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Inventory of data sources for quantification of eco system services

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Preface

This report is an English summary of the original Swedish report "Kartläggning av datakällor för kvantifiering av ekosystemtjänster" produced by Statistics Sweden at the request of the Swedish Environmental Ministry.

The project was carried through in the spring and summer of 2013 by the following group at Statistics Sweden; Sebastian Constantino, Johanna Mietala, Jerker Moström, Viveka Palm and Nancy Steinbach.

The authors would like to thank all the government authorities, data experts and researchers that have provided the project with valuable insight, without this help this report would not be possible.

Statistics Sweden, October 2013

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Introduction

The purpose of this project has been to make an inventory of available statistics and data sources that can be used to find measurable and quantifiable aspects of eco system services. The inventory can further be used to examine the overall data supply and possibly identify areas where important data is missing or can be improved.

This inventory is partly based on a report done by the Swedish Environmental Protection Agency (2012), where available information on eco system services is presented in a standardized framework. The framework used is the CICES[1] classification of eco system services developed by the EEA. Forming this inventory of data sources was also inspired by the work done in the report "Inventory study on natural environment data"[2] by Defra UK (2007).

The same classification, CICES has been used in this report to provide a structure where the data sources can be discussed. Also the same examples of eco system services are used in this report. Hopefully this report can be an aid in the process of going from qualitative description of eco system services to quantitative analysis.

To accomplish the purpose mentioned above, 90 different data sources have been studied. Telephone interviews with experts on the data sources have been carried out. It is not a complete coverage of every available data source but it is believed that the most important sources are included.

The results of the inventory and evaluations are presented in chapters based on four land use categories; Agricultural land, the Forest, the City and Water. Each land use category is exemplified with eco system services and data sources that can be used to quantify the same services. The four categories were chosen because they provide the basis for the most relevant data sources in Sweden. More land use categories would simply mean repetition of the same data sources.

The eco system services in this report have been studied and assessed based on the following criteria;

- The possibility to *operationalize* a quantification. Some services might be well defined and theoretically developed but are missing practical applicability with existing data.
- *Data supply*, how well the data sources studied in this report cover the exemplified eco system service.
- The potential to describe status *changes over time* of the eco system service.
- The level of c*omplexity* in the eco system service and its quantification. Some services require fewer sources of data while others require several different kinds of data and even research modelling.

[1] http://cices.eu/

- With existing data, on what *scale level* is it possible to analyse the eco system service. Local, regional or nationwide are the levels used in this report.

Agricultural land

Eco system service	Opera-tional	Data supply	Change over time	Complexity	Scale level
Cultivated crops				Low	Local
Reared animals and their output				Low	Local
Pollination and seed dispersal				High	Local
Pest control				High	Regional
Heritage and cultural value of landscapes				High	Regional
Aesthetic values				High	Regional

A summarizing figure of the evaluation of data sources and exemplified eco system services on agricultural land. The assessment is illustrated by markings in green, yellow and red meaning good, less well and poor.

Statistics on agriculture has a long tradition of data collection in Sweden. It is possible to find data on harvests back to the 1700s although variables and methods of course have changed over time.

The provisioning services of cultivated crops and output from reared animals have the best data coverage out of the chosen eco system services. This involves statistics on output, area covered, number of animals, the health of the animals, type of crop etc. However, it would be useful to get additional information on where the animals are grazing, this is not available today.

The pollination service is more difficult to measure as there is no complete picture of the number of pollinators, where they are located or the distance pollinators can travel. Research on these topics has been carried out but combining them to provide a national perspective on pollination has not been attempted for statistical purposes. With existing data one can say something about the potential for pollinators by knowing what habitats are preferred. It is also possible to analyse different crop types after their dependence on pollination. Therefore it is possible to quantify certain aspects of the pollination service but not to get the full picture.

There is no on-going statistics published on the occurrence of natural pest control. One issue is the problem with definitions and boundaries, what is considered a pest from one perspective might be a benefactor of another service. For example moose might eat the bark off trees and therefore be damaging for timber production but on the other hand enhance the service wild animals and their output (both services covered in the next section on forests).

Cultural and aesthetic values are difficult to quantify due to their immaterial and subjective nature. A possibility is to use proxies like e.g. real estate prices or association memberships. Preferences for certain

landscapes can be studied and put together with land usage statistics to determine their occurrence.

Besides the services themselves it is interesting to study what data sources can be used to measure long term changes and trends that have an impact on the eco system services. Data that captures building development, urbanisation and infrastructure can be useful, for example the national road database and the registry for real estate assessment. Other data sources are the statistics on fertilizer use, organic farming, large scale and small scale farming (economical structure of the farming industry) and farming methods.

The Forest

Eco system service	Opera-tional	Data supply	Change over time	Complexity	Scale level
Output from wild animals and plants				Medium	Regional
Fibre resources from plants				Low	Regional
Bioenergy from forests				Low	Regional
Global climate regulation				High	Regional
Unorganized recreation activities				High	Regional

A summarizing figure of the evaluation of data sources and exemplified eco system services in the forest. The assessment is illustrated by markings in green, yellow and red meaning good, less well and poor.

A difference from the agriculture data is that there is no specific registry or administrative source of data for forests other than the Real Estate Assessment Registry (which covers most land types in Sweden). Instead, the main source of data is the National Forest Inventory (NFI). In the NFI trees are identified by type, counted, measured, estimation of growth rate and health are done and soil samples are taken. The inventory is done every year but it takes five years to make a complete national circuit. Therefore many of the estimates are five year averages.

Other data sources studied include the calculations for change in carbon storage due to land use and land use change (LULUCF), hunting data from the Swedish Hunters Association, a Swedish research program for recreation, the survey for living conditions, data on stocks of timber resources, data on controls done after felling (Polytax), costs and prices in the forestry industry and data from satellite images.

Regarding the eco system service output from wild animals and plants the data supply differs depending on what type is studied. For example in the NFI occurrence of bilberries and lingonberries (probably the two most popular berries in Sweden) are measured but not the occurrence of mush-rooms, therefore data is lacking on the latter. In the yearly moose hunt every shot moose is required to be reported by law which makes coverage good. Other types of game have voluntary reporting, but according to the Swedish Hunters Association, reporting is still assumed to have good coverage. Business statistics can also be used, especially when extracting information targeting NACE[3] categories 0230 Gathering of wild growing non-wood products and 0170 Hunting, trapping and related service activities

[3] Statistical classification of economic activities in the European Community.

The provision of fibre resources from trees is well covered by the NFI. One of the main purposes of the forest inventory is to keep track of the growth and stock of timber resource and forest land. Time series are available back to the 1920s although again methods and variables might change slightly over time. Besides the NFI, there is data on prices of forest products, yearly fellings, data on stocks of pulpwood and sawlogs and many kinds of business data for the NACE 02 Forestry category.

Regarding bio energy there are statistics available about the use of biofuels as energy for production in sawmills, pulp and the distribution of district heating. Although bio energy is mentioned under forest in this report, agriculture is a common source of providing the raw material with production of Salix, straw and also grain that can be used for the production of ethanol.

Estimating the climate regulation in forests requires knowledge about the standing timber volume (provided by the NFI) but also about the CO2 storage within different tree types and also the storage within the ground. This makes global climate regulation within forest more complicated to estimate than fibre resource or bio energy. There is an international standard for how estimations can be made within the yearly reporting to the United Nations Framework Convention on Climate Change (UNFCCC), specifically the LULUCF category.

People's recreational lives are not as well covered by statistics as their working lives. There is a national survey on living conditions that includes recreational activities but the survey has had trouble with low response rates for many years. Another source is a research program for recreation that lasted for six years, again the survey had low response rates of about 40 percent. But it is still one of the best sources for statistics on recreation with the 55 questions on 40 different recreational activities. Other data sources that can be used involve membership data in associations, tourism statistics and also statistics with relevance to the Classification of Individual Consumption According to Purpose (COICOP) category 09.3.2 Equipment for sport, camping and open-air recreation.

Alongside the exemplified eco system services other data sources can be used to measure drivers and impacts. There are statistics available for the prices of forest products at different levels in the supply chain which can be followed over time. Like for agricultural land, real estate prices can be used to measure changing preferences over time, these statistics also include rough estimates of the percentage of forestry value out of the total real estate price. The production costs of large scale forestry are also compiled into statistics. There is a database on different types of damage on forest which also includes voluntary reporting. The previously mentioned polytax is a control inventory of areas where trees have been felled to overview the state of the land after final felling. The forest ability to maintain game can be approximated by measuring the occurrence of plants and shrubs that certain game likes to feed on.

The City

Eco system service	Opera-tional	Data supply	Change over time	Complexity	Scale level
Mediation by biota				High	Local
Micro and regional climate regulation				High	Local
Possibility of recrea-tional activities				Medium	Local
Reduction of noise pollution				High	Local
Health				High	–

A summarizing figure of the evaluation of data sources and exemplified eco system services in the city. The assessment is illustrated by markings in green, yellow and red meaning good, less well and poor.

The city is different from both agriculture and forestry in the way that it is not synonymous with an economic industry. Therefore data are not generated by incentives for production and business activities; instead data are generated for planning purposes and often by local government. A problem with data from local government is that is rarely comparable over larger regional areas.

Mediation by biota, meaning the greeneries' ability to purify air from pollutants, CO2 and absorb excessive rainwater. The most important data source is land use data on green space within urban areas. It is important to relate this data with other data on spatial distribution of infrastructure and housing. Quantifying this eco system service is however complicated due to the need to also include the qualities of the greenery and their respective purifying ability. Here scientific research plays an important role but it will be difficult to bring all of these parts together for large scale quantification. It is believed that the absorption of rain water will be easier to quantify as there is also data available on soil sealing that can be used in cohesion with the previously mentioned data. Possible units to quantify would be amount of trees in the city, hectares of green areas, amount of particles absorbed by greenery, CO2 absorption, volume of rain water absorbed by green areas and other non soil sealed areas.

A related eco system service is micro and regional climate regulation. Greenery within the city can keep air humidity and counter the effects of heat waves. Largely the same type of data can be used to quantify this eco system service as the previous one, although there might not be the same need for detailed knowledge about the green areas properties.

The possibility for recreational activities can be approximated by calculating the distance a person has to travel from the residence to the closest green area. In Sweden a limit has been set at 300 meters and statistics are compiled on how large proportion of the populace that has green areas within 300 meters.

With the eco system service reduction of noise pollution data on greenery within the city again proves to be vital in order to operationalize quantification. This data needs to be used together with infrastructure and traffic data to find areas where traffic load is heavy. Possible units to quantify would be hectares of greenery in conjunction with roads or amount of roads lined by green areas.

There is plenty of research available on greenery's impact on health issues in urban areas. Most are based on case studies. The subject area health needs to be further broken down and simplified with indicators to avoid subjective analysis.

Water related services

Eco system service	Opera-tional	Data supply	Change over time	Complexity	Scale level
Output from fresh water organisms				Low	Local
Drinking water				Low	Local
Non-drinkable water				Low	Local
Chemical condition, filtration and sequestration in water				High	Local
Maintaining nursery populations and habitats				High	Regional
Heritage and cultural value of landscapes				High	Local

A summarizing figure of the evaluation of data sources and exemplified eco system services in water. The assessment is illustrated by markings in green, yellow and red meaning good, less well and poor.

There is a wide range of eco system services related to lakes, rivers, wetlands and coastal areas, some of which are included in this report on data sources. The first one, output from fresh water organisms has some common ground with agriculture and forestry in that it is linked to a traditional industry, namely fishing. Like forestry and agriculture the production aspects are covered well in existing statistics. There is statistics on prices, the status of fish as a resource, employment in fishing and aquaculture, sold quantities and more.

The water itself can be divided into different classes of ecosystem services, drinkable and non-drinkable water but they are both covered by the same data source. Statistics on water use are compiled every fifth year and covers the largest user groups; industry, waterworks, households, and agriculture. Water scarcity is not a big problem in Sweden but does occur in the summer in densely populated areas.

The chemical condition, filtration and sequestration in water are more complicated eco system services to measure. The availability of data is not as good as for the provisioning services. Measurements of particles in water at different levels can be made, for example at the source and at the outlets. These two can be compared and something can be said about the filtration capacity of the waterways. Wetlands are an important part of this eco system service and there is a special data source on wetlands, an inventory of all larger wetlands in Sweden. The inventory took 25 years to complete. One fifth of Sweden is covered by wetlands and 35 000 of them are included in the inventory where they have been categorized in 47 groups along with hydrology, character, status of impacts and other variables have been documented.

Maintaining nursery populations and habitats is another example of a complicated ecosystem service to measure and quantify. Protected areas are covered in the land use statistics and it is possible that certain habitats can be identified and used together with existing statistics. The Swedish Species Information Centre's database ArtDatabanken contains data that covers both taxonomy and voluntarily reported sightings of species. Also it possible to use government expenditure data to see how much is spent on habitat protection on a yearly basis. It is however difficult to recommend any indicators or measurements for the ecosystem service maintaining nursery populations.

The heritage and cultural value of landscapes was also mentioned under the section on agriculture. The only new source of information regarding water is to use statistics on the coverage in guest harbours and marinas.

Conclusions

The purpose of this project has been to provide an inventory of data sources that can be used to quantify eco system services. 90 different data sources were covered in the original report and a brief overview of some of them have been given in this English summary along with a linkage to a few eco system services from the CICES structure. Following this are conclusions from this project and also recommendations for future work.

The closer the eco system service is to a finished consumer good or economic activity the better the data supply will be. This conclusion stands for all the four land use categories covered in this report. Provisioning eco system services therefore are easier to quantify and are already being quantified.

There is something available on nearly everything. What this means is that even for the eco system services that have been evaluated as very complex to quantify there is often some source of data bordering to what is wanted. Approximations can be made, indicators can be defined. This then provides an opening for further work if it is decided that a specific eco system service should be prioritized.

Given that there is some data available for most ecosystem services it is still clear that some have considerably less data. This is true for all the cultural services in the report, but also the eco system services; pest control, reduction of noise pollution and maintaining of nursery pools and habitats.

Land use data is a key to understanding and quantifying many eco system services, especially in the urban environment where green areas are linked to all of the eco system services in this report. Ensuring high quality land use data that is compatible with registry data and made available for stakeholders will be critical for the development of quantitative measures of eco system services.

Two questions have emerged that can be of interest for the system of environmental accounts. The first involves going from how much land is owned by a specific industry to studying how much land is essential for a specific eco system service, for example maintaining nursery pools and habitats. The second question is the possibility to study the connection of certain imported goods to specific types of land use in other countries.

The work of this project has been done without any pre-conditions with regards to users of this type of statistics. If specific statistics on ecosystem services are to be developed, a clarification of main users will be required. This will simplify the design of estimates. Statistics for local government require different data than central government.

Another related question is that of institutional support, responsibility and competence. If new and improved data are to be developed a clarification of institutional responsibility will be required. Specialist competence needs to be used and maintained, for example a recurring part of this inventory has been the revelation of how many data sources have their origins at the Swedish University for Agricultural Sciences. Knowledge of administrative

data sources and registries are needed as well and here National Statistical Institutes often have a key role.

A large part of the data sources in this report are official statistics. It is possible that development within existing statistical products can help to improve quantitative estimates on eco system services. An example of this is the improvements being done in methodology of the statistics on green areas within urban areas.

A possible development would be to tie land use statistics closer to the environmental accounts by developing new categories of land use. These new categories would then have to be more detailed, one example is the classification used within reporting of Natura 2000 areas.

National coverage high resolution land cover data would improve the possibilities to produce eco system service statistics. Today new land cover data is only produced every sixth year and the lowest scale level is 25 hectares. A pilot project is being funded by the European Space Agency but there is right now no funding for implementation of what is suggested within the project.

References from the summary

Swedish Environmental Protection Agency, 2012, English summary of "Sammanställd information om ekosystemtjänster", http://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/regeringsuppdrag/2012/ekosystem-ekosystemtjanster/sammanfattning-ekosystem-eng-2013.pdf

Defra UK, 2007, "Inventory study on natural environment data 2", http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14750

For a complete list of references, view the original report at: http://www.scb.se/Pages/PublishingCalendarViewInfo 259923.aspx?PublObjId=21133

The Environmental Accounts is an information system developed to systematically describe the connections between environment and economy. Statistics on environment and economy provide a foundation for calculations on costs of environmental measures and damages, analysis of environmental and economic policy as well as indicators on environmental status and sustainable development.

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Inventory of data sources for quantification of eco system services

The purpose of this project has been to make an inventory of available statistics and data sources that can be used to find measurable and quantifiable aspects of eco system services. Around 90 data sources have been studied in the inventory.

The inventory can further be used to examine the overall data supply and identify areas where important data is missing or can be improved.

The report was commissioned by the Environmental Ministry in Sweden.

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