INTERIM METHODOLOGY

Land Use and Conversion Model

Technical Manual

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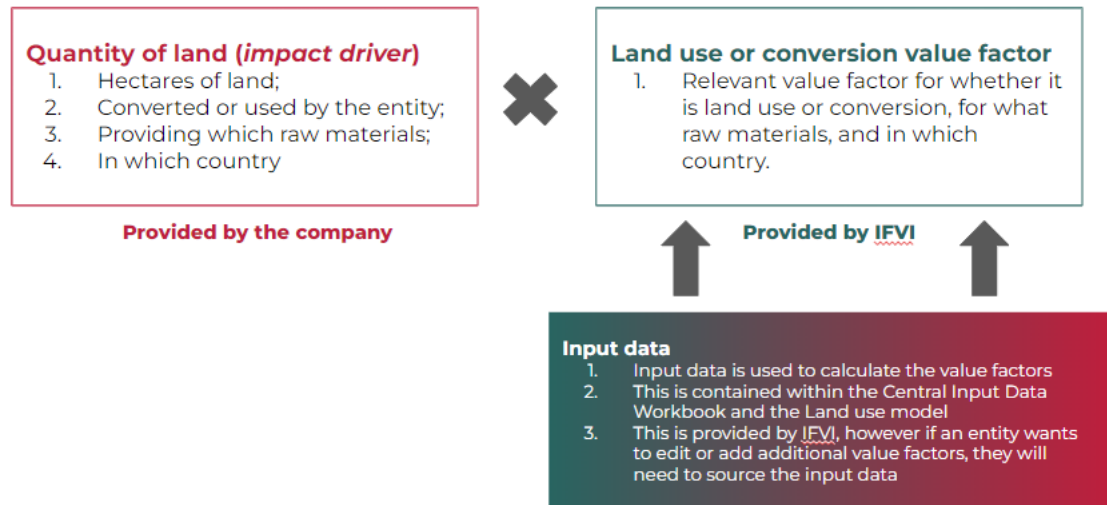
1 Introduction

1.1 Document purpose

1. This document is the Interim Land Use and Conversion Model Technical Manual, which provides a description of the Interim Land Use and Conversion Model's structure and functionality, input data, and assumptions. It aims to help readers better understand and expand the model that informs the Interim Land Use and Conversion Topic Methodology. The Model Technical Manuals aim to improve transparency and confidence in the Global Value Factors Database (GVFD), and support companies' use of the GVFD for decision-making and sensitivity analysis.

2. The Interim Land Use and Conversion Methodology is part of a series of four interim environmental methodologies released by IFVI, as complements to the impact accounting methodologies produced by IFVI in partnership with the Value Balancing Alliance. All four methodologies are designed with similar structures and resources, outlined below.

3. For general implementation and understanding of the Interim Methodologies, the following primary resources should be utilized:

    a) **Global Value Factors Database:** An Excel file compilation of all value factors of all methodologies. Companies should use the outputs shown here in estimating their impact values.

    b) **Methodologies:** These documents describe the methodology of each environmental impact topic, including key assumptions and conceptual underpinnings and the data requirements of entities in using them.

4. These resources are underpinned by supplemental resources, including the following:

    a) **Models:** Excel files for each methodology. All calculations that form the output value factors for each impact topic can be viewed and understood in detail here.

    b) **Technical Manuals:** These documents provide a high-level description of the structure and functionality of each environmental impact valuation model.

    c) **Central Input Data Workbook:** Upon request, users can access a single Excel file of input data that links the models across all methodologies through PowerQuery.

5. These supplemental resources are provided for three main reasons.

a) *Transparency:* along with the methodology documents for each model, the models are made available so each step in the calculation pathway can be examined by interested users.

b) *Sensitivity analysis or bespoke analysis for decision making:* if users want to understand the sensitivity of the value factors to different parameters or data points in the models, then having the full models allows for this. If more geographically specific analysis of impacts under different scenarios is required for business decision making, then the models can be used as a basis for this.

c) *Creation of value factors for additional decision-making contexts:* value factors for all countries are provided in the GVFD but if users want to produce additional value factors for particular decision-making purposes, such as for more granular geographic locations, then the models and technical manuals are provided to allow this.

6. Review of the models and technical manuals should be done in coordination with the other resources available to ensure thorough understanding of the contents.

1.1 Model input data versus impact driver measurements

7. A distinction should be made between impact driver measurements of an entity (i.e. hectares of land converted) and input data used to create the value factors of the methodology. Companies using the GVFD and the Interim Land Use and Conversion Methodology will need impact driver measurements (i.e. hectares of land used or converted for which they are responsible), whereas the input data used in the GVFD is contained within the Land Use and Conversion Model (the full list of input data is outlined in Appendix A). The relationship between these types of data is depicted in Figure 1.

How an entity should estimate land use or conversion impact:

Quantity of land (*impact driver*)
1. Hectares of land;
2. Converted or used by the entity;
3. Providing which raw materials;
4. In which country

Provided by the company

Land use or conversion value factor
1. Relevant value factor for whether it is land use or conversion, for what raw materials, and in which country.

Provided by IFVI

Input data
1. Input data is used to calculate the value factors
2. This is contained within the Central Input Data Workbook and the Land use model
3. This is provided by IFVI, however if an entity wants to edit or add additional value factors, they will need to source the input data

Figure 1: Difference between impact driver measurements and model input data

8. This manual focuses on model input data, rather than impact driver measurements. More detail on impact driver measurements is available in the Interim Land Use and Conversion Methodology.

2 Model Structure and Functionality

2.1 High-level data architecture

9. There are three core elements to the data that informs each Interim Methodology: the Global Value Factors Database (GVFD), the models themselves, and the Central Input Data Workbook (CIDW). The models and the Global Value Factors Database are both publicly available, while the Central Input Data Workbook is available upon request.

10. The Central Input Data Workbook is a central repository for all the input data sources used in all the models including the links to the sources, units and year. It also contains all key assumptions and parameters used in the models. Given the complexity of the data architecture and the importance of consistent and comparable applications of impact accounting, this workbook is only available upon request.

11. The individual models then combine the relevant input data sources and calculate the value factors for each country and impact area.

12. The final value factors are then collated in the Global Value Factors Database. For most users looking to use the value factors to value environmental impacts, this will be the most important resource and can be used independently of the models and CIDW.
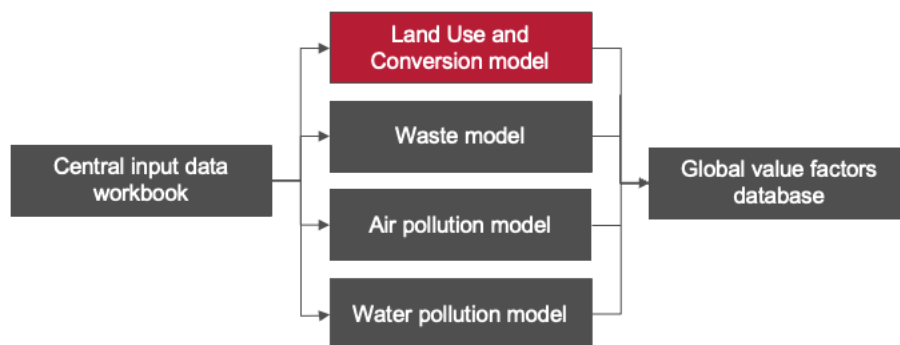
Figure 2: High-level diagram of the model architecture

2.2 Understanding and opening the Model

13. Each model contains a cover sheet that provides an overview of each tab and the appropriate way to navigate them.

14. The Model is organized, and color coded to indicate which sheets represent data inputs, calculations, or value factors. Any updates or changes to the underlying data within the Model should be applied to the data inputs, which will then be carried through the calculation sheets to produce updated value factors.

15. Any modifications to these models may produce distinct value factors distinct from those produced by IFVI and should not be considered endorsed or approved by or a representation of the IFVI methodology.

16. When opening the Excel model for the first time, a banner may appear signifying the file is in protected view. Select 'Enable editing.' A 'Security Warning' banner may then appear as the file has external data connections. Select 'Enable Content.'

2.3 Model structure
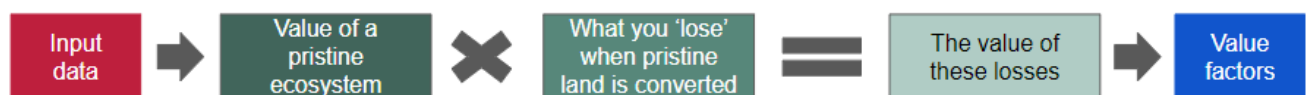
Figure 3: Land use model structure

17. The Interim Land Use Model follows the format of Figure 3.

18. The paragraphs below provide an overview of the functionality of each sheet in the Model. The sheets colored in dark green are calculating the value of a pristine or natural ecosystem. The medium green sheets then calculate what is 'lost' when a pristine land is converted into managed land. The light green sheets calculate the percentage loses when this land is converted and then multiplies this by the value of a pristine ecosystem to get the value of the lost ecosystem.

   a) **Sheet: 1a. ESVD Cleaned**

   This sheet gets the average ecosystem service value per ESVD biome from the ESVD studies and maps it onto the biome list used in the model by weighting the values by number of studies.

   b) **Sheet: 1b. Rescaling**

   This sheet calculates an adjustment factor based on country population density and rural population, applied to ESVD studies to reflect countries that have higher population density or more rural communities value ecosystem services higher. To ensure scaling factors are all positive (e.g., Greenland), bounds can be set in depending on how the user would like the scope of the distribution to fall.

c) **Sheet: 1c. Pristine ES Value**
This sheet calculates the value of each ecosystem services for a hectare of pristine land in each country. Where ecosystem services are local, the raw ESVD pristine values are multiplied by the adjustment factor for each country. Where global, the average value is taken as is.

d) **Sheet: 1d. ES Recalibration**
This sheet applies the actual GIS biome split to countries ES value (i.e. if 0% of country X is Tropical Forest, 0% of ESVD Tropical Forests value is applied), and then, as the average ESVD value per biome has been affected by the adjustment factor and biome split, values are recalibrated to ensure the average ES value for each biome is in line with ESVD original values.

e) **Sheet: 2a. Country Climate**
This sheet uses Koppen-Geiger climate zone input data to determine the dominant climate zone in each country, which are then used to estimate pristine biomass and species in the following sheets.

f) **Sheet: 2b. Biomass**
This sheet takes the biomass lost with changes from pristine land to converted land per climate zone and applies the results to individual countries.

g) **Sheet: 2c. Species**
This sheet takes plant species data for each climate zone for pristine and converted lands, which is used to estimate the species loss associated with change from pristine land to converted land.

h) **Sheet: 2d. SOC**
This sheet calculates the percentage of soil organic carbon (SOC) remaining per biome and country based on each land use change. The sheet uses International Panel on Climate Change soil organic carbon (SOC) factors.

i) **Sheet 3b. Loss Combinations**
This sheet calculates the percentage loss of biomass, species and SOC, based on the loss combinations assigned to the land use types in the assumptions input.

j) **Sheet 3b. Valued Loss**
This sheet combines the percentage losses with the pristine ecosystem services values to get the US$ values of lost ecosystem services.

k) **Sheet: 4a. Interim Land Use Calculations**

This sheet adds ecosystem services losses per "pristine biome type -> converted land type" combination. This is then multiplied by the actual biome % in that country (e.g. if country X has 0% tropical forests, the resulting "tropical forest -> wheat" loss value is $0). Regional averages are calculated to gap fill where data is missing.

l) **Sheet: Interim Land Conversion Calculations**
    This sheet uses a macro to populate the Land Conversion Value Factors tab. The land use value factors for each land type are multiplied by 2 to obtain the marginal value per hectare of land, projected over 100 years and discounted at 2% p.a. to a net present value. This represents the present value of 100 years of lost ecosystem service value.

m) **Sheet: Land Use Value Factors**
a) This sheet provides the final value factors for the impact of land use. These value factors are the same values in the Global Value Factors Database. The sheet divides the valued losses by 2 to account for the marginal versus average effect of land use changes. Where country values are missing, regional averages are used. The value factors as presented are the same values in the Global Value Factors Database, but if a user adjusts the data in the model they may change and should not be considered endorsed or approved by or a representation of the IFVI methodology.

n) **Sheet: Land Conversion Value Factors**
b) This sheet provides the final value factors for the land conversion pathway. The value factors as presented are the same values in the Global Value Factors Database, but if a user adjusts the data in the model they may change and should not be considered endorsed or approved by or a representation of the IFVI methodology. This sheet compiles the final conversion value factors from the macro.

o) **Input Data Sheets**
    ▪ **Sheet: Land Use General Data**: This sheet refers to general data at the country level relevant to the land use model.

    ▪ **Sheet: Ecosystem Service Valuation Database (ESVD) Averages**: This sheet represents the ecosystem service values (in 2020 USD) downloaded from the ESVD on July 3, 2024.

    ▪ **ESVD Mappings**: This sheet converts biome classifications used in the ESVD to biomes used in the model. It also classifies all ecosystem services into categories and areas affected.

- **Species and Richness**: This sheet provides the number of species and species richness across biomes and land use types.

- **Biomass**: This sheet provides biomass data across biomes and land use types.

- **Forest Aboveground Biomass**: This sheet consolidates forest aboveground biomass data from the Biomass sheet.

- **Soil Organic Carbon**: This sheet provides soil organic carbon (SOC) change factors across biomes and land use types.

- **SOC Factors**: This sheet represents the factor selection for the IPCC SOC factors. The SOC methodology calculates the change in SOC based on land use, management and input practices as well as the climate. This sheet shows which factors should be used for reach land use by weighting them.

- **Country Biomes**: This sheet estimates the proportion of each country classified as each biome type.

- **Climate Classifications**: This sheet estimates the proportion of each country in each Koppen-Geiger Climate Classification zone.

- **Countries & Annual Growth**: This sheet classifies each country to the associated region based on World Bank classifications. Additionally, it estimates the annual growth rate from 2005 – 2022 from the OECD.

- **Assumptions and Mapping**: This sheet details basic assumptions used in the model along with mappings of land use, climate, and biomes.

3 Adapting the models for bespoke analysis

3.1 Updates to input data, assumptions, and parameters

19. The intent of the impact accounting methodology is to provide consistent and comparable impact accounting methodologies that can be applied across entities. As such, the methodologies are intended to be used as is. IFVI will update the input data variables, assumptions, and parameters as necessary and on a regular basis, without the need for model users to make their own updates.

20. However, if any sensitivity or bespoke analysis is desired, the input data can be updated in the models.

21. If the input data is changed by the model user, the land conversion value factors will need to be re-run. This will not happen automatically in the model and the Excel macro will need to be manually run by the user.

22. Should an entity wish to add new countries, regions or geographical areas specifically to the Interim Land Use Model, this can be done by amending the Land Use General Data, Country Biomes, and Climate Classifications sheets.

23. This will involve collecting the following data:

    a) Percentage split between WWF Wildfinder biomes

    b) Percentage split between Koppen-Geiger climate zones

    c) Population

    d) Population density

    e) Rural population

    f) Purchasing power per capita

    g) Land area

    h) Above-ground forest biomass

24. A full list of the data points are listed in Appendix A.

25. Some data inputs to the models apply across multiple models. For users wishing to conduct bespoke analysis across multiple models with consistent and efficient data, this can be done by making adjustments to the underlying Central Input Data Workbook. This workbook and a set of models that are directly linked to it via PowerQuery are made available upon request.

Appendix A: Full List of Input Data

Country variable data:

Data point, per country / region / geographic area	Unit
Split between WWF Wildfinder biomes	%
Split between Koppen-Geiger climate zones	%
Population	Number
Population density	Population / land area
Rural population	%
Purchasing power per capita	2023 US$
Land area	Km2
Above-ground forest biomass	Metric tons / hectare

Global data points:

Data point	Unit
Average plant species per pristine biome	Number / hectare
Average biomass per pristine biome	Metric tons / hectare
Average plant species per managed land	Number / hectare
Average biomass per managed land	Metric tons / hectare
Soil organic carbon change factors	%

Bibliography

Greenhouse Gas Protocol (2022) Land Sector and Removals Guidance Part 2: Calculation Guidance, Supplement to the GHG Protocol Corporate Standard and Scope 3 Standard.

IPCC (2019) IPCC National Greenhouse Gas Inventories Program, Good practice guidance for Land-Use, Land-Use Change and Forestry.

Please note: this bibliography only refers to sources referenced in this user guide. For a bibliography that includes the theoretical and empirical basis of the methodology, please refer to the separate methodology document.