MAREA

Output O.T2.2.1

Regional tools for assessing feed-backs and trade-offs between marine ecosystem and anthropocentric systems

Part 1: User guide for the social-economic models implemented in the geoportal

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Introduction

This guide provides a general introduction to the main components of the socio-economic models implemented in the MAREA geoportal (http://www.sea.ee/marea/economy/economymodels) and how to customize them. The generated socio-economic models, also shown as economic models on the geoportal or mentioned as environmental accounting model in some other MAREA materials, are regional tools able to assess feedbacks and trade-offs between marine ecosystems and anthropocentric systems under different scenarios. The tool allows the users to provide their own values for some of the economic variables/parameters considering the possibility that the users have better data sources. This user guide explains the meaning of each variable/parameter that users can modify, provides the needed knowledge to select among the provided options, and recommends values for those users that do not have their own data.

In addition to this user guide, the Deliverable D.T2.2.1 from the MAREA project provides the methods and functions behind the socio-economic models, as well as the data sources underlying the parameters used in the models. The basic concept of the model and the demonstrated results can also be found in Deliverable D.T4.2.1 from the MAREA project.

Economic model (model input page on geoportal)

Blue mussel farming valuation

This section presents and describes the fields where users can insert and modify the values assigned to economic variables/parameters of the socio-economic models used for blue mussel farming valuation. By inputting these values, the model can value the potential supply of provisioning services of blue mussel farming (also called the resource rent of the provisioning services) and the asset value that consider the future flows of these services, assuming that if the farms are established. The function to calculate the resource rent and asset value can be found in Deliverable D.T2.2.1, section 2.1.

Price (Euros per tonne wet weight)

In this field users should provide information on the producer price of blue mussel of the base year. The base year can be the current year or the first year when a mussel farm was established. Table 1 provides the suggested producer price ranges considering 2020 as the base year (=price at 2020 price level). The suggested prices can be adjusted to different base years using the function provided in section 2.2 of the deliverable D.T2.2.1. As the suggested prices are producer price, these suggested values are generally lower than the mussel product prices that can be found in the consumer market. Using the producer price is especially important if the user would like to get the output value that is usable for ecosystem accounting. If the users would like to fill in the price level that is collected from mussel products used for other purposes, they should be aware of the included and excluded cost components in the model (see Deliverable D.T2.2.1, section 2.1).

Table 1 The suggested producer prices (euros per tonne wet weight) at 2020 price level for the three MAREA countries

	Estonia	Finland	Latvia	Comment	References
Higher end option	350	550	320	Converted from Denmark average prices (2016-2020)*	Danish Fisheries Agency (2022)
Lower end option	310	490	280	Converted from Sweden average prices (2016-2020)*	Eurostat (2022a)

*The converting procedures can be found in section 2.2 in Deliverable D.T2.2.1.

Inflation rate

The inflation rate is used to calculate the price level after the base year (in the demonstrated case, the base year is 2020). This value is needed when the user would like to estimate the value/resource rent of future service flows after the base year and to calculate the asset value (see Deliverable D.T2.2.1, section 2.1 and section 2.2). The value that should be filled in the field is 1+ x%, where x is the "inflation rate" that users can get from open access databases (e.g., OECD data). For the demonstration case on the geoportal, 2% is used as it is the European Central Bank (2022) target value.

Farm operational costs (Euros per year)

In this field users should provide information on the yearly operational costs of a mussel farm in the base year or the year in which the mussel farm starts to operate. Such costs should include all kinds of operational costs (UN, 2021), such as cost of energy use or labor (Minnhagen et al., 2019). In the demonstration case, the provided cost values refer to estimations performed in an Estonian pilot farm. Table 2 shows the original costs from Estonia, and the costs of Finland and Latvia were transferred from the estimation for Estonia by using purchasing power parity (PPP) (Eurostat, 2022b). It should be noticed that the use of cost values from own sources should also be adjusted to the price level of the base year when applying those values.

Table 2 Suggested demonstration value for the cost variables in the three MAREA countries

Cost input variables from the geoportal (and their symbol used in table 1 in Deliverable D.T2.2.1)	Estonia	Finland	Latvia
Farm operational costs (*J*)	10000	15 674.34	9 036.88

Farm investment costs (K)	50000	78 372.09	45 184.35
Farm other investment costs (L)	15000	23 511.63	13 555.30

Farm investment costs (Euros)

In this field the user should provide information on the initial investment required to construct and establish the needed long-term farming facilities that can determine the lifetime of the farms. Once again, the demonstration values come from estimations performed in an Estonian pilot farm. These values were transferred to Finland and Latvia by using purchasing power parity (PPP) (Eurostat, 2022b) (see Table 2). Also, the use of cost values from own sources should be adjusted to the price level of the base year when applying those values.

Farm other investment costs (Euros)

In this field the user should provide information on investments required for the construction and establishment of facilities that show shorter lifetimes than the entire mussel farm. This part of the investment can be renewed before the lifetime of the mussel farms ends. Similarly, the demonstration values come from estimations performed in an Estonian pilot farm. These values were transferred to Finland and Latvia by using purchasing power parity (PPP) (Eurostat, 2022b) (see Table 2). Also, the use of cost values from own sources should be adjusted to the price level of the base year when applying those values.

Expected lifetime of farm investment costs (years)

In this field users should provide information on the lifetime of major long-term facilities of a mussel farm. This value is used to annualize the "farm investment costs" during the calculation. The value presented in the geoportal, 20 years, derives from information generated in an Estonian pilot farm.

Expected lifetime of other investment costs (years)

In this field users should provide information on the lifetime of other facilities, which have a shorter lifetime than the that of the entire mussel farms. This value is used to annualize the "farm other investment costs" during the calculation. The value presented in the geoportal, 10 years, derives from information generated in an Estonian pilot farm.

Interest rate

This is the rate that is used to calculate the present value of future price and cost, which is used to calculate the asset value (see Deliverable D.T2.2.1, section 2.1). Typically, rates between 0%-5% are commonly used in economic modeling. In addition, the recent interest rate of the three MAREA countries varies between -0.3%-1% (Eurostat, 2022c). Therefore, the numbers between -0.3% to 5% are reasonable candidates to be filled in the field. However, if users would like to integrate the valuation results of this blue mussel model with the valuation results of other ecosystem services (e.g., the results from the blue carbon model or with other potential models that will be developed in the future), this interest rate should be the same for all the socio-economic models of different ecosystem services. Especially, in the case of integrating the value of blue carbon, the value of the interest rate needs to be limited to the options listed in the blue carbon model. Under the Blue carbon valuation, the section of price for carbon stock, there is a dropdown list for the "Origins" field. In this list of the "Origins" field, the discount rate is mentioned to determine the estimated price of the carbon stock. The filled interest rate in the blue mussel model needs to be the same as the discount rate based on the selected options in the blue carbon model, so the interest rate will be limited to one of the three options below: 2.5%, 3%, or 5%.

Blue carbon valuation (global climate mitigation services)

This section presents and describes the fields in the blue carbon model which uses a couple of dropdown lists to give ranges of prices for carbon sequestration and for carbon stocks. Carbon sequestration and carbon stock are two components of global climate mitigation services (UN, 2021). Due to the characteristic differences between the two components, the suggested valuation approaches are different (NCAVES and MAIA, 2022). The valuation approaches and functions to estimate the value of the global climate mitigation services and the blue carbon asset value can be found in Deliverable D.T2.2.1, section 3.

Price for carbon sequestration (euros per tC)

This price for carbon sequestration will be given by choosing the Year and Origin. For the price before 2022, the given price is based on the historical market price of CO_2 emission allowance in the EU emissions trading systems (EU ETS) from ICAP (2022). For the price after 2023, the given price is based on the projection price from Pietzcker et al. (2021). All the price levels have been transferred[1] from EUR/tCO_2 in the original data sources to the current unit: EUR/tC. In addition, the price has been transferred to the 2020 price level to compare/integrate with other ecosystem service values that are currently demonstrated on the MAREA geoportal.

[1] 1 tC = 3.67 tCO2 (Salcone et al., 2016)

Year

This dropdown list provides the option of years between 2009-2050. When choosing the year before 2021, the list of "Origin" only has one option: "Actual average of the year". When choosing the year after 2022, the list of "Origin" provides two options to be chosen: Min projected value and Max projected value.

The current version of the model only provides the sum-up service value of the carbon sequestration and carbon stocks. Therefore, the selected year in this section needs to be the same as the selected year in the section of "Price for carbon stock". The options between 2009-2015 are provided for the case that the users would only need to estimate the value of carbon sequestration. This case is not opened in the current demonstration, but it can be included in future model development.

Origin

Table 3 gives a brief explanation of the sources of the price data for each option listed in the "Origin" field. The reasons to use these collected data can be found in Deliverable D.T2.2.1, section 3.1.

Table 3 explanation of the options listed in the "Origin" field

Year	Origin	Explanation
2009-2021	Actual average of the year	Yearly average based on the historical daily price of CO2 emission allowance in the EU ETS from ICAP (2022)
2022	Min projected value	Minimum daily price between 01/01/2022-28/06/2022, from the daily price of CO2 emission allowance in the EU ETS from ICAP (2022)*
	Max projected value	Maximum daily price between 01/01/2022-28/06/2022, from the daily price of CO2 emission allowance in the EU ETS from ICAP (2022)*
2023	Min projected value	Based on the min projected value used in 2022 and the projected EU ETS prices in 2045 and 2050 under the reference scenario in Pietzcker et al. (2021).
	Max projected value	Based on the max projected value used in 2022 and the projected EU ETS prices in 2025, 2030, 2035, 2040, 2045, and 2050 under the ambitious scenarios from Pietzcker et al. (2021).

*The prices after 28/06/2022 are not available yet when the price data were downloaded to use for developing the geoportal.

Price for carbon stock (euros per tC)

This price for carbon stock will be given by choosing the Year and Origin. All the price data in this section was from the global damage measured in the social cost of carbon, estimated by the revised DICE model (Nordhaus, 2017). The original values from Nordhaus (2017) were first transferred to the USD 2020 price level using the GDP deflator of the United States from OECD (2022) database. Then, the price was transferred to the EU price level through PPP (Eurostat, 2022b) to align with price data for carbon sequestration. Same as for carbon sequestration, the price levels have been transferred[2] from EUR/tCO_2 from the original data sources to the current unit: EUR/tC.

Year

The user can choose a specific year between 2015-2050. For each year, the list of the "Origin" field further provides three options to be selected. The current version of the model only provides the sum-up service value of the carbon sequestration and carbon stock. Therefore, the selected year in this section needs to be the same as the selected year in the section of "Price for carbon sequestration".

Origin

For each year, the list of the "Origin" field further provides three options to be chosen: estimation assuming a discount rate of 2.5%, 3%, or 5%. This follows the discount rate assumption of different scenarios given in Nordhaus (2017). The option assuming discount rate of 2.5% gives the highest carbon stock price and the one assuming discount rate of 5% gives the lowest carbon stock price.

Rate of return

Carbon stock is considered a component of global climate mitigation services, which is the concept of flows (UN, 2021). However, when multiplying the amount of carbon stock by the carbon stock price, the result is the value of the stock. Therefore, a parameter, "rate of return", is used to annualize the value of carbon stock to a "flow" value, in order to combine the valuation results of the carbon sequestration and carbon stocks (NCAVES and MAIA, 2022). The value to be filled in this field needs to follow the interest rate/discount rate used in other parts of the model. Therefore, the suggested value is following the assumed discount rate listed in the options of the "Origin" field. The filled value in this "rate of return" will also be used as the interest rate/discount rate that is used to calculate the asset value.

Model's map output

Blue mussel farm model

The current version of the model only reports the asset value of the mussel farms, assuming if the farms will be established. The value of the current and future services flows could be provided later in the geoportal as those values have been estimated during the procedures of calculating the asset value (Deliverable D.T2.2.1, section 3). The current valuation results are based on one scenario that uses the

[2] 1 tC = 3.67 tCO_2 (Salcone et al., 2016)

business-as-usual setting with current environmental and human use conditions. The options of other scenarios will be opened later with further development of the geoportal.

Blue carbon model

The current version of the model only reports value of the ecosystem services (EUR/year) that are summed up from the values of carbon sequestration and carbon stock from the same year. The asset value of blue carbon is possible to be developed in the future (see Deliverable D.T2.2.1, section 3). The current valuation results are based on one scenario that uses the business-as-usual setting with current environmental and human use conditions. The options of other scenarios will be opened later with further development of the geoportal.

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