustainable management of the environment in their planning

¹ Plans for the use of land, water and snow

strategy (Piteå Kommun, 2016). The municipality of Arjeplog showed the most extensive use of ES in their comprehensive plan.

The municipality of Arjeplog is 12 558 km² and has a population of 2 821 (Regionfakta, 2018), the major enterprises are reindeer herding, tourism and a car testing industry (Arjeplogs kommun, 2018).

Arjeplog demonstrates the most advanced development of the use of ES in the county of Norrbotten. Besides including the definition of ES it also takes into account and promotes ES as a part of their strategy to achieve the environmental objectives. It considers to create nature reserves as an investment in ES, and has ongoing plans to develop procedures for ES and green infrastructure to be considered in all of the municipality's planning and operations. They also acknowledges that ES are issues that concern a wider geographical context than administrative municipal borders, and has a vision of a strong regional cooperation to utilize opportunities for cultural ES as outdoor activities. (Arjeplogs kommun, 2017)

Overall, an implicit strategic use of ES is common in the Norrbotten County. However, four municipalities have included ES explicitly.

Ecosystem Services in local governance – instrumental use

The concept *instrumental use* reflects if the municipality e.g. uses GIS-layers of ES or ecosystem service assessments (ESA) as part of the basis for decisions.

Of the respondents, 14 answered that there is no instrumental use, and 8 that they do not have knowledge of such use. One respondent from the municipality of Luleå, believed that ESA had been used. This was also seen in the analysis of comprehensive plans, where the municipality included the monetary value of a local ES in their comprehensive plan (Luleå Kommun, 2013).

Milestone target of biodiversity and ecosystem services.

The respondents were asked if they believe the Milestone target would be achieved by 2018 and to motivate their answer. Most of the respondents (13) did not think they would, and 8 did not know the outcome. Recurring motivations to these answers were that ES is not used, that there is a lack of interest, and that there is no ongoing work to integrate ES. Also, that other issues than ES are in focus. Further, that active work does not always take place to reach the adopted goals, that there is a lack of clarity in how the target will be achieved, and a lack of guidelines.

Only two of the respondents pointed out a possibility to achieve the target. One respondent from the municipality of Arjeplog could see the opportunity to achieve the target by the end of 2018. This as ES are included in the not yet adopted comprehensive plan and there are possibilities that they, if funding is approved, can implement ES in the operations of the municipality. Also one respondent in the municipality of Piteå perceived the implicit use of ES as extensive and, that with an explicit use, the municipality should be able to achieve the target.

The respondents were also asked to provide examples of how their municipality could contribute to the milestone target. The provided examples were both on strategic and operational level as well as how to increase public knowledge on ES.

Suggestions by the respondents on how to achieve the milestone target included:

- increased knowledge on ES to attain understanding of the concept and reach commitment.
- the need for political decisions to use ES in municipal managing. This to achieve implementation of ES in strategic documents, administration issues and decision-making.
- that access to guidance could facilitate the introduction of ES in permit processes.
- possibilities to increase public knowledge of ES through, e.g. allotment gardens.

The voluntary commitment to achieve the environmental objectives was also mentioned as an obstacle in a small municipality with strained financial and staff resources.

None of the respondents perceived that there is a widespread public knowledge of ES. Some of the respondents added that some groups of the society probably have knowledge of ES, but not the vast majority. Those mentioned to be likely to know about ES were individuals engaged in environmental issues, and in reindeer herding. One respondent said that the society probably have a general

understanding of the interdependence of human and nature, but believed that ES is still a concept for professional use.

All respondents considered public knowledge of ES as important, as it could provide increased understanding for values provided by nature, and thereby an increased understanding for decisions and measures taken to strengthen or maintain ES. One respondent in the Älvsbyn municipality said that public knowledge is important due to the dependencies of ES among the major employers of the municipality, a bread bakery and a manufacturer of wooden houses.

The interviews show that there are challenges when it comes to achieving the milestone target, and that only two of 23 respondents could see a possible achievement. At the same time, there is an idea of how the municipalities could work to approach the target.

There is a consensus that public knowledge of ES is important as it could provide an understanding between decision-makers and the society.

Climate adaptation

The respondents were asked if there is ongoing work for climate adaptation by using Ecosystem-based Adaptation, EbA, in the municipality. They were also asked to provide examples of measures taken, and how they perceive EbA in the matter of an effective strategy.

None of the respondents knew of explicit use of ES in their municipalities for this purpose. The use of green infrastructure, e.g. green areas for storm-water management, was mentioned by 7 respondents from different municipalities as implicit use of ES in climate adaptation.

Five of the respondents had a positive attitude to EbA. Comments they made were that it is perceived as positive, possibly with low costs and few interventions required and with multifunctional benefits. Also that it can be efficient while both strengthening ES and benefit on nature. Also, that infrastructure options can have the same effect as EbA options, however, not with the same visual impression.

The interviews also indicated that climate adaptation takes place mostly on a strategic level, e.g. as guidelines on climate adaptation and by increasing knowledge of expected changes. It was also shown in plans, where e.g. building permits are not given in areas with risk of adverse effects from climate change. This was seen as a viable approach by some of the respondents, as their municipalities have large available areas.

Discussion

The purpose of the study was to analyse if there a conscious use and understanding of the ES concept within the 14 investigated municipalities. Another purpose was to get a deeper insight in what knowledge officials and politicians have of ES and, municipalities' contribution in achieving the milestone target on biodiversity and ES. Finally it was to see if ES is used in local governance and especially in climate adaptation.

Comprehensive plans are not binding documents, but provides a direction for the long-term development of the municipality's physical environment (SFS 2010:900). This means that the presence of ecosystem services in comprehensive does not necessarily mean that the concept can be found in more detailed plans or on an operational level.

The interviews and the analysis of explicit use of ES in comprehensive plans showed that ES is currently used at a conceptual and strategic level in 4 of the 14 municipalities. At an instrumental level the results showed that ESA had been used in one municipality. The low level of implementation of ES explicitly in local governance in this study is not unique for the county, as earlier studies on the use of ES in comprehensive plans in Sweden showed similar results (Hanson, et al., 2016). However, the implicit use is more widespread, and with an understanding of the implicit use of ES, an explicit use can be facilitated (Schubert, et al., 2017).

Regarding the knowledge of the ES concept among the interviewed officials and politicians. 13 of 23 respondents had prior to the interview met the concept of ES. Only three of these had earlier worked with ES. Limited knowledge of the ES concept and how to integrate this in plans, is a barrier for integration of ES in local governance (Schubert, et al., 2017) which also seem to be the case in this study.

The interviews indicate that there is a focus in local governance on risks with damaged ecosystems. Six of the respondents commented during the interviews that ES is a part of everyday life. This was expressed as an appreciation of the proximity to nature, but can also indicate that the delivery of ES might be taken for granted and is hence not considered as an important asset that contributes to human well-being.

An explicit use of ES, can possibly raise awareness of the important services that provide the basis of human well-being. The use of ecosystem service assessments has shown to increase understanding of ES among decision-makers (Posner, et al., 2016).

Concerning achievement of the milestone target on biodiversity and ecosystem services, most of the respondents were hesitant or did not think their municipality would achieve the milestone target. Several challenges were seen, but the respondents had several suggestions on how the municipalities could increase their contribution to the milestone target.

Among the respondents there is a consensus that public knowledge of ES is important. It was seen as a useful way of communicating the background of decisions were ES are included. In other words it is seen as possible to provide a link between decision-makers and the society.

The use of ES in local governance is not widespread, and when it comes to climate adaptation, the interviews show no explicit use of ES. However, the use of green infrastructure, e.g. green areas for uptake of storm-water, is used in 7 of the 14 municipalities.

A reflection from the interviews, is that where green infrastructure is not mentioned, there seems to be an overall reactive approach to climate adaptation in the county. This as the results provide a picture that the municipalities adapt to the expected conditions, and do not have to take measures to actively counteract the adverse effects of climate change. However, this statement is based solely on the interviews, and further studies of adaptation strategies need to be conducted to show this.

The interviews also indicated that climate adaptation takes place mostly on a strategic level, e.g. as guidelines on climate adaptation and by increasing knowledge of expected changes. This is also seen in plans, where e.g. building permits are not given in areas with risk of adverse effects from climate change. This was seen as a viable approach by some of the respondents, as their municipalities have large available areas.

By implementation of EbA in existing strategies, a more pro-active approach with possible win-win options addressing climate change, biodiversity and human well-being could be achieved (Roberts, o.a., Exploring ecosystem-based adaptation in Durban, South Africa: “learning-by-doing” at the local government coal face, 2012). Even though the use of EbA provides several wins, there are also trade-offs to consider both among ecosystem services and stakeholders, leaving decision-makers with complex decisions (Reid & Alam, Ecosystem-based approaches to adaptation: evidence from two sites in Bangladesh, 2017). But can we afford *not* to take action on adaptation, even if wins and trade-offs create a complex issue?

Conclusions

This study is an indication of the explicit use and knowledge of ES in local governance in the Norrbotten County. This to investigate if there is a conscious understanding of the ES concept, and if ecosystems contribution to human well-being are taken into account. The study shows that explicit use of ES in local governance is currently on a low level, and that the perception that the *Milestone target on biodiversity and ES* can be achieved in the county is low. This indicates that the level of knowledge about the ES concept is low and that implementation has not been successful in the county. This is consistent with the study's hypothesis, that there are gaps in implementation and knowledge, and that there is a need for both increased education and capacity building on how to incorporate ES in local governance (Schubert, et al., 2017).

However, although the level of knowledge is low, the respondents show a noticeable interest in ES, and an awareness of possible measures to achieve the milestone target. This indicates a potential positive outcome, should these measures be implemented.

The study further shows an absence of ES explicitly in climate adaptation, but indicates implicit use of ecosystem services as when the use of green infrastructure was mentioned.

Positively though, the county has a forerunner in the Arjeplog municipality, which can serve as role model for the rest of the county to achieve an implementation of ES in local governance.

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