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Forest and Society's Welfare: Impact Assessment in Lithuania

Stasys Mizaras and Diana Lukmine *

Lithuanian Research Centre for Agriculture and Forestry, Institute of Forestry, LT-53101 Girionys, Lithuania; stasys.mizaras@gmail.com

* Correspondence: diana.lukmine@lammc.lt; Tel.: +370-68-623-855

Abstract: Effective formation and implementation of forest policy can only be achieved with orientation to the most important goal—increasing society's welfare. The global problem is, at present, that the impact of forests on society welfare indexes have not been identified. The aim of the study is to design an assessment model and assess the impact of Lithuanian forests on the society welfare index. The impact of forests was determined by multiplying the country's welfare of society index by the forest contribution coefficient. In this study, to assess the index of the welfare of Lithuanian society, a five-dimensional model with 16 indicators was applied. The study is based on the Eurostat database and on Lithuanian forestry statistics. The Lithuanian welfare of society index calculated according to the model was 51.4% and the contribution of forests in this index was 3.9%. It represented 7.6% of the index of the welfare of society. Forests have the greatest impact in the environmental dimension, according to the assessment results.

Keywords: welfare of society index; forest impact assessment; forest contribution coefficient

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1. Introduction

Forests are one of the most significant world ecosystems. They provide wood and non-wood products as well as serve different social-ecological purposes, namely, recreation, absorption of greenhouse gas, biodiversity, water, soil, and air protection. The benefit of forests is expressed by various indicators such as a share within gross domestic product (GDP), volume of forest cutting, areas of protected forests, protection of biodiversity, the amount of absorbed greenhouse gas, the number of visitors in forests, etc. [1].

The Food and Agriculture Organization of the United Nations (FAO) stated that the economic benefits from the world forest is 1.1% of the global economy, 83.3 million forest-related workers and forest owners, 0.6% of food supply, and 6.1% energy. Forests indirectly contribute to human well-being by performing environment (water, air, soil) protection functions. Forests account for about 80% of the world's biodiversity. They supply genetic material for the improvement of plants and animals [2].

A number of research papers were reviewed that mentioned that the relationship between forests and public welfare has been studied: forests and economic welfare [3], the welfare effects of forestry best management practices [4], forest ecosystem services—a cornerstone for human well-being [1,5]; forest and human health and well-being in light of climate change and urbanization [6], market and welfare economic impacts of sustainable forest management practices [7], the economic contribution of forests [8], the contribution of the forest sector to national economies [9], the contribution of forestry to well-being of mountain forest-dependent communities [10], the role of national-level indicators within sustainable development goals [11], the impacts of community forest management on human economic well-being [12], linking forest naturalness and human well-being [13], forest resources of nations in relation to human well-being [14], and others.

S. Kant et al. analyzed the effects of forests on welfare of society in a case study from West Bengal (India) and found that returns from non-timber forest products (NTFP) reduce income inequality, expressed by the Gini coefficient. To describe the welfare of society,

average household income from the NTFP indicator was used as a descriptor. It was an attempt to link the impact of one group of forest products (NTFP) to one indicator of public welfare (Gini coefficient) [3].

In the United States, a multi-type equilibrium displacement model was constructed to examine how a forestry best management practices (BMP) program affected the welfare positions of consumers mills, loggers, and landowners. Forestry BMP programs are a combination of operational practices designed to protect stream water quality during timber harvesting operations. The welfare implication of forestry BMPs was measured by producer and consumer surplus. The results of the study showed that all agents experience higher or lower welfare losses [4]. As indicated by the study authors, the welfare measures did not capture nonmarket welfare effects of BMPs. Thus, the study evaluates the impact of BMP programs on forest sector welfare in terms of consumers and products surplus.

An ecosystems approach is proposed to analyze the impact of forests on the well-being of society in the Report of the Millennium Ecosystem Assessment. According to the report, ecosystems perform functions that benefit society by becoming services. Ecosystem services are divided into provisioning, regulating, supporting, and cultural. They affect elements of the well-being of society (basic material for good life, health, security, good social relations, freedom of choice). The main services from forest ecosystems include habitat provision, clean water, flood protection, carbon sequestration and storage, climate regulation, oxygen production, nutrient cycling, genetic and spiritual resources, cultural recreational, and tourism value [1]. The report describes the links between forest services and the well-being of society, and provides indicators that express them, but there are no studies on the impact of forest services on the welfare of society.

Chapter 12, "Forests, Human Health and Well-Being in the Light of Climate Change and Urbanizations" from the book *Forest and Society—Responding to Global Drivers of Change* states that many of the positive effects that forests have on human health and well-being may be altered as a result of climate change and subsequent changes in forest structure and forest cover. This book applies the broader definition of health, which embraces aspects of well-being. A quantitative interpretation of the impact of forests on human health and well-being provides data on forests as a source of health-promoting and bioactive components, vector-borne diseases in forested areas, and forest and human health in protected areas [6].

The economic welfare impacts of sustainable forest management (SFM) provide empirical evidence that there is a loss of economic welfare impacts in the timber industry in Peninsular Malaysia. If the forest area were managed according to the SFM practices, it would affect several economic elements such as harvested area, operational costs, and price and market changes in these elements influencing the economics of timber supply and demand. The total sum of the consumer and producer surplus was used as the most important indicator of economic welfare [7].

The contribution of forestry to the well-being of mountain forest-dependent communities in the Ukrainian Carpathian Mountains was investigated. Well-being there was a term used to describing the general condition of an individual or group, for example, their social, economic, ecological, psychological, spiritual, or medical state. High well-being means that, in some sense, the individual or group's experience is positive. A questionnaire survey of business representatives, forestry specialists, and local community representatives found that in a broad sense, economic, environmental, social, cultural, and aesthetic functions of forests contribute considerably to the well-being of forest-depended communities in the Ukrainian Carpathians [10].

Evaluating the impact of communities' forest management on human economic well-being across Madagascar determined that forest use restrictions had a negative impact on household well-being. In this study, human economic well-being was measured by per capita consumption expenditures [12].

The studies were conducted with the general goal to contribute to the empirical rationale for linking forest naturalness with human well-being in Malaysia. A subjective approach that takes into account individual experiences in nature and is able to reveal

the synergistic well-being benefits of nature on physical, mental, and social well-being is adopted in this study. Well-being was assessed by respondents using the interview method. Respondents were asked about their perceived well-being, physical and mental health gained by visiting the forest, and experimental connection to nature. "Nature" was divided into botanical garden, abandoned rubber estate, secondary forest, and primary forest. The study determined a positive correlation between environmental preferences and concluded that naturalness is an important dimension of environmental experience that may benefit human well-being [13].

There are studies not only on the impact of forests on the welfare of society, but also on the impact of the welfare of society on forests. For a description of social welfare, the Human Development Index (HDI) stated that it entails forest resources of nations improving along with progress in human well-being. Highly developed countries apply modern agricultural methods on good farmlands and abandon marginal lands, which become available for forest expansion. Developed countries invest in sustainable programs of forest management and nature protection [14]. A similar conclusion was formulated by analyzing the socio-economic factors affecting global forest area changes. The results show that many socio-economic factors have a negative impact on forest area in countries at low levels of human development, but their impacts become positive in countries at higher levels of human development, such as the rate of rural population, the adult literacy rate, and GDP per capita [15].

However, forest benefit evaluations [1–17] are not linked to index assessments on the welfare of society, and do not show which part of the welfare of society is determined by forests.

There is a great variety of concepts describing the welfare of society (well-being, welfare, quality of life, sustainable development, etc.) and the methods of assessing them. From the traditional point of view, the size of GDP was considered to be the indicator of the welfare of society within a country. However, currently there is common agreement to express welfare not only by financial indicators but also by taking into consideration quality of life [18]. Quality of life is determined by material conditions, personal security, environmental quality, population health status, expression possibilities, and moral psychological climate [19]. In different methodologies, the welfare of society (quality of life) is described by indicators that are often grouped into economic, social, political, health, environmental, and other dimensions. Various aggregated indices are constructed on that basis. They include various constructions of composite index steps: selection and combination of variables, data selection, multivariate analysis, normalization, weighting, and aggregation [20].

Different methodologies to assess society's quality of life (QL) have been created [21]: Physical QL Index (1970), Living Condition Index (1974), Michigan QL Assessment Methodology (1975), Ferrans and Powers QL Index (1984), Individual's Social Development Index (1990), Genuine Progress Indicators (1995), World Health Organization QL Model (1997), Calvert-Henderson QL Assessment Methodology (2000), Economist Intelligent Unit QL Index (2005), Legatum Prosperity Index (2007), J. Stiglitz, A. Sen and J. P. Fitoussi QL index (2009), International Living QL Index (2010), Indirect QL Indicator (2010), and the Complex LQ Assessment Methodology (2011). Newer indexes include the European Deprivation Index [22], Global Sustainable Competitiveness Index [23], Sustainable Progress Index [24], index of the welfare of society [25], and the Sustainable Development Goals (SDG) index [26,27]. Following Brundtland's report "Our common future" (1987), stating that "humankind development must be sustainable in order to assure welfare at present without diminishing possibilities of welfare in the future" [28], the concept of the welfare of society has been transformed into the concept of sustainable development of society. In the 70th session of the United Nations, the 2030 Agenda for Sustainable development was adopted and it includes the Sustainable Development Goals (SDG) and targets. The SDGs cover a broad range of social economic development issues (poverty, hunger, health, gender equality, water, sanitation, energy, environment, social justice, etc.). It includes 17 goals, 169

targets, and 247 indicators [29]. The analysis of correlation between forestry and the 2030 Agenda for Sustainable Development goals and targets was undertaken. The strongest correlation was identified with goal 15: "to preserve, restore and promote sustainable use of dryland ecosystems, to sustainable manage forests, fight with deserting, prevent the loss of biodiversity." Moreover, forests have an impact on the implementation of goals related to increasing inhabitants' income, food resources, healthy way of life, water access, climate change, etc. [16,17].

There is a tendency to increasingly integrate environmental indicators into public welfare assessments. For instance, the Genuine Progress Index (GPI) is one of the most widespread indexes and changes GDP in assessing the welfare of society by taking into consideration not only economic benefit but also social and environmental indicators. Environmental indicators show costs and losses due to water and air pollution [30]. A specialized Environmental Performance Index [31] and individual environmental dimensions have been created [22–27,30]. The lists of evaluation indicators are supplemented by forest-related indicators, for example, permanent deforestation, meaning an area that is protected in terrestrial sites important to biodiversity, greenhouse emissions, and the share of renewable energy in the total primary energy supply [26,27]. However, the overall impact of forests on indexes of the welfare of society has not been determined.

The aim of this study is to assess the impact of Lithuanian forests on the welfare of society on the basis of assessments of Lithuanian social welfare indexes. The area of Lithuanian forest land covers 2197 thousand ha, whereas forests occupy 33.7% of the territory (data from 1 January 2019) [31]. The proposed solutions of this study, which elaborate on the Lithuanian case, are important internationally because the developed methodology and assessment are replicable.

2. Materials and Methods

The impact of forests on the welfare of society was determined by multiplying the country's index of the welfare of society by the forest contribution coefficient:

$$\mathrm{SWIF} = \mathrm{SWI} * \mathrm{k} \quad (1)$$

where SWIF—contribution of forests on the welfare of society index, %; SWI—welfare of society index for the country, %; and k—forest contribution coefficient.

The SWI calculation is based on the multidimensional welfare of society and sustainable development assessment method [20,21,25,27,32]: (1) selection of dimensions and indicators of the welfare of society, (2) defining indicator performance, (3) defining indicator performance threshold, (4) normalization, (5) weighting, and (6) aggregation.

Dimensions and indicators. The dimensions and indicators used for Lithuania in this study were suggested by J. Kisieliauskas. After analyzing various methodologies for assessing the level of the welfare of society, the 5 dimensions that met the objective needs of members of society were distinguished: economic, political, social, health, and environmental. Sixteen indicators of the welfare of society selected were based on statistical and expert methods. The dimensions were expressed by the following indicators: the economic dimension—indicators of GDP per capita, annual inflation, employment rate, and government debt; the social dimension—indicators of income inequality, poverty rate, divorce rate, and expected duration of education; the political dimension—indicators of perception of corruption and democracy; the health dimension—indicators of life expectancy, infant mortality, and suicide rate; and the environmental dimension—indicators of greenhouse gas emissions, energy from renewable sources, and water productivity [25].

Indicator performance. The performance of indicators was defined in the Eurostat database [33].

Indicators performance threshold. The majority of threshold performance (optimal and minimum values) was defined in the Europe Sustainable Development Report 2020 [27]. The missing optimal and minimum values of indicators were determined according the

abovementioned report's [27] methodology by using the average of the top two performers in Europe.

Normalization. To make the data comparable across indicators, each variable was normalized using the following formula [20,34]:

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)} * 100 \quad (2)$$

where x'—the normalized value after rescaling (the same as the SWI), %; x—indicator value; and max/min denote the bounds for best and worst performance, respectively.

Weighing. Equal weights for the indicators and dimensions were applied.

Aggregation. The country overall SWI index was estimated according to the following formula [20,34]:

$$SWI = \sum_{j}^{m} \frac{1}{m} \sum_{i}^{n} \frac{SWI_{ij}}{n_{ij}} \quad (3)$$

where SWI—welfare of society index for the country, SWI_{ij}—index of indicator i under dimension j, i—indicator, j—dimension, n—number of indicators for dimension j, and m—number of dimensions.

The contribution of forests coefficient (k) was measured by the ratio of the forest-related effect to its size in the country. The welfare of society indicators were divided into three groups according to the impact of forests. First were the indicators for which the impact of forests was clearly expressed and could be determined on the basis of statistics (GDP per capita, employment rate, greenhouse gas emissions, energy from renewable sources). The annual GDP per capita in the Lithuanian forest sector (forestry; wood, paper, and furniture industries) was EUR 618.7 in 2019 [35]. The contribution of the forest sector to the employment rate was 5.1% in 2019 [35]. The impact of forests on greenhouse gas emissions was determined by increasing the country's total emissions by the amount of greenhouse gases absorbed in the forests. Forests in Lithuania absorbed 4743 kt of greenhouse gases in 2018, or 1.7 t per capita [36]. The contribution of energy from wood to the total energy consumption was 16% in 2019 [37]. Second were indicators for which forest impacts were possible but statistically not identified (poverty rate, health indicators, water productivity). Indicators were assessed based on various assumptions and known information. The forest contribution coefficient for the poverty rate was determined by the ratio of food products from forests (mushrooms, berries, and hunting game) to total agricultural production. In 2015, agricultural production in Lithuania was EUR 2530.4 million [37], and food from forests was EUR 72.7 million [35]. The contribution of forests was 2.9%. Forests certainly had an impact on health indicators. We assumed that the importance of forests to human health was proportional to the proportion of leisure time spent in forests. The contribution coefficient for indicators of the health dimension was determined as the ratio of the duration of leisure time in the forests to the total length of leisure time of the country's population. In 2015, leisure time in Lithuania was 1788.5 million hours/year, of which 72.7 million hours/year were spent in forests [38]. Forest contribution was 4.3%. The forest contribution coefficient for water productivity was determined as the ratio of the transfer of forest-influenced surface water runoff to groundwater per year (279.3 million m^3) [39] and the amount of Lithuanian groundwater (14,670 million m^3) [40]. The forest contribution was 1.9%. Third were indicators for which there was no possibility or for which it was impossible to estimate forest impact (e.g., divorce rate, expected duration of education, corruption perception index, democracy index, inflation rate, government debt). The calculation of the forest contribution coefficients is presented in Table 1.

Table 1. The forest contribution coefficient in Lithuania.

Indicators	Year	Lithuania	Forest Sector	Forest Contribution Coefficient
1. GDP per capita, EUR	2019	17460	618.7	0.035
2. Employment rate, %	2019	78.2	5.1	0.065
3. Greenhouse gas emissions per capita, t	2018	7.4	1.7	0.230
4. Energy from renewable sources, %	2019	25.5	16.0	0.627
5. Food resources, million t	2015	2530.4	72.7	0.029
6. Citizens' leisure time, million hours/year	2015	1788.5	77.3	0.043
7. Groundwater recharge, million m^3	2019	14,670.0	279.3	0.019

For other social and political indicators (Gini income inequality coefficient, divorce rate, expected duration of education, corruption perception index, democracy index), we assumed that they were not influenced by forests.

3. Results

The calculation of forests' impact on the welfare index of Lithuanian society is presented in Table 2.

Table 2. Forest impact on the welfare of Lithuanian society.

Dimension and Indicators	Value for all Lithuania, x *	Year	Optimal Value = 100, max (x)	Lower Bound Value = 0, min (x)	Normalized Value, SWI (x')	Forest Contribution Coefficient (k)	SWIF
1. Economic							
1.1 GDP, EUR per capita	17,460	2019	30,000	5000	49.8	0.035	1.74
1.2 Inflation rate, %	2.2	2019	0.5	3.4	41.4	-	-
1.3 Employment rate, %	78.2	2019	80	55	92.8	0.065	6.03
1.4 Government debt, % of GDP	35.9	2019	0	157.6	77.2	-	-
On average	-	-	-	-	**65.3**	-	**1.94**
2. Social							
2.1 Poverty rate, %	20.6	2019	0	25.6	19.5	0.029	0.6
2.2 Gini income inequality coefficient	35.4	2019	27.5	63	77.7	-	-
2.3 Divorce rate per 1000 persons	3.1	2018	0.9	3.1	0.0	-	-
2.4 Expected duration of education	19	2018	21	15.5	63.6	-	-
On average	-	-	-	-	**40.2**	-	**0.15**
3. Political							
3.1 Corruption perception index	60	2019	88.6	13	62.2	-	-
3.2 Democracy index	7.5	2019	10	6.5	28.6	-	-
On average	-	-	-	-	**45.4**	-	**-**
4. Health							
4.1 Life expectancy, years	75.8	2019	83	54	75.2	0.043	3.23
4.2 Infant mortality rate per 1000 born	3.4	2018	2.6	130	99.3	0.043	4.27
4.3 Suicide death rate per 100,000 persons	33.9	2017	4	30	15.0	0.043	0.65
On average	-	-	-	-	**63.2**	-	**2.72**
5. Environmental							
5.1 Greenhouse gas emissions per capita, metric tons	7.4	2018	0	20	63.0	0.230	14.5
5.2 Share of energy from renewable sources, %	25.5	2019	50	3	47.9	0.627	30.0
5.3 Water productivity, GDP EUR per m^3	131.2	2018	664.5	9.7	18.6	0.019	0.35
On average	-	-	-	-	**43.1**	-	**14.9**
Total on average	-	-	-	-	**51.4**	-	**3.94**

* Data from Eurostat database [36].

The calculation shows that the contribution of forests to the welfare index of Lithuanian society (51.4%) was 3.9%. It represented 7.6% of the SWI. Most of the SWIF had environmental dimensions—75.6% of the SWIF (Table 2). This was calculated by dividing the environmental dimension of the SWIF (14.9%) by the sum of all the SWIF (19.7%).

4. Discussion

Several problems remain in assessing the impact of forests on the welfare of society. First, the compilation of the list of dimensions and indicators already showed that different results are obtained from different lists.

Our assessment results from to the five-dimensional and 16-indicator model were compared to the European Sustainable Development Report 2020 [20] model, where the assessment is based on the 2030 Agenda for Sustainable Development SDGs (17 goals) with 106 indicators. According to the first model, SWI was 51.4% (Table 1), and according to the second, 64.4% (Appendix A). The SWIFT, on the other hand, was 3.9% and 4.9%, respectively. As the data sources of indicator performance and their thresholds overlapped, the same data normalization formula was applied, and the differences in the assessment were due to the differences in dimensions and indicators. For example, the suicide rate in Lithuania is large and its negative impact on the health dimension of the three indicators is more significant than in the other model, where the good health and well-being dimension has 20 indicators. However, models with fewer indicators due to information provision problems are more appropriate for assessing forest impacts. As regards studies on the impact of forests on the index of the welfare of society, it should be noted that a comprehensive analogous study such as the one done by the authors for Lithuania does not exist for other countries, so in this respect it is difficult to comment on the results obtained by the authors. In Lithuania, the issues of assessing the impact of agriculture on the welfare of society were studied [41]. The study concluded that interrelated economic, social, and environmental dimensions must be applied in assessing the impact of agriculture on the welfare of society.

In Lithuania, the share of forest impact in the country was assessed according to nine indicators, where forests influenced the overall indicators of the country: GDP, material investment, energy generation, protected territories, forest coverage, absorption of CO_2, number of employees, leisure time, and food resources. It was established that on average this share in 2015 was 17.6%. This shows the share of forests only according to the abovementioned nine indicators, but does not show the share of forests in the system of indicators of the welfare of society in the country [38]. This study evaluated the share of forests according to the country's indicators for the welfare of society. the evaluated impact of forests on the index of the welfare of society was 3.9%. The assessed index was significantly lower because some indicators of the welfare of society were not affected by forests or were unknown. The calculation of the total SWI, SWIF, and its share in the SWI only for the items from Table 2 that had a specific k showed a higher share of SWIF in SWI (SWI was 49.3%, SWIF was 5.5%, share was 11.2%).

Debatable is the weighting of dimensions and indicators in the calculation of the index of the welfare of society. The main approaches to designing weights include equal weights, mathematical weights, expert weights, and subjective weights [32]. Due to the difficulty and uncertainty in determining weighting factors based on experts' opinion, equal weighting was suggested [20]. Equal weighting was used in methodology of the Europe Sustainable Development Report 2020. Equal weights were therefore retained and countered as the most suitable option [27]. This view was followed in this study.

Assessing the impact of forests on the welfare of society, it has become clear that many indicators are not quantified in relation to the welfare of society. Forests contribute to most SDGs. Forests contribute to the food supply. Wood fuel is an important source of energy. Forests generate employment in rural areas and in the wood industry. Wood is a renewable resource, and forests mitigate climate change, contributing to low carbon economies. Forests provide medicines and contribute to human health and a healthy

environment. Forest ecosystems provide services, including climate regulation, social stabilization, regulation of water flows, and biodiversity, as well the gene pool and home of pollinators of agricultural crops [42]. The study "Sustainable development goals: their impacts on forest and people" found that all 17 SDGs are related to forests—for example, SDG1 (No Poverty): "Forests are both a mainstay of rural livelihoods and buffer and source of natural insurance," SDG2 (Zero Hunger): "We need a reimagined food system that does not polarise agricultural production and the conservation of forest resources," SDG3 (Health and Well-Being): "Forests are of crucial importance to global health and well-being," etc. [43]. This justifies the need to assess the impact of forests on the SDGs. The United Nations Economic Commission for Europe (UNECE) Committee of Forests and the Forest Industry and the FAO European Commission's 10 key targets for forests and trees in the 2030 Agenda for Sustainable Development are subdivided into three groups: (1) improving social and cultural benefit from forests and trees, (2) enhancing resilience and ecosystem benefits of forests, and (3) increasing green economy contribution of forest and trees [44]. However, the current statistical systems do not have sufficient data on the impact of forests on many indicators of the welfare of society. Our study reflects the most important forest-related indicators: the GDP of the forest sector, the number of its employees, the absorption of greenhouse gases, energy from wood fuel, food resources from forests, leisure time spend in forests, and groundwater recharge by forests.

Assessments of the impact of forests on the welfare of society are important in formulating and implementing forest policy. The assessments of the impact of forests on the welfare of society in this study highlight the feasibility of such assessments and raise issues for further research into improving assessment methods, such as estimation dimensions and indicators and their weighting, as well as the improvement of forest contribution coefficient determination.

5. Conclusions

The assessment of the welfare of society and sustainable development provided preconditions for assessing the impact of forests on the index of the welfare of society. The impact of forests on the welfare of society can by determined by multiplying the country's index of the welfare of society by the forest contribution coefficient. The estimated contribution of forests to the index of the welfare of society in Lithuanian was about 8% in 2019. In Lithuania, forests have the greatest impact on the environmental dimension of the welfare of society. Statistical databases and other sources of information can identify the impact of forests on only a part of indicators of the welfare of society (GDP per capita, employment rate, greenhouse gas emissions per capita, share of energy from renewable sources). Other indicators of the welfare of society lack such information. Future research and efforts should focus on filling these data gaps.

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Appendix A

Table A1. Lithuanian Sustainable Development indicators [27].

SDGs and Indicators	Value, x	Year	Optimal Value = 100, max (x)	Lower Bound Value = 0, min (x)	Normalized Value, SWI (x′)
SDG1—No Poverty					
1.1 People at risk of income poverty after social transfers (%)	22.9	2018	0	25.6	10.5
1.2 Severely materially deprived people (%)	9.4	2019	0	31.4	70.1
1.3 Poverty headcount at USD 5.50/day (%)	2.7	2020	0	21.0	87.1
On average			-	-	**55.9**
SDG2—Zero Hunger					
2.1 Prevalence of obesity, BMI ≥30 (% of adult population)	26.3	2016	3.0	35.1	27.4
2.2 Human trophic level (best—2, 3—worst)	2.5	2017	2.04	2.47	7.0
2.3 Yield gap closure (%)	45.6	2015	80.0	28.0	33.8
2.4 Gross nitrogen balance on agricultural land (kg/hectare)	25	2015	10	200	92.1
2.5 Ammonia emissions from agriculture (kg/hectare)	8.8	2017	8	60	98.5
2.6 Exports of pesticides banned in the EU (kg per 1000 population)	0.0	2019	0	550	100.0
On average			-	-	**59.8**
SDG3—Good Health and Well-Being					
3.1 Life expectancy at birth (years)	76.0	2018	83	54	75.9
3.2 Gap in life expectancy at birth among regions (years)	0.4	2018	0	11	96.4
3.3 Population with good or very good perceived heath (% of population aged 16 or over)	44.0	2018	80	25	34.5
3.4 Gap in self-reported health, by income (p.p.—percentage of people)	35.4	2018	0	60	41.0
3.5 Self-reported unmet need for medical examination and care (%)	2.2	2018	0	30	92.7
3.6 Gap in self-reported unmet need for medical examination and care, by income (p.p.)	1.1	2018	0	20	94.5
3.7 Gap in self-reported unmet need for medical examination and care, urban vs. rural areas (p.p.)	0.0	2018	0	1.2	100.0
3.8 New reported cases of tuberculosis (per 100,000 population)	37.8	2018	3.6	561	93.9
3.9 Age-standardized death rate due to cardiovascular disease, cancer, diabetes, and chronic respiratory disease (per 100,000 population aged 30 to 70)	20.7	2016	9.3	31	47.5
3.10 Suicide rate (per 100,000 population)	25.8	2017	4	30	16.2
3.11 Age standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population)	34	2016	0	369	90.8
3.12 Mortality rate, under-5 (per 1000 live births)	4.0	2018	2.6	130	98.9
3.13 People killed in road accidents (per 100,000 population)	6.2	2018	3	34	89.7
3.14 Surviving infants who received 2 WHO-recommended vaccines (%)	92	2018	100	41	86.4
3.15 Alcohol consumption (liter/capita/year)	11.2	2018	7	17	58.0
3.16 Smoking prevalence (%)	29	2017	12	50	55.3
3.17 People covered by health insurance for a core set of services (%)	98.7	2019	100	50	97.4
3.18 Share of total health spending financed by out-of-pocket payments (%)	31.6	2018	10	66	61.4
3.19 Subjective well-being (average ladder score, worst—0, 10—best)	6.3	2018	7.6	3.3	69.8
3.20 Cumulative COVID-19 tests performed, Feb–June 2020 (per 1000 population)	41.1	2020	50	0	82.2
On average			-	-	**74.1**

Table A1. *Cont.*

SDGs and Indicators	Value, x	Year	Optimal Value = 100, max (x)	Lower Bound Value = 0, min (x)	Normalized Value, SWI (x')
SDG4—Quality Education					
4.1 Participation in early childhood education (% of population aged 4 to 6)	91.0	2018	100	35	86.2
4.2 Early leavers from education and training (% of population aged 18 to 24)	4.0	2019	4	31	100.0
4.3 PISA score (worst—0, 600—best)	479.7	2018	525.6	350	73.9
4.4 Underachievers in science (% of population aged 15)	22.2	2018	12	53	75.1
4.5 Variation in science performance explained by students' socio-economic status (%)	12.5	2018	8.3	21.4	67.9
4.6 Resilient students (%)	26.4	2018	46.6	5	51.4
4.7 Tertiary educational attainment (% of population aged 30 to 34)	57.8	2019	52	0	100.0
4.8 Adults participation in learning (%)	7.0	2019	28	0	25.0
4.9 Mean numeracy score in the Survey of Adults Skills (PIAAC) (worst—0, 500—best)	267.2	2019	280	200	84.0
On average			**-**	**-**	**73.7**
SDG5—Gender Equality					
5.1 Unadjusted gender pay gap (% of gross male earnings)	14.0	2018	0	40	65.0
5.2 Gender employment gap (p.p.)	1.6	2019	0	41	96.1
5.3 Population inactive due to caring responsibilities (% of population aged 20 to 64)	18.7	2019	6	66	78.8
5.4 Seats held by women in national parliaments (%)	24.1	2019	50	12	31.8
5.5 Positions held by women in senior management positions (%)	12.0	2019	50	0	24.0
5.6 Women who feel safe walking alone at night in the city or area where they live (%)	65	2019	90	33	56.1
On average			**-**	**-**	**58.6**
SDG6—Clean Water and Sanitation					
6.1 Population having neither a bath, nor a shower, nor an indoor flushing toilet in their household (%)	9.1	2018	0	30	69.7
6.2 Population connected to at least secondary wastewater treatment (%)	73.8	2017	100	20	67.3
6.3 Freshwater abstraction (% of long-term average available water)	0.4	2017	1	80	100.0
6.4 Scarce water consumption embodied in imports (m^3/capita)	21.5	2013	0	100	78.5
6.5 Population using safely managed water services (%)	92.0	2017	100	10.5	91.1
6.6 Population using safely managed sanitation services (%)	91.3	2017	100	14.1	89.9
On average			**-**	**-**	**82.8**
SDG7—Affordable and Clean Energy					
7.1 Population unable to keep home adequately warm (%)	26.7	2019	0	35	23.7
7.2 Share of renewable energy in gross final energy consumption (%)	24.4	2018	50	3	45.5
7.3 CO_2 emission from fuel combustion per electricity output ($MtCO_2$/TWh)	3.5	2017	0	5.9	40.7
On average			**-**	**-**	**36.6**
SDG8—Decent Work and Economic Growth					
8.1 Gross disposable income (EUR/capita)	18,391	2018	30,000	5000	53.6
8.2 Youth not in employment, education, or training (NEET) (% of population aged 15 to 29)	10.9	2019	8	27	84.7
8.3 Employment rate (%)	78.2	2019	80	55	92.8
8.4 Long-term unemployment rate (%)	1.9	2019	1	14	93.1
8.5 People killed in accidents at work (per 100,000 population)	2.8	2017	0	5	44.0
8.6 In work at-risk-of-poverty rate (%)	8.1	2018	3.3	18.6	68.6
8.7 Fatal work-related accidents embodied in imports (per 100,000 population)	0.6	2010	0	6	90.0
On average			**-**	**-**	**75.3**

Table A1. *Cont.*

SDGs and Indicators	Value, x	Year	Optimal Value = 100, max (x)	Lower Bound Value = 0, min (x)	Normalized Value, SWI (x')
SDG9—Industry, Innovation, and Infrastructure					
9.1 Gross domestic expenditure on R&D (% of GDP)	0.9	2018	3.3	0.4	17.2
9.2 R&D personnel (% of active population)	0.8	2018	2	0.3	29.4
9.3 Patent applications to the European Patent Office (per million population)	10.4	2019	240	3	3.1
9.4 Households with broadband access (%)	81	2019	96	60	58.3
9.5 Gap in broadband access, urban vs. rural areas (p.p.)	9	2019	0	26	65.4
9.6 Individuals aged 55 to 74 years with basic or above digital skills (%)	23	2019	65	5	30.0
9.7 Logistics performance index: quality of trade and transport-related infrastructure (worst—1, 5—best)	2.7	2018	4.2	1.8	37.5
9.8 The Times Higher Education Universities Ranking: Average score of top 3 universities (worst—0, 100—best)	19.3	2020	50	0	38.6
9.9 Scientific and technical journal articles (per 1000 population)	0.8	2018	1.2	0	66.7
On average			**-**	**-**	**38.5**
SDG10—Reduced Inequalities					
10.1 Gini coefficient adjusted for top income	44.2	2015	27.5	63	53.0
10.2 Palma ratio	1.6	2017	0.9	2.5	56.3
10.3 Elderly poverty rate (%)	28.2	2017	3.2	45.7	41.2
On average			-	-	**50.2**
SDG11—Sustainable Cities and Communities					
11.1 Share of green space in urban areas (%)	32.0	2012	50	0	64.0
11.2 Overcrowding rate among people living with below 60% of median equivalized income (%)	23.8	2018	6	65	69.8
11.3 Recycling rate of municipal waste (%)	52.5	2018	62	0	84.7
11.4 Population living in a dwelling with a leaking roof; damp walls, floors, or foundation; or rot in window frames or floor (%)	14.8	2018	6	30	63.3
11.5 Satisfaction with public transport (%)	44.1	2018	82.6	21	37.5
11.6 Access to improved water source, piped (% of urban population)	99.0	2017	100	6.1	98.9
On average			**-**	**-**	**69.7**
SDG12—Responsible Consumption and Production					
12.1 Circular material use rate (%)	4.8	2017	19	1	21.1
12.2 Gross value added in environmental goods and services sector	2.2	2017	5.5	1	26.7
12.3 Production-based SO_2 emissions (kg/capita)	94.1	2012	0	525	82.1
12.4 Imported SO_2 emissions (kg/capital)	11.9	2012	0	30	60.3
12.5 Nitrogen production footprint (kg/capita)	48.6	2010	2	100	52.4
12.6 Net imported emissions of reactive nitrogen (kg/capita)	8.0	2010	0	45	82.2
On average			**-**	**-**	**54.1**
SDG13—Climate Action					
13.1 Greenhouse gas emissions (t/capita)	7.4	2018	0	20	63.0
13.2 CO_2 emissions embodied in imports (tCO_2/capita)	1.8	2015	0	3.2	43.8
13.3 CO_2 emissions embodied in fossil fuel exports (kg/capita)	0.0	2018	0	44000	100.0
On average			**-**	**-**	**68.9**

Table A1. *Cont.*

SDGs and Indicators	Value, x	Year	Optimal Value = 100, max (x)	Lower Bound Value = 0, min (x)	Normalized Value, SWI (x')
SDG14—Life Below Water					
14.1 Excellent bathing site quality (%)	84.6	2018	100	25	79.6
14.2 Fish caught by either trawling or dredging (%)	1.4	2016	0	90	98.4
14.3 Fish caught that are then discarded (%)	5.0	2016	0	20	75.0
14.4 Marine biodiversity threats embodied in imports (per million population)	0.1	2018	0	2	95.0
14.5 Mean area that is protected in marine sites important to biodiversity (%)	83.4	2019	100	0	83.4
On average			-	-	**86.3**
SDG15—Life on Land					
15.1 Mean area that is protected in terrestrial sites important to biodiversity (%)	91.1	2019	100	4.6	90.7
15.2 Mean area that is protected in freshwater sites important to biodiversity (%)	95.2	2019	100	0	95.2
15.3 Biochemical oxygen demand in rivers (mg O_2/litre)	2.1	2017	1	10	87.7
15.4 Red List Index of species survival (worst—0, 1—best)	1.0	2019	1	0.6	100.0
15.5 Terrestrial and freshwater biodiversity threats embodied in imports (per million population)	0.8	2018	0	10	92.0
On average			-	-	**93.1**
SDG16—Peace, Justice, and Strong Institutions					
16.1 Death rate due to homicide (per 100,000 population)	2.8	2017	0.3	23	89.0
16.2 Population reporting crime in their area (%)	3.7	2018	4	24	100.0
16.3 Gap in population reporting crime in their area, by income (p.p.)	1.0	2018	0	15	93.3
16.4 Corruption Perception Index (worst—0, 100—best)	60	2019	88.6	13	62.2
16.5 Unsentenced detainees (% of prison population)	9.1	2018	7	75	96.9
16.6 Exports of major conventional weapons (TIV constant 1990 million USD per 100,000 population)	2.2	2019	0	3.4	35.3
16.7 Press Freedom Index (best—0, 100—worst)	22.1	2019	10	80	82.7
On average			-	-	**79.9**
SDG17—Partnership for the Goal					
17.1 Official development assistance (% of GNI)	0.1	2019	1	0.1	0.0
17.2 Corporate Tax Haven Score (best—0, 100—worst)	54.8	2019	40	100	75.3
On average			-	-	**37.7**
Total average			-	-	**64.4**

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