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# RESOURCES OF THE POLISH OFFICIAL STATISTICS FOR VALUATION OF PROVISIONING ECOSYSTEM SERVICES

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## ZASOBY POLSKIEJ STATYSTYKI PUBLICZNEJ DO OCENY I WYCENY ZAOPATRUJĄCYCH USŁUG EKOSYSTEMOWYCH

STRESZCZENIE: Jedną z głównych przeszkód w ocenie usług ekosystemowych jest brak odpowiednich danych do ilościowego ujęcia popytu i podaży na poszczególne usługi. Przedmiotem artykułu jest ocena potencjału statystyki publicznej do wsparcia ocen i wycen zaopatrujących usług ekosystemowych w Polsce. Analizę dostępności danych źródłowych przeprowadzono w trzech wymiarach: dla klas Wspólnej Międzynarodowej Klasyfikacji Usług Ekosystemowych (CICES), jednostek podziału administracyjnego Polski oraz głównych typów ekosystemów. Oceniono także dostępność czasową danych i związaną z nią możliwość określania wieloletnich trendów zmian w poziomie usług.

Dokonany przegląd zasobów statystycznych pozwala oceniać, iż dostarczają one rozległego materiału do ocen i wycen zaopatrujących usług ekosystemowych, niemniej występują trudności przy korzystaniu z istniejących danych. Należą do nich szczególnie: zróżnicowana dostępność danych statystycznych na różnych poziomach przestrzennych, brak informacji o niektórych usługach, a także rozproszenie danych związane z faktem, że usługi ekosystemowe nie stanowią kryterium organizującego w zbieraniu i prezentowaniu danych.

SŁOWA KLUCZOWE: usługi ekosystemowe, ocena, wycena, raportowanie, dane statystyczne, źródła danych

## Introduction

The interest in ecosystem services (ES) in both the research and policy communities has grown substantially[1]. The main obstacles in the valuation of ES include the lack of appropriate data for the quantification of the supply and demand for individual services.[2] The analysis of available data is considered to be a necessary first step towards the development of a reliable and feasible indicator for ES mapping and assessment[3]. Data sources that may be used for the quantification of ES may include both maps and statistical data[4]. The latter are perceived as particularly useful in the quantification of provisioning ES. Many of these services are market-related;[5] therefore, the input data for their analyses may be obtained from statistical reports for individual economic sectors.

The aim of this paper is to assess the potential of public statistics for the support of valuations of provisioning ES and the reporting concerning the value of these services in Poland. The aims of the studies include the identification and assessment of the available source data for the quantification of provisioning services in physical and monetary units. The practical aim involves the assessment of the usefulness of the public statistics database for the implementation of target 2, action 5 of the European Union Biodiversity Strategy. This action involves mapping and assessment of the state of ecosystems and their services in member states by 2014 and the assessment of the economic value of such services and promoting the integration of these values into accounting and reporting systems by 2020[6].

## Methodology

The analysis of the source data availability for the valuations of provisioning services was carried out in three dimensions: for classes covered by the Common International Classification of Ecosystem Services (CICES version 4.3), Polish

[1] L.M. Cox, A.L. Almeter, K.A. Saterson, *Protecting our life support systems. An inventory of U.S. federal research on ecosystem services*, "Ecosystem Services" 2013 no. 5, p. 163-169; L. Braat, R. de Groot, *The ecosystem services agenda: bridging the worlds of natural science and economics, conservation and development, and public and private policy*, "Ecosystem Services" 2012 nr 1, p. 4-15; R. Seppelt, et al., *A quantitative review of ecosystem service studies: approaches, shortcomings and the road ahead*, "Journal of Applied Ecology" 2011, p. 630-636.

[2] B. Burkhard, F. Kroll, p. Nedkov, F. Müller, *Mapping ecosystem service supply, demand and budgets*, "Ecological Indicators" 2012 no. 21, p. 17-29.

[3] *Available data for mapping and assessing ecosystems in Europe*, 2013 Final Report – task 5.2.5, www.projects.eionet.europa.eu [04-07-2014]; *Indicators for mapping ecosystem services: a review,* 2012 Report EUR 25456 EN, www.publications.jrc.ec.europa.eu [03-07-2014]. *Mapping of ecosystems and their services in the EU and its member states (MESEU). Final report, part 5: task 4 – Recommendations on mapping approaches*, Alterra Wageningen 2013.

[4] Ibidem.

[5] *Study on the role of agriculture as provisioning ecosystem service*, 2012 Final report, www.ecologic.eu [03-07-2014].

[6] *Our life insurance, our natural capital: an EU biodiversity strategy to 2020* [COM(2011) 244].

administrative units and the main ecosystem types. The assessment covered also the temporal availability of data and the associated possibility of defining multi-annual change trends.

The studies were based on the following data of the Central Statistical Office (CSO):

- Local Data Bank[7];
- Environment – statistical yearbooks of 2005-2013[8];
- Municipal infrastructure – statistical yearbooks of 2003-2012[9];
- Forestry – statistical yearbooks of 2005-2013[10];
- Agriculture – statistical yearbooks of 2007-2012[11];
- Agricultural and horticultural crops production – publications of 2003-2012[12];
- Farm animals – publications of 2002-2012[13];
- Physical dimensions of livestock production – publications of 2006-2012[14];
- Horticultural crops – publications from the National Agricultural Censuses 2002 and 2010[15];
- Agricultural crops and selected elements of crop production methods – a publication from the National Agricultural Census 2010[16];
- Arable soil use and quality – a publication from the National Agricultural Census 2002[17];
- Maritime Economy – statistical yearbooks of 2007-2013[18];
- Energy from renewable sources – publications of 2011-2012[19];
- Energy Statistics – publications of 2007-2012[20];
- Energy consumption in households in 2009[21].

In this analysis the term *ecosystem services indicator* is used to refer to the number expressing the level of the service, presented in an absolute or relative form[22]. Source data for the quantification of provisioning services were analysed in two groups: indicators expressed in physical units (such as tons, square kilometres, cubic meters) and monetary indicators (in PLN). The former

[7] *Bank Danych Lokalnych*, www.stat.gov.pl [20-0-2014].
[8] *Ochrona środowiska 2005-2013*, www.old.stat.gov.pl [16-06-2014].
[9] *Infrastruktura komunalna 2003-2012,* www.stat.gov.pl [16-06-2014].
[10] *Leśnictwo 2005-2013*, www.old.stat.gov.pl [16-06-2014].
[11] *Rocznik Statystyczny Rolnictwa 2007- 2012,* www.stat.gov.pl [16-06-2014].
[12] *Produkcja upraw rolnych i ogrodniczych 2003- 2012,* www.stat.gov.pl [16-06-2014].
[13] *Zwierzęta gospodarskie 2002- 2012,* www.old.stat.gov.pl [16-06-2014].
[14] *Fizyczne rozmiary produkcji zwierzęcej 2006-2012,* www.stat.gov.pl [16-06-2014].
[15] *Uprawy ogrodnicze. Powszechny Spis Rolny 2010,* www.stat.gov.pl [16-06-2014].
[16] *Uprawy rolne i wybrane elementy metod produkcji roślinnej. Powszechny spis rolny 2010,* www.stat.gov.pl [16-06-2014].
[17] *Użytkowanie gruntów i ich jakość. Powszechny Spis Rolny 2002*, www.stat.gov.pl [16-06-2014].
[18] *Rocznik statystyczny gospodarki morskiej 2007-2013,* www.stat.gov.pl [16-06-2014].
[19] *Energia ze źródeł odnawialnych w 2011 r, w 2012 r.,* www.stat.gov.pl [16-06-2014].
[20] *Gospodarka paliwowo-energetyczna w latach 2007-2008, w latach 2011-2012,* www.stat.gov.pl [16-06-2014].
[21] *Zużycie energii w gospodarstwach domowych w 2009 r.,* www.stat.gov.pl [16-06-2014].
[22] Joint Research Centre, op. cit.

provide a source material for the biophysical valuation of provisioning services, whereas the latter – for economic valuation.

# Results

## Inventory of data at different spatial scales

In the analysed resources of the national public statistics, 588 provisioning services indicators in physical units and 164 monetary indicators have been identified altogether (Table 1). These indicators enable the quantification of the services at different administrative levels. In the course of the studies, indicators for the valuations of provisioning services at the national, provincial and commune levels were identified. The analysis did not cover districts, as – apart from the Local Data Bank – in CSO's publications used as a source material, no reporting on this administrative level was found.

As regards indicators for the biophysical valuations of provisioning services, 58% of them were identified at the provincial level, 38% at the national level and 4% at the commune level. Most of the monetary indicators were identified at the national level (94%). Monetary indicators at the provincial level represent only 6% of the total number, while no such indicators were identified at the commune level.

At the national level, a considerable share (50%) of the indicators for the biophysical valuation of provisioning services is represented by the indicators for the services from the CICES class concerning plant-based resources. They include the statistics of production and energy consumption from plant-based resources. The indicators for the class of genetic materials from all biota are also widely represented (24% of all indicators in physical units). They are mainly characterised by forest genetic resources, including parents of family as well as seed tree stands and seed orchards. Monetary indicators describing the level of provisioning services at the national level are mainly related to the classes of cultivated crops (40% of all indicators), reared animals and their outputs (33%) as well as fibres and other materials from plants, algae and animals for direct use or processing (16%). The indicators related to the above-mentioned classes reflect the

Table 1

The number of identified indicators for provisioning services at different administrative units

| Type of valuation | Communes | Provinces * | Country * | Total |
|---|---|---|---|---|
| Biophysical valuation | 22 | 342 | 224 | 588 |
| Economic valuation | 0 | 10 | 154 | 164 |

* source data that do not occur in the reporting for lower-level administrative units

Source: own study.

value of the crop and animal agricultural production in total and divided by products, as well as the value of the wood sales of the National Forest Holding, according to product assortments.

The indicators, that are useful for the biophysical valuation of provisioning services at the provincial level, are most widely represented by the classes of cultivated crops (44% of all indicators) and materials from plants, algae and animals for agricultural use (17%). As regards the first of the above-mentioned classes, the analysed indicators are characterized by the size of the production of consumer crops, whereas the second one – by the size of fodder crops. Monetary indicators at this administrative level cover the value of the purchase of agricultural produce, fruit and forest mushrooms as well as game.

At the commune level, as far as indicators expressed in physical units are concerned, the classes of cultivated crops (36% of all indicators) and reared animals and their output (27%) are the most widely represented. They are related to the sowing area of selected farmlands and orchards as well as the headage of farm animals. At the commune level, no indicators reporting the level of provisioning services in monetary units were identified.

## CICES classification coverage by data on provisioning services

The analysis covered the completeness of source data related to the classes of provisioning services specified in CICES version 4.3. The number of indicators for individual classes is presented in table 2. As regards indicators in physical units at the national level, at least one indicator for 7 out of 16 CICES classes was identified, at the provincial level – for 12 classes, whereas at the commune level – for 6 classes. The analysed indicators were not identified for four CICES classes altogether. As regards monetary indicators at the national level, at least one indicator for 5 out of 16 CICES classes was identified, whereas at the provincial level – for 4 classes. No monetary indicators were identified at the commune level. Monetary indicators were not identified for nine CICES classes altogether.

## Availability of statistical data for the main ecosystem types

In the next phase of the works, the coverage of the main ecosystem types with provisioning ES indicators was identified. The analysis results are included in Table 3. Indicators in both physical and monetary units are dominated by the ones describing provisioning services of agricultural areas and forests. For many indicators concerning the class of plant-based resources, it was impossible to explicitly match them to ecosystem types. These were indicators that covered the total use of various forest, agricultural and peat biomass types for power-related purposes, without taking into account their origin.

Temporal availability was determined for all identified indicators. When services are only assessed on the one-year basis, the drawback is the omission of temporal changes of ES supply and demand. Provisioning services vary over the

Table 2
The number of indicators for provisioning services available in the resources of the national public statistics according to CICES classes

| CICES classes | Number of indicators for the administrative level * | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Communes | | Provinces | | Country | | Total | |
| | P | M | P | M | P | M | P | M |
| Cultivated crops | 8 | 0 | 148 | 2 | 2 | 62 | 158 | 64 |
| Reared animals and their outputs | 6 | 0 | 21 | 2 | 22 | 51 | 49 | 53 |
| Wild plants, algae and their outputs | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 |
| Wild animals and their outputs | 0 | 0 | 25 | 4 | 10 | 0 | 35 | 4 |
| Plants and algae from in-situ aquaculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Animals from in-situ aquaculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Surface water for drinking | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| Ground water for drinking | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| Fibres and other materials from plants, algae and animals for direct use or processing | 3 | 0 | 30 | 0 | 6 | 24 | 39 | 24 |
| Materials from plants, algae and animals for agricultural use | 2 | 0 | 57 | 0 | 18 | 4 | 77 | 4 |
| Genetic materials from all biota | 0 | 0 | 17 | 0 | 53 | 0 | 70 | 0 |
| Surface water for non-drinking purposes | 2 | 0 | 10 | 0 | 0 | 0 | 12 | 0 |
| Ground water for non-drinking purposes | 1 | 0 | 8 | 0 | 0 | 0 | 9 | 0 |
| Plant-based resources | 0 | 0 | 22 | 0 | 113 | 13 | 135 | 13 |
| Animal-based resources | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Animal-based energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

P – indicators in physical units, M – monetary indicators
* A class with at least 1 indicator [grey color]

Source: own study.

years based on growing seasons or regulations, e.g. concerning the agriculture, fishing or hunting. Such information has to be taken into account when communicating ES supply and demand to stakeholders. It was determined that 85% of the indicators in physical units cover the period of at least 10 years, whereas 15% of them are based on one-year data. As regards monetary indicators, these shares are 95% and 5% respectively. The predominance of indicators covering the period of 10 years and longer provides a good possibility of defining multi-annual change trends at the level of provisioning services.

Table 3
The number of identified provisioning services indicators for the main ecosystem types

| The main ecosystem types | CICES classes | Number of indicators | | | |
|---|---|---|---|---|---|
| | | For CICES classes | | Total | |
| | | P | M | P | M |
| Agriculture areas | Cultivated crops | 158 | 64 | 315 | 121 |
| | Reared animals and their outputs | 49 | 53 | | |
| | Fibres and other materials from plants, algae and animals for direct use or processing | 12 | 0 | | |
| | Materials from plants, algae and animals for agricultural use | 77 | 4 | | |
| | Plant-based resources | 19 | 0 | | |
| Forests | Genetic materials from all biota | 25 | 4 | 180 | 30 |
| | Fibres and other materials from plants, algae and animals for direct use or processing | 2 | 2 | | |
| | Wild animals and their outputs | 27 | 24 | | |
| | Wild plants, algae and their outputs | 70 | 0 | | |
| | Plant-based resources | 56 | 0 | | |
| Freshwater | Ground water for drinking | 1 | 0 | 24 | 0 |
| | Surface water for drinking | 1 | 0 | | |
| | Ground water for non-drinking purposes | 1 | 0 | | |
| | Surface water for non-drinking purposes | 12 | 0 | | |
| | Wild animals and their outputs | 9 | 0 | | |
| Baltic Sea | Wild animals and their outputs | 9 | 0 | 9 | 0 |
| Forests/Agriculture areas | Plant-based resources | 58 | 13 | 58 | 13 |
| Forests/Grasslands | Plant-based resources | 2 | 0 | 2 | 0 |

P – indicators in physical units, M – monetary indicators

Source: own study.

## Discussion

The identified indicators of the provisioning ES are included in the list of preferred indicators provided by Joint Research Centre (JRC)[23]. In the JRC's work, almost a half (46%) of the proposed indicators is characterised by food provision, 30% by water provision, while the remaining ones are medicinal resources (4%) and genetic resources (3%). Indicators found in the resources of the Polish public statistics are also consistent with the indicators of ES proposed by the

[23] Ibidem.

European Commission Working Group: "Mapping of Ecosystems and Their Services in the EU and its Member States" (MAES).[24] Examples of indicators for agricultural areas recommended by MAES available in the Polish official statistics include the yields of food and feed crops, food and feed crop area, livestock data, meat production and consumption. As regards forests, the examples of such indicators include the data on forest harvesting, and as far as freshwater is concerned – on domestic water consumption and water use for sectors of economy.

As pointed out by the authors of PEER[25], indicators referring to ES need to reflect (the actual distance from) the sustainable production rates to ensure that the long-term benefit flow of services is represented. High values may arise from over-exploitation of ecosystems and lead to wrong conclusions concerning the most advantageous strategies of the use and protection of ecosystems. Currently, there is no clear definition concerning the meaning of sustainability with regard to individual ES. However, in the Polish statistical data, no indicators characterising the level of provisioning services covering the aspects of sustainability of production were identified.

It should also be noted that provisioning ES provided by agriculture are not "pure" ES, but they originate from deeply modified habitats. The values of those services depend not only on the natural capital (e.g. the soil as a natural resource for plant production), but also on the contribution of man-made input into the system (i.e. labour, machinery, fertilisers, irrigation).[26] The availability of indicators characterising both elements should enhance the usefulness of valuations of provisioning services for the support of decision-making processes.

The presented indicators focus mainly on ES-supply assessment. ES-supply indicators show the capacities of different ecosystems to provide ecosystem services, but the locations of respective demands for these services cannot be determined on their basis. ES-demand indicators represent ⅓ of all identified indicators. This type of indicators makes it possible to determine the amount of ES consumed or used in a particular area, and thus to assess where ES are actually provided. In order to analyse the source and sink dynamics and to identify service flow, the information about the ES supply and demand needs to be merged.[27] The indicators identified during the presented studies enable the creation of budgets of ecosystem service supply and demand only for 5 out of 16 classes of provisioning services: surface and ground water for drinking purposes, surface and ground water for non-drinking purposes and plant-based resources.

[24] MAES, *Mapping and assessment of ecosystems and their services. Indicators for ecosystem assessments under Action 5 of the EU Biodiversity Strategy to 2020*, 2014 Technical Report – 2014 – 080, www.ec.europa.eu [03-07-2014].
[25] *A spatial assessment of ecosystem services in Europe: Methods, case studies and policy analysis – phase 1*, 2011 PEER Report No 3, www.peer.eu [03-07-2014].
[26] FRAGARIA consortium, op. cit.
[27] B. Burkhard, F. Kroll, S. Nedkov, F. Müller, op. cit.

## Conclusions

The analysis of the existing statistical data makes it possible to conclude that they provide a great deal of useful material for the valuations of provisioning ES; there are yet still several challenges to be dealt with.

In particular, data are plentiful, but their availability is different at individual spatial scales. On the national level, data availability is not so much the problem, as many statistics are readily available, or national aggregations can be done from regional and local data. At the local level, on the other hand, provisioning ES remain poorly characterised by data; therefore, a comprehensive valuation of services cannot be carried out on their basis. It is possible to use data from higher administrative units (e.g. yields on regional level) in order to carry out ES valuation on the local scale. However, this may result in over-simplification and coarse assessment, since the crucial local specificity remains hidden due to the high level of aggregation of data coming from national and regional scales.[28] Great progress may, therefore, be done by the improvement of the availability of local data on ES by means of extending the scope of data collected at the commune level.

As not all ES are represented in the resources of the Polish public statistics, treating them as the only source of data may lead to the under-representation of some services and lack of information on other ones. The most important difficulties include also data fragmentation related to the fact that ES do not constitute an organising principle in collecting and presenting data. Currently, the term "ecosystem services" is not used in the public statistics resources; therefore, statistical data on them may be found only indirectly – through the analysis of statistical publications concerning various economic sectors and subjects. The creation of an on-line platform storing data on ES on a central and accessible server would increase data availability and enable the users to perform queries of data for a particular output.

The presented analysis opens the discussion on the development of a complete system of provisioning ES indicators in Poland. The identified data need to be discussed in an interdisciplinary manner, involving the correctness and usefulness of particular indicators, the *necessary* number of indicators and desired proportion between the indicators in physical and monetary units.

[28] M. Kandziora, B. Burkhard, F. Müller, *Mapping provisioning ecosystem services at the local scale using data of varying spatial and temporal resolution*, "Ecosystem Services" 2013 no. 4, p. 47-59.