

Calibrating and Updating the Global Forest Products Model (GFPM version 2012)

by

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1 Introduction

The Global Forest Products Model (GFPM) is an economic model of global production, consumption, and trade of forest products. An earlier version of the model is described in Buongiorno et al. (2003). The 2012 version of the GFPM projects world forest commodity markets for 180 countries and 14 forest commodities from a base year (such as 2009) to a target year (such as 2100).

All the data needed to run the GFPM are in the WORLD.XLS in the C:\GFPM directory. One part of the data describes the world forest sector in the base year. The other data refer to the exogenous changes, such as GDP growth, that drive the forest sector over time. The GFPM can be used with the included WORLD.XLS successfully without recalibration. This manual is meant only for users who want to recalibrate the model with new data.

The calibration creates most of the base year data in WORLD.XLS. The exogenous changes must be entered directly in WORLD.XLS. The GFPM User Manual (Buongiorno and Zhu 2012), which should be read first, describes the WORLD.XLS file.

The present manual describes the steps in calibrating and updating the GFPM:

- Updating data from the Food and Agriculture Organization (FAO), World Bank, and other sources.
- Calibrating the base year data so that they satisfy economic equilibrium in each country, given prior knowledge on technology and other constraints.
- Checking the data consistency
- Validating the base year solution
- (Optional) adding bilateral trade flows
- (Optional) adding/removing countries and commodities

2 FAO and World Bank data

2.1 Pre-downloaded FAO and World Bank data

The GFPM (version 2012) includes pre-downloaded FAO and World Bank data for all countries and selected commodities from 1992 to 2010 (data from 1992 to 2009 are official while most 2010 data are estimated) in the folder C:\GFPM\input\InputFiles (Table 1). They are sufficient to calibrate GFPM models with base years from 1992 to 2009 and with the default 180 countries and 14 commodities (Tables 1 and 2 in GFPM User Manual (Buongiorno and Zhu 2012)). If the FAO and World Bank data have already been downloaded, you can go directly to part 3.

Updating may be desirable as newer FAO and World Bank data become available. To add or remove countries or commodities, see part 8.

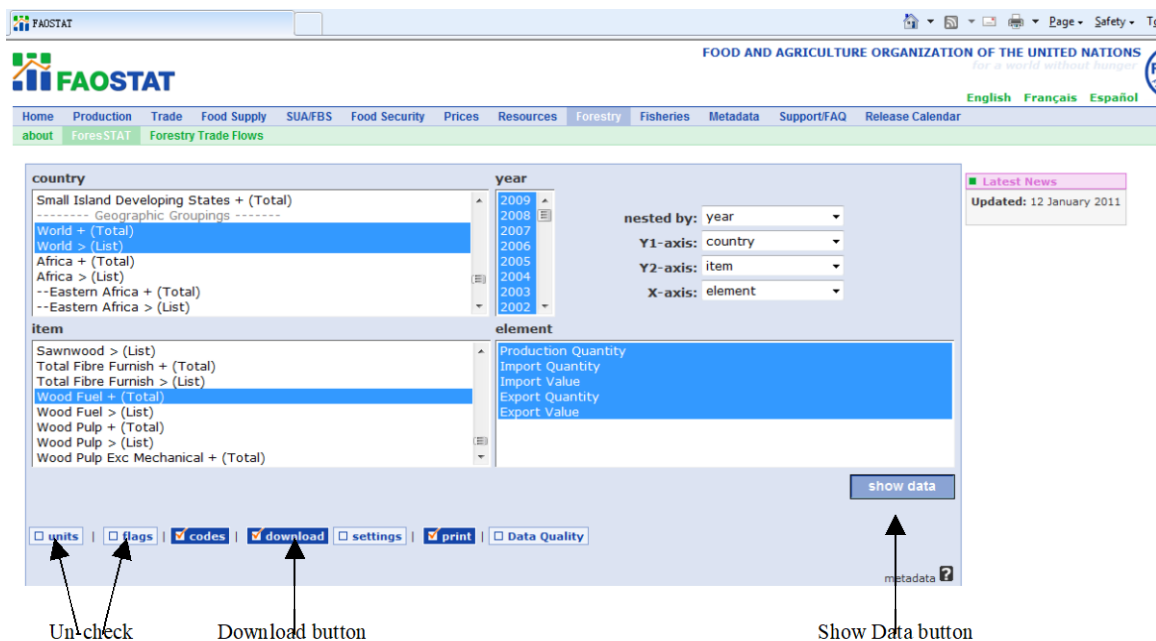
Table 1: Names of files in C:\GFPM\input\InputFiles.

GFPM names	Item Name	File Name
	FAO	
Fuelwood	WOOD FUEL+	Fuelwood.csv
Chips and Particles	Chips and Particles	Chips.csv
Industrial Roundwood	INDUSTRIAL ROUNDWOOD+	IndRound.csv
Other Industrial Roundwood	OTHER INDUST ROUNDWD+	OthIndRound.csv
Sawnwood	SAWNWOOD+	Sawnwood.csv
Plywood	Plywood	Plywood.csv
Veneer Sheets	Veneer Sheets	Veneer.csv
Particleboard	Particle Board	ParticleB.csv
Fiberboard	FIBREBOARD+	FiberB.csv
Mechanic Pulp	Mechanical Wood Pulp	MechPlp.csv
Chemical Pulp	Chemical Wood Pulp	ChemPlp.csv
Semi-chemical Pulp	Semi-Chemical Pulp	SemiChemPlp.csv
Other Fiber Pulp	Other Fibre Pulp	OthFbrPlp.csv
Newsprint	Newsprint	Newsprint.csv
Printing and Writing Paper	Printing+Writing Paper	PWPaper.csv
Other Paper and Paperboard	Other Paper+Paperboard	OthPaper.csv
Waste Paper	Recovered Paper	WastePaper.csv
Forest Stock and Area	Forest Stock and Area	Forest.csv
	World Bank	
GDP, Population	GDP, Population	GDPPopulation.XLS
GDP Deflator	GDP deflator for United States	GDPDeflatorUS.xls

2.2 Updating FAO forest commodity data

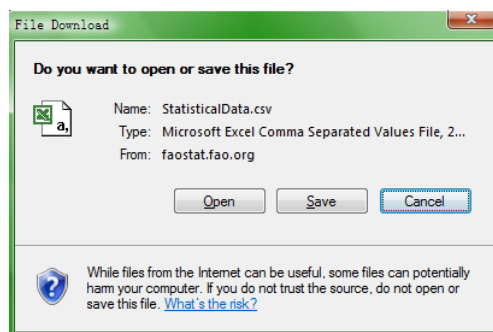
Go to the FAOSTAT (forestry data) web site. The current address

<http://faostat.fao.org/site/626/default.aspx#ancor> is subject to change. The following screen appears:

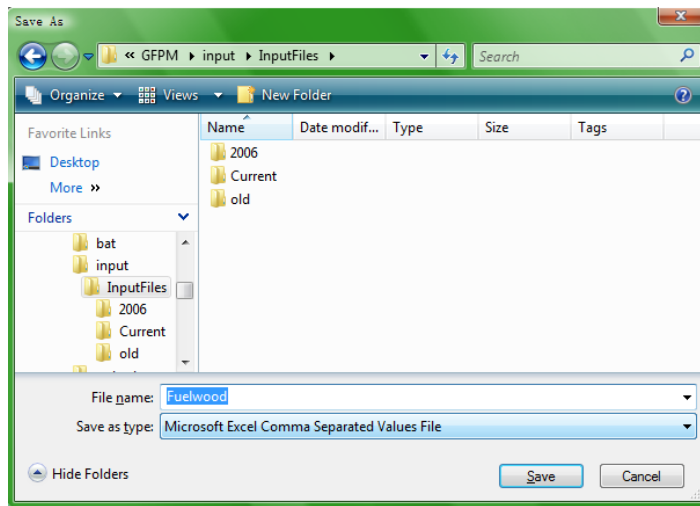


- Select *WORLD>* and *WORLD+* from the **Country** list, by clicking on the names while holding down the *Ctrl* key.
- Select *WOODFUEL+* from the **Item** list.
- Select *Production Quantity*, *Imports Quantity*, *Import Value*, *ExportsQuantity* and *Exports Value* from the **Element** list, by clicking on the element while holding down the *Ctrl* key.
- Select the desired years from the **year** list. The GFPM2012 uses data from 1992 to 2009. For the current FAOSTAT web site, there may be a limit to the number of years that can be downloaded. First download 2000 to 2009 data, then download 1992 to 1999 data, and combine them in one file, giving it the name in Table 1.
- Select *year* from the nested-by list.
- Select *country* from the **Y1-axis** list.
- Select *item* from the **Y2-axis** list.
- Select *elements* from the **X-axis** list.
- Un-check options *units*, *flags*, *settings*, and *data quality*.

Click on “show data”. The selected data will appear on the web page. Click on “download”. The following box appears:



Click on **Save**. The **Save As...** box appears:



To save the downloaded data:

- Select the C:\GFPM\INPUT\INPUTFILES directory.
- Specify the file name in the **File name** (you must use the names in Table 1).
- Click **Save**.

Repeat the above steps for all the FAO data in Table 1 except forest area and forest stock.

Each downloaded cvs file contains the FAO country name and its code, the item (commodity) name and its code, the year, production, import quantity, import value, export quantity, and export value.

2.3 Updating forest stock and area data

The data on forest stock and area are not available for every year. The FAO “Global Forest Resources Assessment 2010” (<http://www.fao.org/forestry/fra/fra2010/en/>) was used to prepare the Forest.csv input file in GFPM 2012. The Forest.csv file contains estimated data on forest stock, forest stock growth rate, forest area, and forest area growth rate in the same format as the other input data such as Fuelwood.csv. Users may modify or update the data by directly editing this file.

2.4 Updating World Bank GDP and population data

Go to the World Bank Development Indicators web page. The current address of World Development Indicators online database <http://ddpext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=135> is subject to change. Keep selecting “World Development Indicators & Global Development Finance”, and then click the “Next” button at the right below the Database choice list panel. The WDI browser country selection window appears:

The World Bank Group
Quick Query
selected from
World Development Indicators

Select English

Select Variables Show Report Info Help ?

Country Series Time

Classification

- Aggregates
- East Asia & Pacific
- Europe & Central Asia
- Latin America & Caribbean
- Middle East & North Africa
- North America
- South Asia
- Sub-Saharan Africa

Search

Available - 227

- Afghanistan
- Albania
- Algeria
- American Samoa
- Andorra
- Angola
- Antigua and Barbuda
- Argentina
- Armenia

Select Select All Deselect Deselect All

Selected - 227

- Afghanistan
- Albania
- Algeria
- American Samoa
- Andorra
- Angola
- Antigua and Barbuda
- Argentina
- Armenia

Next »

- Click on **Select all** to add all selected countries to the **Selected** panel.
- Click **Next**.

The Series Selection window appears:

The World Bank Group
Quick Query
selected from
World Development Indicators

Select English

Select Variables Show Report Info Help ?

Country Series Time

Topic

- Balance of payments
- Development framework
- Environment
- Exchange rates & prices
- External debt
- Financial statistics
- Government finance
- National accounts
- Social indicators
- Trade

Search

Available - 54

- Forest area (sq. km)
- GDP (current US\$)**
- GDP growth (annual %)
- GNI per capita, Atlas method (current US\$)
- GNI per capita, PPP (current international \$)
- GNI, Atlas method (current US\$)
- GNI, PPP (current international \$)
- Gross capital formation (% of GDP)
- High-technology exports (% of manufactured exports)

Select Select All Deselect Deselect All

Selected - 2

- GDP (current US\$)
- Population, total

Next »

- To add the *GDP (current US\$)* series, use the scroll bar to move down to the series name in the **Available** panel, click on the series name to highlight it, and click the **Select** button.
- The name of the series appears in the **Selected** panel at the bottom of the window.
- In the same way, select the *Population, total* series.
- Click **Next**.

The Years Selection window appears:

The screenshot shows the 'Quick Query' interface for 'The World Bank Group'. It is set to 'English'. The 'Year' selection window is active, showing a search bar and buttons for 'Search', 'Reset', and 'Notes'. Below the search bar, there are two panels: 'Available - 48' and 'Selected - 15'. The 'Available' panel lists years from 2006 down to 1998. The 'Selected' panel lists years from 1992 up to 2000. Buttons for 'Select', 'Select All', 'Deselect', and 'Deselect All' are located between the two panels. A 'Next »' button is at the bottom right of the 'Selected' panel.

- To download data for a specific year use the scroll bar to move down to the year in the **Available** panel, click on the year to highlight it, and click the **Select** button. To select multiple years, use the Ctrl key to highlight more than one year, then click the **Select** button.
- The years appear in the **Selected** panel.
- Click **Next**.

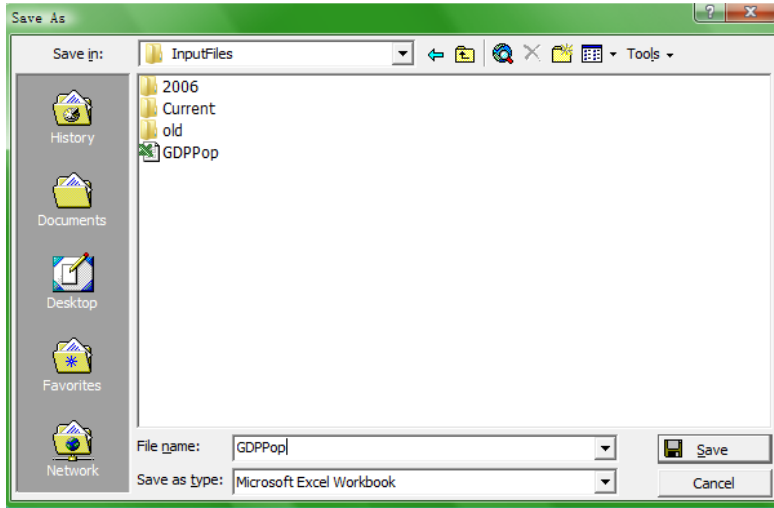
The following formatting table appears:

The screenshot shows the 'World dataBank' formatting table interface. It includes a breadcrumb trail: 'You are here > World Bank Data > World Development Indicators & Global Development Finance'. Below this, there are tabs for 'Select Database', 'Select Variables', and 'Format Report'. The 'Format Report' tab is active, showing a table for 'Orientation' with columns 'Page', 'Column', 'Row', and 'Data'. The 'Options' section includes 'Scale' (Units), 'Precision' (0), and 'Get Data' buttons (Export, View Data, Format Report). A note states: 'Note: Chart and Map are available through Formatted Report. Metadata are not available in View Data.' The 'Header and Footer' section has two empty text boxes.

Select:

- Units from **Scale** list.

- 0 from **Precision** list.
- Click the “Export” button to let a popup to show up (make sure the browser pop-up is allowed for this page). Click the Excel icon in Data Download section and the file can be saved as an Excel file like:



To save the downloaded data:

- select the C:\GFPM\INPUT\INPUTFILES directory.
- Specify the file name, GDPPopulation, in the **File name** box.
- Click **Save**.

The format of the World Bank GDP and population database may change over time. Download the data as they are, and then process them into the format of the GDPPopulation.xls file. The first column contains the year, followed by the country name and abbreviation, the GDP, and the population.

Repeat this procedure to download the data for the US GDP deflator. The US GDP deflator is used to express all price series in US dollars of the base year. As for GDP and population some processing may be required to cast the US deflator data in the format of GDPDeflatorUS.xls.

3 ***Calibrating the base year***

The calibration of the GFPM for the base year can be static, using only data for the base year, say 2009, or dynamic, using three years of smoothed or unsmoothed data. The GFPM 2012 was calibrated dynamically with unsmoothed data from 2007 to 2009 for a base year of 2009.

Calibration is done for the countries in the CALIBRATION.XLS workbook shown below, which defines the correspondence between the GFPM country code and name, and the codes of the country in FAOStat and in the World Bank database. Refer to section 8.3 to change the country list.

GFPM Code	Country Name	FAO Country Code	WDI Country Code
a0	Algeria	4	DZA
a1	Angola	7	AGO
a2	Benin	53	BEN
a3	Botswana	20	BWA
a4	Burkina Faso	233	BFA
a5	Burundi	29	BDI
a6	Cameroon	32	CMR
a7	Cape Verde	35	CPV
a8	Central African Republic	37	CAF
a9	Chad	39	TCD
b0	Congo, Republic of	46	COG
b1	Côte d'Ivoire	107	CIV
b2	Djibouti	72	DJI
b3	Egypt	59	EGY
b4	Equatorial Guinea	61	GNQ
b5	Ethiopia	238	ETH
b6	Gabon	74	GAB
b7	Gambia	75	GMB
b8	Ghana	81	GHA
b9	Guinea	90	GIN
c0	Guinea-Bissau	175	GNB
c1	Kenya	114	KEN
c2	Lesotho	122	LSO
c3	Liberia	123	LBR
c4	Libyan Arab Jamahiriya	124	LBY
c5	Madagascar	129	MDG
c6	Malawi	130	MWI
c7	Mali	133	MLI
c8	Mauritania	136	MRT

The files containing downloaded and unformatted FAO and World Bank data are in C:\GFPM\INPUT\InputFiles. The calibration procedure merges these various input files into a single RAWDATA.XLS.

A permanent version of RAWDATA.XLS is also stored in C:\GFPM\INPUT\INPUTFILES\PROCESSEDRAWDATA.XLS. If this file exists, it is used for calibration. If raw data files in INPUTFILES are updated, the calibration process retrieves the raw data from INPUTFILES, and creates a new PROCESSEDRAWDATA.XLS.

With the PROCESSEDRAWDATA.XLS, users can extrapolate the raw data easily to approximate a new year's raw data to calibrate a more recent base year before the FAO data are published. For example, we applied this technique to calibrate the 2006 base year model with 1992 – 2005 FAO data before FAO published the 2006 data.

If the data smoothing option is selected, the calibration transforms PROCESSEDRAWDATA.XLS into SMOOTHEDDATA.XLS.

The calibration creates the base year data in INPUTDATA.XLS. It also stores the I-O coefficients and the manufacturing cost for the current base year in TECHTREND.XLS. Users can produce time series of I-O coefficients and manufacturing cost in TECHTREND.XLS by redoing the calibration for several base years. INPUTDATA.XLS and TECHTREND.XLS are in the C:\GFPM\INPUT folder (Figure 1).

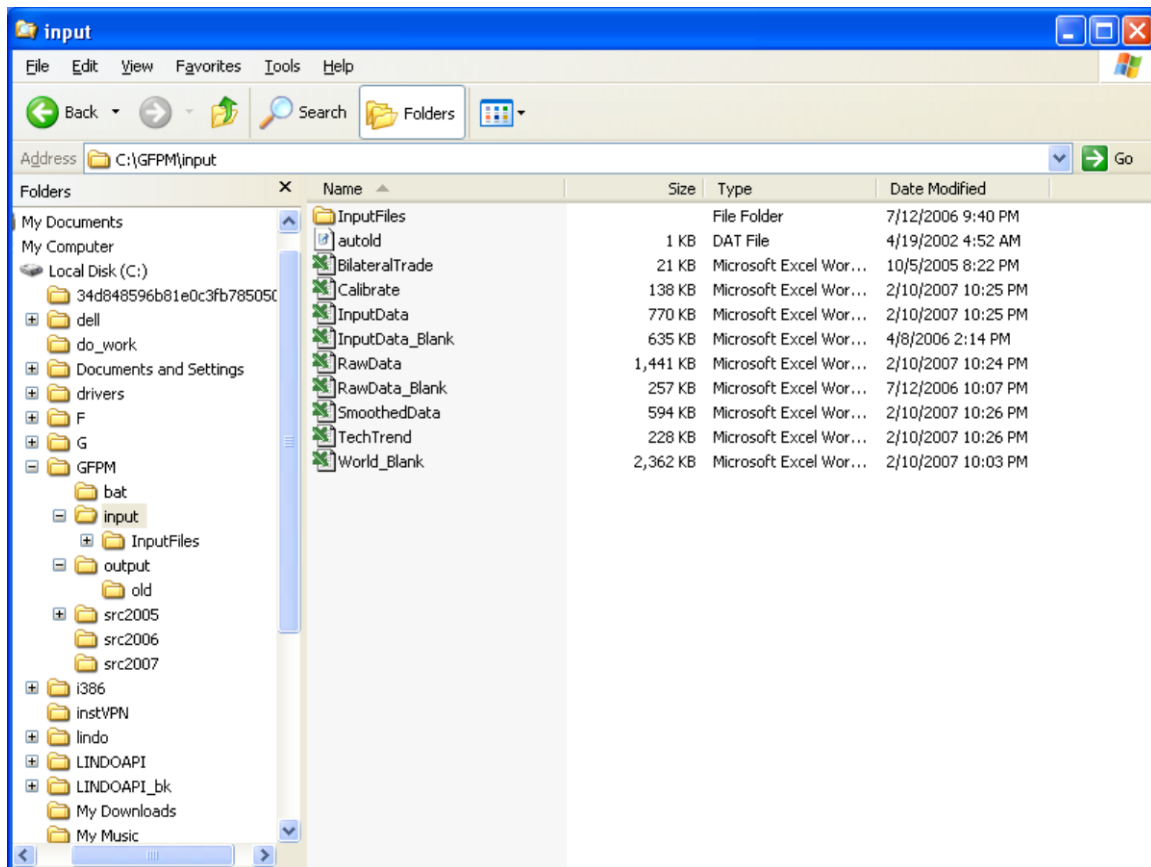


Figure 1. Files used by the calibration procedure.

3.1 Supplementary data

Some of the data in INPUTDATA.XLS must be inserted manually by users in INPUTDATA_blank.xls. They are highlighted in Figure 2 and shown in dark in Table 2. The other data in INPUTDATA.XLS result from the calibration which estimates the I-O coefficients and the manufacturing costs.

The calibration computes for each country I-O coefficients and manufacturing costs that are consistent with the observed quantities and prices, assuming competitive world markets. The procedure keeps the data on imports and exports equal to the observed, but may alter the data on production.

The calibration determines production levels, I-O coefficients, and manufacturing costs that minimize the sum of the price-weighted deviations between the observed and calibrated productions (see section 10.2). The I-O coefficients are constrained to stay within user-specified bounds and the manufacturing cost must be non negative (Figure 2).

If there is no feasible solution, the procedure widens all the bounds gradually until it finds a feasible solution. However, this automatic adjustment may give unlikely estimates of production (see warning option in the calibration menu, below), in which case the bounds should be adjusted manually.

Countries and products that obtain zero consumption after calibration are highlighted in INPUTDATA.XLS.

Microsoft Excel - InputData_blank.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

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B I

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Reply with Changes...

End Review...

U109

	A	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	Base Year: 1994		Demand Elasticities	Trade Inertia								Input	Upper	Lower	Initial	Data to be input by the user	
2	Country	WorldPrice	Price	Income	GDP Elas	Bound	Tariff	FreightFactor	CapacityMultiplier	Scale Elasticity	ManuCost	IndRound	IndRound	IndRound	IndRound		
98	Indonesia	-0.21	0.46	2.71	0.05	0.00	0.11	-1.00	0.10				2.35	1.00			
99	Iran, Islamic Rep of	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.26	1.00			
100	Iraq	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.78	1.00			
101	Israel	-0.16	0.32	2.71	0.05	0.00	0.11	-1.00	0.10				2.59	1.00			
102	Japan	-0.16	0.32	2.71	0.05	0.02	0.11	-1.00	0.10				2.59	1.00			
103	Jordan	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				3.60	1.20			
104	Korea, Dem People's Rep	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.59	1.00			
105	Korea, Republic of	-0.21	0.46	2.71	0.05	0.05	0.11	-1.00	0.10				2.03	1.00			
106	Kuwait	-0.16	0.32	2.71	0.05	0.10	0.11	-1.00	0.10				3.45	1.15			
107	Laos	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.89	1.00			
108	Lebanon	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.19	1.00			
109	Macau	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.90	1.00			
110	Malaysia	-0.21	0.46	2.71	0.05	0.00	0.11	-1.00	0.10				2.36	1.00			
111	Mongolia	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				3.02	1.01			
112	Myanmar	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.47	1.16			
113	Nepal	-0.21	0.46	2.71	0.05	0.00	0.11	-1.00	0.10				2.71	1.00			
114	Oman	-0.21	0.46	2.71	0.05	0.05	0.11	-1.00	0.10				3.60	1.20			
115	Pakistan	-0.21	0.46	2.71	0.05	0.05	0.11	-1.00	0.10				2.40	1.00			
116	Philippines	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.24	1.00			
117	Qatar	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				3.60	1.20			
118	Saudi Arabia	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				3.60	1.20			
119	Singapore	-0.21	0.46	2.71	0.05	0.00	0.11	-1.00	0.10				2.19	1.00			
120	Sri Lanka	-0.21	0.46	2.71	0.05	0.00	0.11	-1.00	0.10				3.40	1.13			
121	Syrian Arab Republic	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.32	1.00			
122	Thailand	-0.21	0.46	2.71	0.05	0.00	0.11	-1.00	0.10				2.27	1.00			
123	Turkey	-0.21	0.46	2.71	0.05	0.01	0.11	-1.00	0.10				2.19	1.00			
124	United Arab Emirates	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				2.75	1.00			
125	Viet Nam	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				3.58	1.19			
126	Yemen	-0.21	0.46	2.71	0.05	0.10	0.11	-1.00	0.10				3.60	1.20			
127	Australia	-0.16	0.32	2.71	0.05	0.05	0.11	-1.00	0.10				2.18	1.00			
128	Cook Islands	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				3.60	1.20			
129	Fiji Islands	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				2.32	1.00			
130	French Polynesia	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				3.60	1.20			
131	New Caledonia	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				3.02	1.01			
132	New Zealand	-0.16	0.32	2.71	0.05	0.05	0.11	-1.00	0.10				2.41	1.00			
133	Papua New Guinea	-0.21	0.46	2.71	0.05	0.40	0.11	-1.00	0.10				3.38	1.13			
134	Samoa	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				3.60	1.20			
135	Solomon Islands	-0.21	0.46	2.71	0.05	0.05	0.11	-1.00	0.10				3.01	1.00			
136	Tonga	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				3.35	1.12			
137	Vanuatu	-0.21	0.46	2.71	0.05	0.35	0.11	-1.00	0.10				3.27	1.09			
138	Albania	-0.21	0.46	2.71	0.05	0.11	0.11	-1.00	0.10				2.98	1.00			
139	Austria	-0.16	0.32	2.71	0.05	0.01	0.11	-1.00	0.10				2.59	1.00			
140	Belgium	-0.16	0.32	2.71	0.05	0.01	0.11	-1.00	0.10				2.59	1.00			
141	Bosnia and Herzegovina	-0.21	0.46	2.71	0.05	0.01	0.11	-1.00	0.10				2.57	1.00			
142	Bulgaria	-0.21	0.46	2.71	0.05	0.01	0.11	-1.00	0.10				2.60	1.00			
143	Croatia	-0.21	0.46	2.71	0.05	0.01	0.11	-1.00	0.10				2.57	1.00			

Fuelwood IndRound OthIndRound Sawnwood Plywood ParticleB FiberB MechPip Cher

Start Eudora

ComparativeAdvantage input

Microsoft Excel - Inpu...

8:32 AM

Figure 2: Example of INPUTDATA.XLS. Data supplied by users in INPUTDATA_blank.xls, are highlighted.

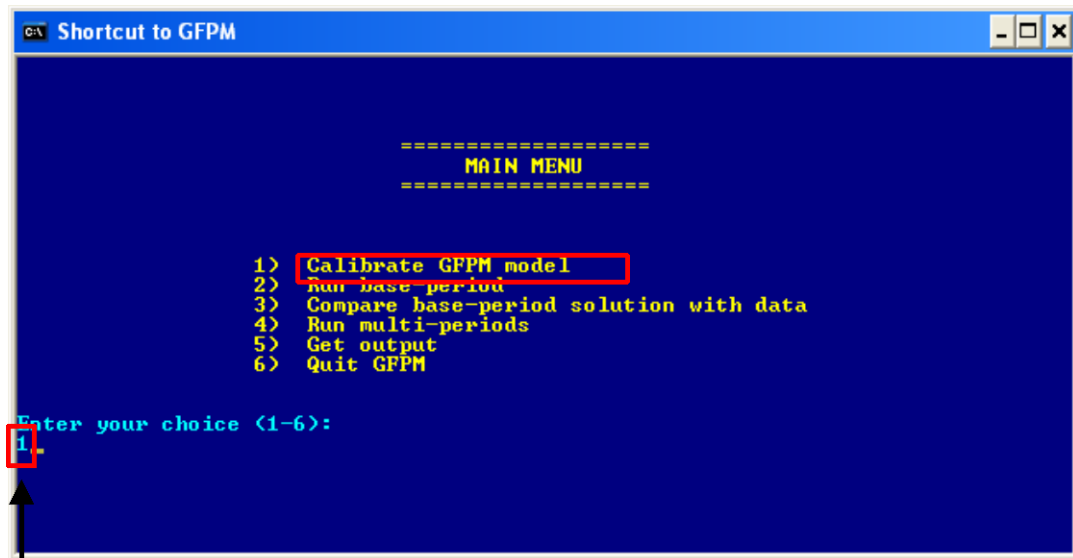
Table 2: Data in INPUTDATA.XLS.

Data	Description	Source	Use
Country	Country name as in the GFPM	GFPM	
Production	Production (000 m ³ or 000 tonne)	Calculated	Update WORLD.XLS
Import	Import volume (000 m ³ or 000 tonne)	FAOStat	Update WORLD.XLS
Export	Export volume (000 m ³ or 000 tonne)	FAOStat	Update WORLD.XLS
Consumption	Consumption volume (000 m ³ or 000 tonne)	Calculated	Update WORLD.XLS
WorldPrice	World export unit value (\$US/ m ³ or tonne)	Calculated	Calibration and Update WORLD.XLS
Price Elasticity of Demand	Price elasticity of demand for final products	User*	Update WORLD.XLS
Income Elasticity of Demand	Income elasticity of demand for final products.	User	Update WORLD.XLS
Trade Inertia GDP Elasticity	Elasticity of trade with GDP.	User	Update WORLD.XLS
Trade Inertia Bound	Range of variation in trade as fraction of trade volume.	User	Update WORLD.XLS
Tariff	Ad valorem tax on imports or exports	User	Calibration and Update WORLD.XLS
Freight Factor	Freight cost as proportion of export unit value	User	Calibration and Update WORLD.XLS
Price Elasticity of Supply	Price elasticity of supply for raw materials	User	Update WORLD.XLS
Endogenous or Exogenous	Endogenous wood supply: zero entries.	User	Update WORLD.XLS
Indication of Supply	Exogenous wood supply: non-zero entries.		
Stock Elasticity of Supply	Forest stock elasticity of wood supply.	User	Update WORLD.XLS
Area Elasticity of Supply	Forest area elasticity of wood supply.	User	Update WORLD.XLS
GDP Per Capita	GDP per capita elasticity of wood supply.	User	Update WORLD.XLS
Elasticity of Supply			
maxRecovery	Maximum fraction of paper consumption recovered as waste paper.	User	Update WORLD.XLS
EstRecovery	Estimated fraction of total paper consumption recovered as waste paper	Calculated	Update WORLD.XLS
Capacity Multiplier	Manufacturing capacity as a percentage of production volume. Use -1 if no capacity limitation.	User	Update WORLD.XLS
Scale Elasticity	Elasticity of manufacturing cost with respect to output.	User	Update WORLD.XLS
ManuCost	Manufacturing cost above cost of wood or fiber input	Calculated	Update WORLD.XLS
Input	input per unit of output.	Calculated	Update WORLD.XLS
Upper, Lower	Upper, lower bound on Input-output coefficient.	User	Calibration
Initial	Initial estimated value of input-output coefficient.	Calculated	Calibration
Elasticity of stock growth	Elasticity of stock growth with stock level.	User	Update WORLD.XLS
Effect of GDP per capita on area growth	Coefficient of GDP/capita in area growth equation.	User	Update WORLD.XLS
Effect of squared GDP per capita on area growth	Coefficient of (GDP/Capita) ² in area growth equation.	User	Update WORLD.XLS
Fraction of fuelwood from forest	Fraction of fuelwood that comes from forests.	User	Update WORLD.XLS
Ratio of inventory drain to harvest	Ratio of wood produced from forest to the reduction of inventory	User	Update WORLD.XLS
Maximum ratio of inventory drain to growth of inventory without harvest (>0, -1 if unlimited)	Limit of harvest relative to forest growth	User	Update WORLD.XLS
CO2 sequestered by wood (tonne per CUM)	CO2 equivalent per unit of wood	User	Update WORLD.XLS
Price of CO2 (US\$ per tonne)	CO2 price	User	Update WORLD.XLS

*All user-supplied data must be inserted in INPUTDATA_blank.xls

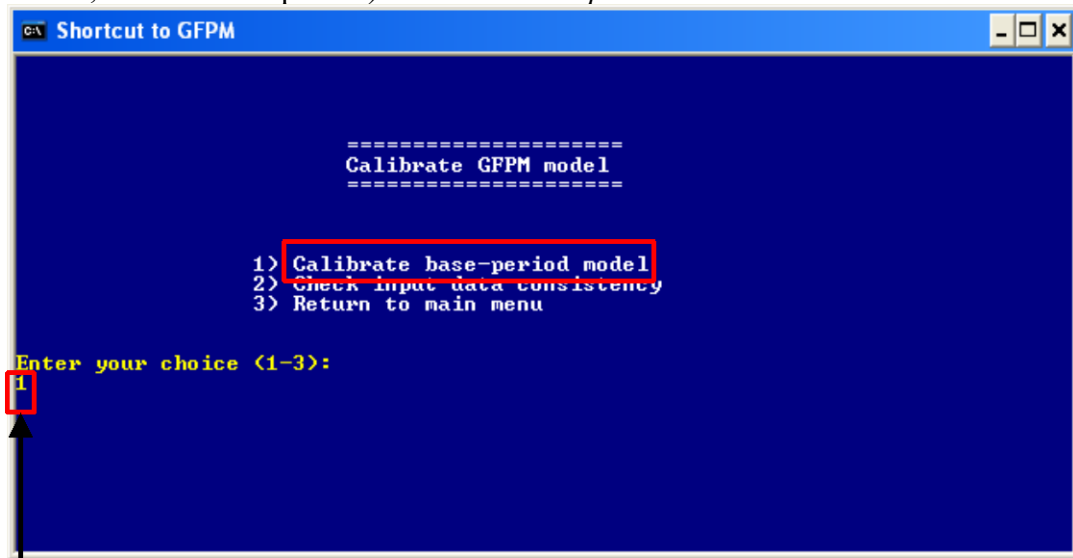
3.2 Calibration steps

To start calibration, select menu option 1) *Calibrate GFPM model* from the GFPM Main Menu:



Type 1 here

Then, select menu option 1) *Calibrate base-period model*:



Type 1 here

Click the **Enable the macros** button if the program asks you to do so. The following Calibration Menu appears:

Calibrate calculates country production and consumption in the INPUTDATA.XLS

Calibrate Results are in the C:\GFPM\INPUT

Base Year 2006

Smoothing
☒ No Smoothing ☐ Three-year Moving Average

Calibration Type
☐ Static ☒ Dynamic

☒ Show warning messages when preset I-O bounds are exceeded during calibration

Update WORLD.XLS copies the calibrated data from INPUTDATA.XLS to the WORLD.XLS

Update WORLD.XLS Results are in the C:\GFPM\INPUT

Update Historical Data updates SUMMARYCHANGE.XLS, OUTPUT.XLS, and SUMMARY.XLS with deflated historical data for specified baseyear

Update Historical Data Results are in the C:\GFPM

Add Bilateral Trade inserts data for bilateral trade flows from BILATERALTRADE.XLS to the WORLD.XLS

Add Bilateral Trade Results are in the C:\GFPM\INPUT directory

Quit Excel

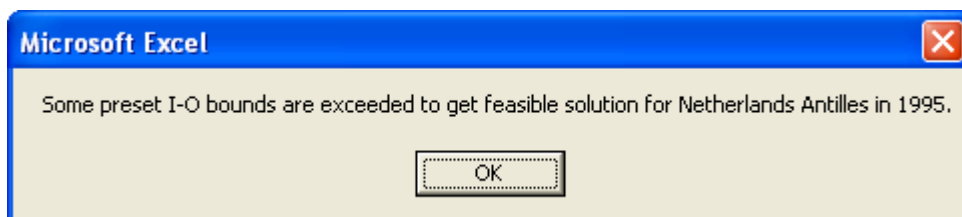
Click on **Calibrate**.

The **Base Year** is the year for which the GFPM is calibrated. With un-smoothed data, the base year can be the last year of historical data. With smoothed data it must be at least one year less.

Choosing **No Smoothing** keeps the historical data as is, while **Three-year Moving Average** smoothes the data by making, for example the data for 2006 the average of the historical data for 2005, 2006, and 2007. Thus, with smoothing and historical data from 1992 to 2009, the latest base year can be only 2008.

Choosing the **Static** calibration uses only the base-year data, while **Dynamic**, uses 3 years of data. The dynamic calibration mitigates excessive changes in the I-O coefficients and manufacturing costs when the base year is updated with new data.

Checking the “Show warning message” box, produces the following warning message if the calibration procedure had to extend the bounds of the I-O coefficients outside these preset bounds:



The results of the calibration, consisting of the input-output coefficients and of the manufacturing costs, are in INPUTDATA.XLS in the INPUT folder.

The differences between the calibrated production and the FAO reported production are in the CALIBRATE.XLS workbook in the INPUT folder. The RegionProductionError worksheet below shows the difference, in percent, at regional level for each commodity group. The calibration errors reported in percentage and value are reported in %Error and Error spreadsheets respectively.

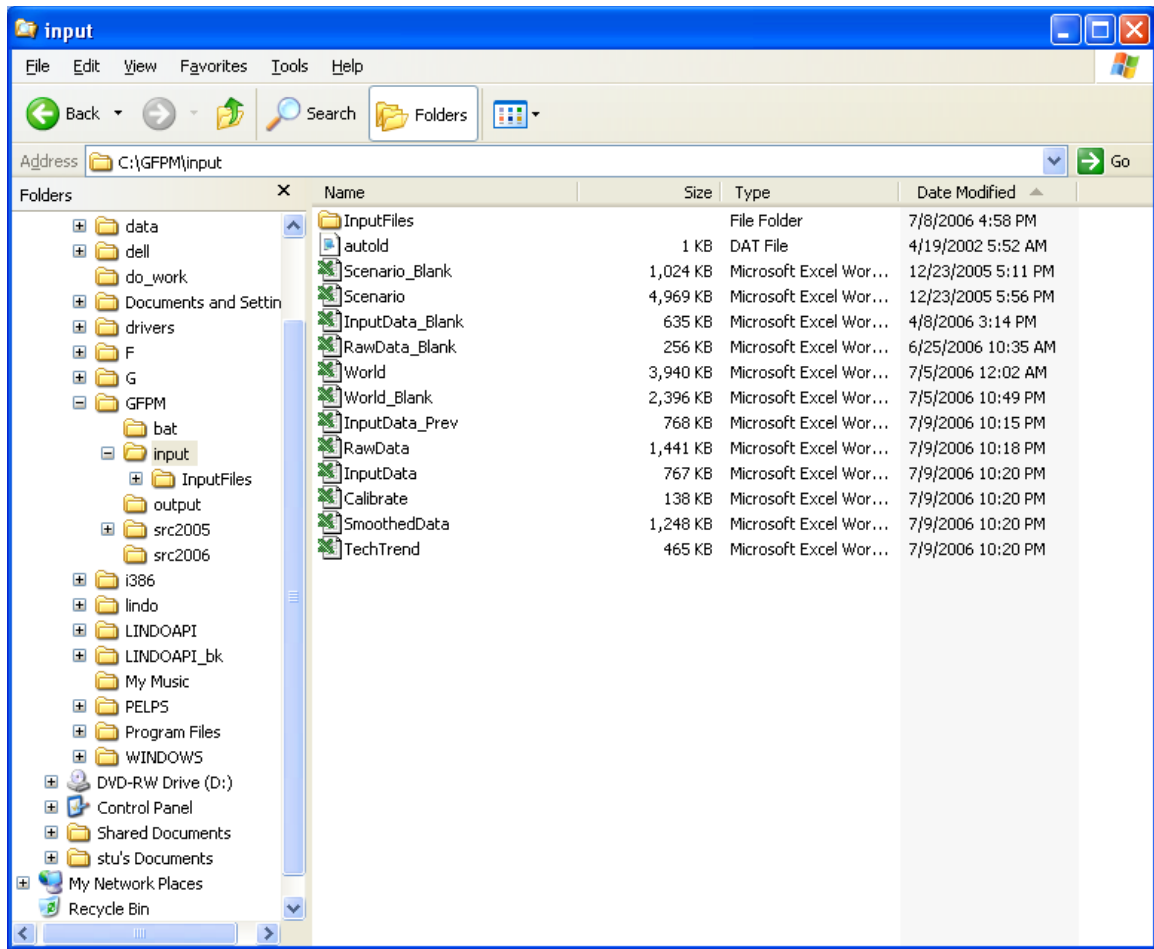
Year: 2009	Commodity	Region	Production Reported	Estimated	%	World Reported	Estimated	%
3	Fuelwood	Africa	598757	598757	0.0%			
4		North/Central America	128189	128189	0.0%			
5		South America	198034	198034	0.0%			
6		Asia	763709	763709	0.0%			
7		Oceania	10704	10705	0.0%			
8		Europe	87539	87539	0.0%			
9		Former USSR	56397	56397	0.0%	1849329	1849330	0.0%
10	IndRound	Africa	44080	42437.015	-3.7%			
11		North/Central America	406742	406276.639	-0.1%			
12		South America	177194	179384.961	1.2%			
13		Asia	181651	282333.679	55.5%			
14		Oceania	41592	46529.749	11.3%			
15		Europe	291841	297107.572	1.8%			
16		Former USSR	127676	130234.794	2.0%	1270676	1384304.409	8.9%
17	OthIndRound	Africa	28586	28586	0.0%			
18		North/Central America	11705	11705	0.0%			
19		South America	10179	10179	0.0%			
20		Asia	58019	58019	0.0%			
21		Oceania	8637	8637	0.0%			
22		Europe	10092	10092	0.0%			
23		Former USSR	16037	16037	0.0%	143315	143315	0.0%
24	Sawnwood	Africa	8470	8470	0.0%			
25		North/Central America	94134	94134	0.0%			
26		South America	35744	35744	0.0%			
27		Asia	88104	88111	0.0%			
28		Oceania	8558	8558	0.0%			
29		Europe	92041	92041	0.0%			
30		Former USSR	36946	37047.357	0.3%	363997	364105.357	0.0%
31	Plywood	Africa	1862	2330.695	25.2%			
32		North/Central America	12256	12266.951	0.1%			
33		South America	5377	5575.895	3.7%			
34		Asia	65013	65024.891	0.0%			
35		Oceania	1208	1273.547	5.4%			
36		Europe	3928	3932	0.1%			
37		Former USSR	3157	3158	0.0%	92801	93561.979	0.8%
38	ParticleB	Africa	693	696	0.4%			
39		North/Central America	21845	21845	0.0%			
40		South America	3909	3909	0.0%			
41		Asia	22645	22649	0.0%			
42		Oceania	1129	1129	0.0%			
43		Europe	36563	36569	0.0%			
44		Former USSR	7609	7609	0.0%	94399	94406	0.0%
45	FiberB	Africa	193	194	0.5%			
46		North/Central America	10505	10505	0.0%			
47		South America	5265	5525	4.9%			
48		Asia	43381	43463	0.2%			
49		Oceania	1341	1342	0.1%			

3.3 Updating WORLD.XLS

All the data needed to run the GFPM are in the WORLD.XLS file. The data come from the base year calibration, such as consumption, production, prices, input-output coefficients, manufacturing cost, and from user-supplied data, such as the elasticities. The exogenous change data are all user-supplied and described in “Using the GFPM 2012” (Buongiorno and Zhu 2012).

To copy the calibrated base year data to the WORLD.XLS workbook, click the “Update WORLD.XLS” button on the calibration menu (p. 15). This creates WORLD.XLS in the C:\GFPM\INPUT directory, including the “Specification” sheet of WORLD.XLS with the list of countries and commodities, and the model base year. Other information can be recorded manually in the Specification sheet.

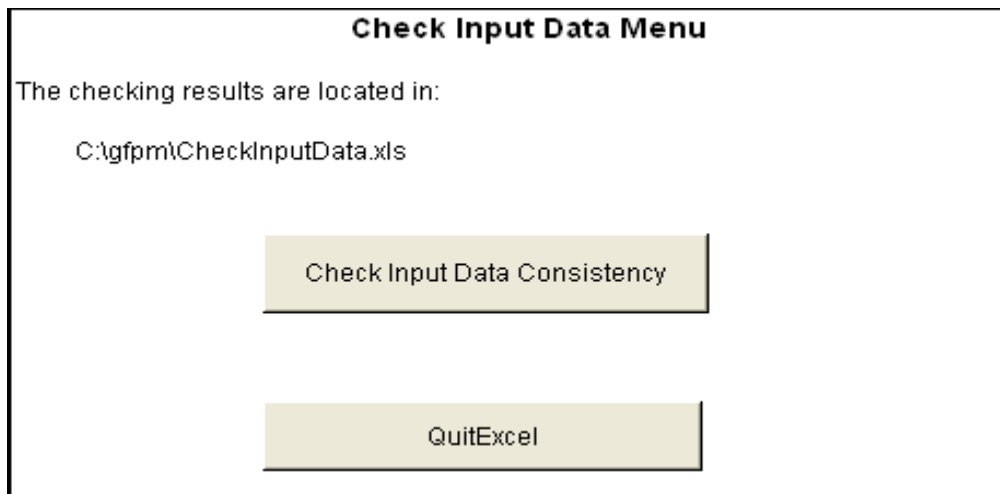
Copy or move this new WORLD.XLS to C:\GFPM before checking input data consistency, running the base period (and optionally validating the base period, or running multi-period projections).



For explanations of the “Update Historical Data” and “Add Bilateral Trade” buttons, refer sections 6 and 7. To exit the Calibration Menu and return to the Calibrate GFPM Model menu click the **Quit Excel** button on the Calibration menu (p. 15).

4 **Checking input data consistency**

Option 2) *Check input data consistency* in the Calibrate GFPM model sub menu (p. 15) produces this menu:



Make sure that the WORLD.XLS being checked is in C:\GFPM. Clicking on “Check Input Data Consistency” gives the results in the “Data Consistency” worksheet in C:\GFPM\CHECKINPUTDATA.XLS (Figure 3).

Model Input														Combined		Derived		Check					
Country & product	Consump	Producti	Export	Import	Local price	Maanf cost	World XTras cost	Tariff rate	81/87	88	89	90	Max consum Rate	World X price	Local Consumpt price	Local Consumpt price	Local Maanf cost	Local Consumpt price	Maanf cost	Max waste paper available			
s080	7425	7425			31									31	7425.00	31.00	7425.00	31	0.000	0.000			
s081		109.601		23	92.04		66	12	0.18					66	132.60	92.04	132.60	92.04	-0.001	0.000			
s082		110			66									66	110.00	66.00	110.00	66	0.000	0.000			
s083	778	13		765	2415	83.19	207	23	0.05	1.72				207	778.00	2415.00	778.00	2415	83.191	0.000	0.000	0.000	
s084	270	25		245	539.72	259.9	396	16	0.31	3.04				396	270.00	539.72	270.00	539.7	259.92	0.000	0.000	0.000	
s085	60	23		37	278.75	142.5	214	9	0.25	1.48				214	60.00	278.75	60.00	278.8	142.53	0.000	0.000	0.000	
s086	19			19	386.25		297	12	0.25					297	19.00	386.25	19.00	386.3		0.000	0.000		
s087														305	0.00	305	0.00	305		0.000	0.000		
s088		0.056		15		156	431	34	0.05	3.61				431	15.06	488.25	15.06	488.3	155.93	0.000	0.000	0.000	
s089		5.358			864									864	5.36	864.00	5.36	864		0.000	0.000		
s090		7.549	6		108									108	1.55	108.00	1.55	108		0.000	0.000	33.69 OK	
s091	45.053	8.153		37	535.5	1	486	24	0.05	0	0.61	0.25	0.19	45.15	486	45.15	535.50	45.15	535.5	1	0.000	0.000	0.000
s092	76	14	2	64	991.3	397.8	813	43	0.15	0	0.72	0.28	0	76	813	76.00	991.30	76.00	991.3	397.84	0.000	0.000	0.000
s093	138			138	880.9		723	43	0.15					138	723	138.00	880.90	138.00	880.9		0.000	0.000	
s094	3403	3403			31									31	3403.00	31.00	3403.00	31		0.000	0.000		
s095		46	1	1	66		66	12	0.18					66	45.00	66.00	45.00	66		-0.001	0.000		
s096	1050	1050			66									66	1050.00	66.00	1050.00	66		0.000	0.000		
s097	10	5		5	271.4	114.3	207	23	0.18	2.38				207	10.00	271.40	10.00	271.4	114.32	0.000	0.000	0.000	
s098	12	11		1	506.76	319.4	396	16	0.23	2.839				396	12.00	506.76	12.00	506.8	319.41	0.000	0.000	0.000	
s099	0				214									214	0.00	214.00	0.00	214		0.000	0.000		
s096	2			2	383.16		297	12	0.24					297	2.00	383.16	2.00	383.2		0.000	0.000		
s097														305	0.00	305	0.00	305		0.000	0.000		
s098		0.712			164.4					4.04				431	0.71	431	0.71	431	164.36	0.000	0.000	0.000	
s099		0.19			864									864	0.19	864.00	0.19	864		0.000	0.000		
s090		0.13			108									108	0.13	108.00	0.13	108		0.000	0.000	0.84 OK	
s091	1	1			486	1				0	0.712	0.19	0.13	1	486	1.00	486.00	1.00	486	1	0.000	0.000	0.000
s092	2			2	1034.4		813	43	0.2					813	2.00	1034.40	2.00	1034		0.000	0.000		
s093	4			4	888.56		723	43	0.16					723	4.00	888.56	4.00	888.6		0.000	0.000		

Figure 3. Checks of input data consistency.

The checks verify the following conditions for the base year data in the WORLD.XLS. After a static calibration the conditions should hold exactly. After a dynamic calibration the conditions should hold closely:

- Apparent consumption (production + import - export) = final demand, or intermediate demand (for an input used by other products).
- Local price = world price plus the transport cost to the country of interest (for net importers), or = world price (for net exporters).
- Manufacturing cost = price of the output minus cost of all inputs, given the price of inputs and the input-output coefficients.
- Waste paper production ≤ waste paper recoverable.

5 Validating the base year solution

After getting a base-year solution with option 2) in the Main menu (p. 14), you can compare the model solution with the base year input data in WORLD.XLS.

The solution should be with free trade, i.e. without bound on exports and imports. In a well-calibrated model, imports and exports may differ from observed values, but net trade (exports minus imports) should be near the observed value. The input data and the solution should be nearly the same after a static model calibration. Some small differences are to be expected after a dynamic calibration.

To validate the base year solution, choose option “3) Compare base-period solution with data” in the Main menu (p. 14). The following sub-menu will appear:

Validate Baseyear Menu

The validation results are located in:

C:\gfp\ValidateBaseyear.xls

Compare Solution with Input Data

QuitExcel

Clicking on “Compare Solution with Input Data” produces the differences between base year input data and base year solution in the following spreadsheets in the workbook C:\GFPM\VALIDATEBASEYEAR.XLS.

The DEMAND sheet shows the difference between calculated and input demand and price of end products.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V				
***** DEMAND *****																									
A: Region number (01 to 39, in ascending order)																									
B: Commodity number (01 to 39, in ascending order within each region)																									
C: Base period price in common currency																									
D: Base period quantity demanded at price C																									
E: Price elasticity (<0, enter 0.00 for horizontal demand)																									
F: Elasticity of demand with respect to the first shift variable (optional, enter 0.00 if omitted)																									
G: Elasticity of demand with respect to the second shift variable (optional, enter 0.00 if omitted)																									
H: Elasticity of demand with respect to the third shift variable (optional, enter 0.00 if omitted)																									
I: Elasticity of demand with respect to the fourth shift variable (optional, enter 0.00 if omitted)																									
J: Elasticity of demand with respect to the fifth shift variable (optional, enter 0.00 if omitted)																									
K: Elasticity of demand with respect to the sixth shift variable (optional, enter 0.00 if omitted)																									
L: Elasticity of demand with respect to previous-period demand (optional, enter 0.00 if omitted)																									
M: Lower bound on the quantity demanded (optional, enter 0.00 if omitted)																									
N: Quantity demanded in the period before the base period																									
O: Minimum fraction of recycled content																									
																Calculated by model, and difference with input data									
																Demand	Difference	%Diff	Price	Difference	%Diff				

a0	80	30	7305	-0.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7305	0.00	7305	0	0	30	0	0				
a0	82	66	182	-0.37	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	182	0.00	182	0	0	66	0	0				
a0	83	223.65	348	-0.21	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	348	0.00	348	0	0	223.7	0	0				
a0	84	539.72	145	-0.22	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	145	0.00	145	0	0	539.7	0	0				
a0	85	220.00	31	-0.05	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31	0.00	31	0	0	220	0	0				
a0	86	340.00	6	-0.52	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6	0.00	6	0	0	340	0	0				
a0	31	520.80	29	-0.18	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29	0.00	29	0	0	520.8	0	0				
a0	32	333.80	67	-0.37	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67	0.00	67	0	0	333.8	0	0				
a0	33	815.35	126	-0.14	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	126	0.00	126	0	0	815.4	0	0				
a1	80	30	3320	-0.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3320	0.00	3320	0	0	30	0	0				
a1	82	66	1050	-0.37	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1050	0.00	1050	0	0	66	0	0				
a1	83	192	5	-0.21	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5	0.00	5	0	0	192	0	0				
a1	84	396	11	-0.22	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11	0.00	11	0	0	396	0	0				

The SUPPLY sheet shows the difference between calculated and input supply and price of raw material.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V				
***** SUPPLY *****																									
A: Region number (01 to 99, in ascending order)																									
B: Commodity Number (01 to 99, in ascending order within each region)																									
C: Base period price in common currency																									
D: Base period quantity supplied at price C																									
E: Price elasticity (>0)																									
F: Elasticity of supply with respect to the first shift variable (optional, enter 0.00 if omitted)																									
G: Elasticity of supply with respect to forest stock (optional, 0 if omitted)																									
H: Elasticity of supply with respect to forest area (optional, 0 if omitted)																									
I: Elasticity of supply with respect to GDP per capita (optional, 0 if omitted)																									
J: Elasticity of supply with respect to the fifth shift variable (optional, 0 if omitted)																									
K: Elasticity of supply with respect to the sixth shift variable (optional, 0 if omitted)																									
L: Elasticity of supply with respect to previous-period supply (optional, enter 0.00 if omitted)																									
M: Lower bound on the quantity supplied (optional, enter 0.00 if omitted)																									
N: Upper bound on the quantity supplied (optional, enter 0.00 if omitted)																									
O: Quantity supplied in the period before the base period																Calculated by model, and difference with input data									
																Supply	Difference	%Diff	Price	Difference	%Diff				
80	30	7305	1.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0	7305	7305	0	0	30	0	0					
81	32.04	74	1.31	0.00	1.60	0.00	0.30	0.00	1.00	0.00	0.00	0	74	74.5	0	0	32	0	0						
82	66	182	1.31	0.00	1.60	0.00	0.30	0.00	1.00	0.00	0.00	0	182	182	0	0	66	0	0						
83	741	2	0.80	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	2	2	0	0	741	0	0						
90	30	39	12	0.80	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0	39	12.4	0	0	30	0	0						
80	30	3320	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0	3320	3320	0	0	30	0	0						
81	66	66	1.31	0.00	1.60	0.00	0.30	0.00	1.00	0.00	0.00	0	66	66	0	0	66	0	0						
82	66	1050	1.31	0.00	1.60	0.00	0.30	0.00	1.00	0.00	0.00	0	1050	1050	0	0	66	0	0						
83	741	0	0.80	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	-741	0	0						
90	30	39	0	0.80	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	-39	0	0						
80	30	5366	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0	5366	5366	0	0	30	0	0						
81	32.04	29	1.31	0.00	1.60	0.00	0.30	0.00	1.00	0.00	0.00	0	29	29.5	0	0	32	0	0						
82	66	237	1.31	0.00	1.60	0.00	0.30	0.00	1.00	0.00	0.00	0	237	237	0	0	66	0	0						

The MANUFACTURE sheet shows the difference between the computed and input manufacturing cost and quantity manufactured.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
***** MANUFACTURE *****																			
A: Record type (two types of records are used, M and P)																			
-> Record type M (manufacturing cost) :																			
B: Region number (01 to 99, in ascending order)																			
D: Commodity (primary) number (01 to 99, in ascending order within each region)																			
E: Commodity (secondary) number (01 to 99, in ascending order within each region, and leave blank if not applicable)																			
F: Process number(01 to 99, in ascending order within each commodity)																			
G: Input mix number(1 to 9, in ascending order with each process)																			
H: Net manufacturing cost in common currency																			
I: Base period manufactured quantity																			
J: Output elasticity of manufacture cost, $s \geq 0$																			
-> Record type P (manufacturing coefficients) :																			
B: Region number (01 to 99, in ascending order)																			
D: Input commodity number (01 to 99, in ascending order within each output commodity)																			
E: Output commodity number (01 to 99, in ascending order within each region)																			
F: Process number(01 to 99, in ascending order within each commodity)																			
H: Amount of input commodity per unit of output commodity																			
-> Record type B (by-product coefficients) :																			
B: Region number (01 to 99, in ascending order)																			
D: Primary commodity number (01 to 99, in ascending order within each output commodity)																			
E: Secondary commodity number (01 to 99, in ascending order within each region)																			
F: Process number(01 to 99, in ascending order within each commodity)																			
G: Input mix number(1 to 9, in ascending order)																			
H: Amount of secondary commodity per unit of													Calculated from model solution						
													Manufacturing cost	Difference	%Diff	Quantity manufactured	Difference	%Diff	Price
M	83	10	1	123.3264	13	0.10							123.3	-0.0264	0	13.0000	0.0000	0	223.7
M	84	10	1	358.4012	25	0.10							358.4	-0.0012	0	25.0000	0.0000	0	539.7
M	85	10	1	122.4376	24	0.10							122.4	-0.0376	0	24.0000	0.0000	0	220
M	87	10	1	132.7360	135	0.10							132.7	-0.0360	0	14.0000	0.0500	5	280
M	88	10	1	280.6795	6.83	0.10							280.7	0.0205	0	6.8000	-0.0300	-3	448.4
M	92	10	1	488.4779	14	0.10							488.5	0.0221	0	14.0000	0.0000	0	933.8
M	93	10	1	536.1185	27	0.10							536.1	-0.0185	0	27.0000	0.0000	0	815.4
M	83	10	1	1.0000	5	0.10							1	0.0000	0	5.0000	0.0000	0	132
M	84	10	1	32.8182	11	0.10							32.8	-0.0182	0	11.0000	0.0000	0	336

The TRANSPORTATION sheet shows the difference between the computed and input trade, and the difference between the calculated and input price (observed price= world price +

transport cost). To handle bilateral trade flows, another sheet "TransAggregated" shows total imports and exports from each country.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
***** TRANSPORTATION COST AND TAX *****																			
A: Origin region number (01 to 99)																			
C: Destination region number (01 to 99, in ascending order within each origin)																			
E: Commodity number (01 to 99, in ascending order within each origin-destination)																			
F: Freight cost of shipping one unit of commodity from origin to destination																			
G: Import ad-valorem tax rate																			
H: Export ad-valorem tax rate																			
I: Base period quantity shipped from origin region to destination region																			
J: Mean elasticity of trade with respect to GDP (>=0; 0 for fixed trade, no trade, or free trade)																			
K: Trade inertia bounds as fraction of trade (>= 0; 0 for fixed trade; -1 for no trade; 1 for Calculated by model, and difference with input data)																			
L: Base period price of commodity in exporting country																			
														Trade	Difference	%Diff	Price	Difference	%Diff
a1	22	81	0.00	0.000	0.00	1	0	0.0001	66	1	0	0	66	0	0				
a2	22	83	0.00	0.000	0.00	2	0	0.0001	192	2	0	0	192	0	0				
a4	22	81	0.00	0.000	0.00	1	0	0.0001	66	1	0	0	66	0	0				
a5	22	81	0.00	0.000	0.00	4	0	0.0001	66	4	0	0	66	0	0				
a6	22	81	0.00	0.000	0.00	219	0	0.0001	66	219	0	0	66	0	0				
2v	22	81	0	0.00	0.00	6171	0.00	0.0001	0	6171	0	0	0	0	0				
2v	22	84	0	0.00	0.00	288	0.00	0.0001	0	288	0	0	0	0	0				
2v	22	86	0	0.00	0.00	2030	0.00	0.0001	0	2030	0	0	0	0	0				
22	a0	91	24	0.05	0.00	29	0.00	0.0001	472	29	0	0	520.8	-1.1E-13	0				
22	a0	92	46	0.15	0.00	53	0.00	0.0001	766	53	0	0	933.8	0	0				
22	a0	93	40	0.15	0.00	39	0.00	0.0001	669	39	0	0	815.4	0.05	0				
22	a1	86	10	0.24	0.00	1	0.00	0.0001	262	1	0	0	337.3	0.02	0				
2v	80	0.00	0.000	0.00	0.00	1144	0	0.0001	0	1144	0	0	0	0	0				
2v	83	0.00	0.000	0.00	0.00	2736	0	0.0001	0	2736	0	0	0	0	0				
2v	85	0.00	0.000	0.00	0.00	367	0	0.0001	0	367	0	0	0	0	0				
2v	91	0.00	0.000	0.00	0.00	522	0	0.0001	0	522	0	0	0	0	0				
2v	92	0.00	0.000	0.00	0.00	1755	0	0.0001	0	1755	0	0	0	0	0				

The NET TRADE sheet shows the difference between the input and calculated net trade. The country code, such as a0 for Algeria, is joined to the commodity code, such as 80 for fuelwood.

	A	B	C	D	E
1	Country code	Actual net trade	Calculated by model	Difference	% Diff
2	a080	0	0	0	
3	a081	-29	-29	0	0
4	a082	0	0	0	
5	a083	-935	-935	0	0
6	a084	-120	-120	0	0
7	a085	-7	-7	0	0
8	a086	-6	-6	0	0
9	a087	0	0	0	
10	a088	-17	-17	0	0
11	a089	0	0	0	
12	a090	0	0	0	
13	a091	-29	-29	0	0
14	a092	-53	-53	0	0
15	a093	-99	-99	0	0
16	a180	0	0	0	
17	a181	1	1	0	0

6 Updating historical and base year data in summary output tables and graphs

Clicking *Update Historical Data* in the calibration menu (p. 15) updates the historical data from 1992 to the base year in the output workbooks SUMMARYCHANGE.XLS , OUTPUT.XLS, and SUMMARY.XLS with the latest data downloaded from the FAO and World Bank data bases.

All prices and values are expressed in constant US dollars of the base year. This updating may be done as soon as the FAO and World Bank data have been downloaded (see section 2). It can be done before or after base-year calibration. However, it should be done before base-year calibration if the base year is to reflect the more recent data.

7 Adding bilateral trade data to WORLD.XLS

The *Add Bilateral Trade* option of the calibration menu (p. 16) allows data on bilateral trade flows to be added to WORLD.XLS. The input data are in the BILATERALTRADE.XLS workbook in the C:\GFPM\INPUT\ directory (Figure 4).

	A	B	C	D	E	F	G	H	I	J	
	Exporter	Code	Importer	Code	Import	GOPElas	Bound	Tariff	FreightFactor	ExporterPrice	
1	Canada	f3	Mexico	g5	30	0.97	0.050	0.05	0.14	198.0	
2	Canada	f3	USA	h1	45059	0.97	0.050	0	0.14	198.0	
3	Canada	f3	Chile	h5	3	0.97	0.050	0.08	0.14	198.0	
4	Canada	f3	China	j1	57	0.97	0.050	0.03	0.14	198.0	
5	Canada	f3	Japan	j9	8007	0.97	0.050	0.002	0.14	198.0	
6	Canada	f3	Australia	m4	399	0.97	0.050	0.05	0.14	198.0	
7	Canada	f3	ROW	zz	2565	0	0.050	0	0	198.0	
8	Mexico	g5	Canada	f3		0.97	0.050	0	0.14	237.0	
9	Mexico	g5	USA	h1	260	0.97	0.050	0	0.14	237.0	
10	Mexico	g5	Chile	h5		0.97	0.050	0.08	0.14	237.0	
11	Mexico	g5	China	j1		0.97	0.050	0.03	0.14	237.0	
12	Mexico	g5	Japan	j9	2	0.97	0.050	0.002	0.14	237.0	
13	Mexico	g5	Australia	m4		0.97	0.050	0.05	0.14	237.0	
14	Mexico	g5	ROW	zz	0	0	0.050	0	0	237.0	
15	USA	h1	Canada	f3	1718	0.97	0.050	0	0.14	226.0	
16	USA	h1	Mexico	g5	783	0.97	0.050	0.05	0.14	226.0	
17	USA	h1	Chile	h5	3	0.97	0.050	0.08	0.14	226.0	
18	USA	h1	China	j1	203	0.97	0.050	0.03	0.14	226.0	
19	USA	h1	Japan	j9	1245	0.97	0.050	0.002	0.14	226.0	
20	USA	h1	Australia	m4	70	0.97	0.050	0.05	0.14	226.0	
21	USA	h1	ROW	zz	3757	0	0.050	0	0	226.0	
22	Chile	h5	Canada	f3	12	0.97	0.050	0	0.14	198.0	
23	Chile	h5	Mexico	g5	12	0.97	0.050	0.05	0.14	198.0	
24	Chile	h5	USA	h1	774	0.97	0.050	0	0.14	198.0	
25	Chile	h5	China	j1	4	0.97	0.050	0.03	0.14	198.0	
26	Chile	h5	Japan	j9	478	0.97	0.050	0.002	0.14	198.0	
27	Chile	h5	Australia	m4	1	0.97	0.050	0.05	0.14	198.0	
28	Chile	h5	ROW	zz	654	0	0.050	0	0	198.0	
29	China	j1	Canada	f3	2	0.97	0.050	0	0.14	233.0	
30	China	j1	Mexico	g5		0.97	0.050	0.05	0.14	233.0	
31	China	j1	USA	h1	51	0.97	0.050	0	0.14	233.0	
32	China	j1	Chile	h5		0.97	0.050	0.08	0.14	233.0	
33	China	j1	Japan	j9	494	0.97	0.050	0.002	0.14	233.0	
34	China	j1	Australia	m4	1	0.97	0.050	0.05	0.14	233.0	
35	China	j1	ROW	zz	199	0	0.050	0	0	233.0	
36	Japan	j9	Canada	f3		0.97	0.050	0	0.14	230.0	
37	Japan	j9	Mexico	g5		0.97	0.050	0.05	0.14	230.0	
38	Japan	j9	USA	h1		0.97	0.050	0	0.14	230.0	
39	Japan	j9	Chile	h5		0.97	0.050	0.08	0.14	230.0	
40	Japan	j9	China	j1	3	0.97	0.050	0.03	0.14	230.0	
41	Japan	j9	Australia	m4		0.97	0.050	0.05	0.14	230.0	
42	Japan	j9	ROW	zz	12	0	0.050	0	0	230.0	
43	Australia	m4	Canada	f3		0.97	0.050	0	0.14	237.0	
44	Australia	m4	Mexico	g5		0.97	0.050	0.05	0.14	237.0	
45	Australia	m4	USA	h1	9	0.97	0.050	0	0.14	237.0	
46	Australia	m4	Chile	h5		0.97	0.050	0.08	0.14	237.0	
47	Australia	m4	China	j1	9	0.97	0.050	0.03	0.14	237.0	
48	Australia	m4	Japan	j9	25	0.97	0.050	0.002	0.14	237.0	
49	Australia	m4	ROW	zz	236	0	0.050	0	0	237.0	
50	ROW	zz	Canada	f3	114	0.97	0.050	0	0.14	198.0	
51	ROW	zz	Mexico	g5	58	0.97	0.050	0.05	0.14	198.0	
52	ROW	zz	USA	h1	4093	0.97	0.050	0	0.14	198.0	
53	ROW	zz	Chile	h5	10	0.97	0.050	0.08	0.14	198.0	
54	ROW	zz	China	j1	2267	0.97	0.050	0.03	0.14	198.0	
55	ROW	zz	Japan	j9	8264	0.97	0.050	0.002	0.14	198.0	
56	ROW	zz	ROW	zz							

Bilateral trade volume for sawnwood exports from Canada to Australia

GDP elasticity, tariff and freight factor, zero for trade to rest of world.

Fuelwood IndRound Sawnwood Plywood ParticleB FiberB Mec

Figure 4: Example of data stored in BILATERALTRADE.XLS.

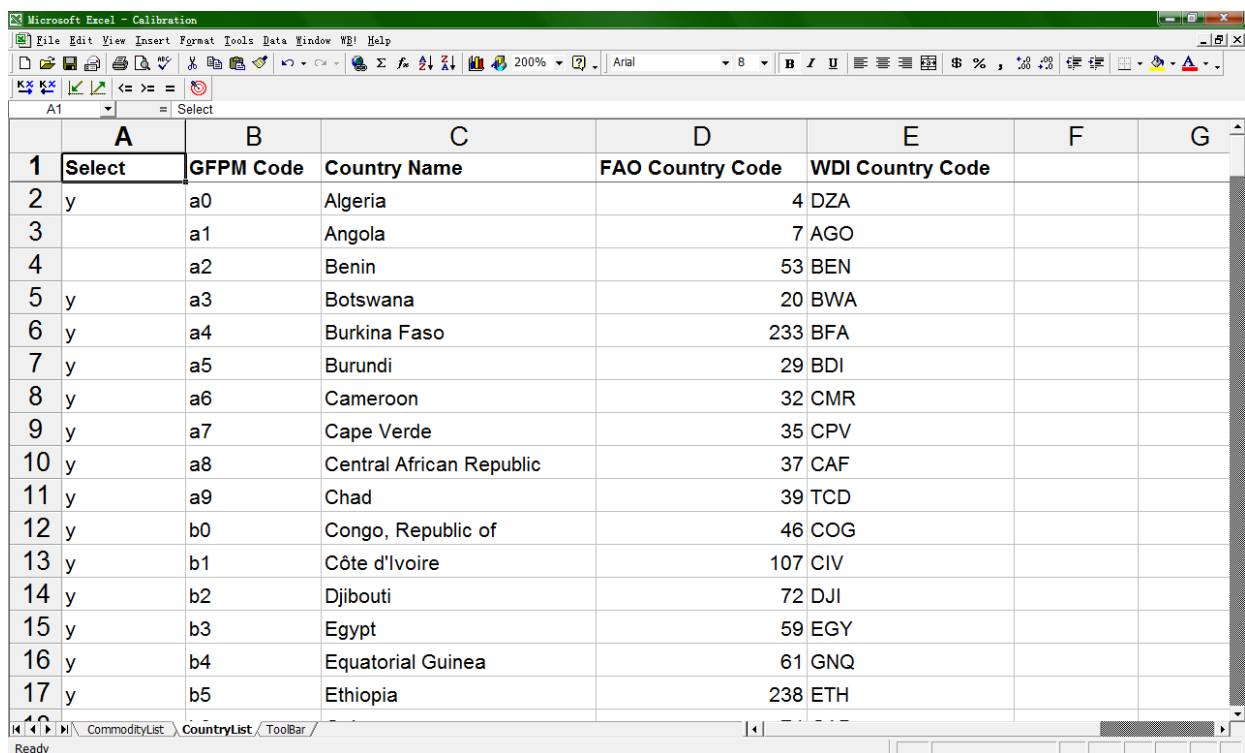
The worksheets in BILATERALTRADE.XLS are similar to the *Transportation* worksheet in WORLD.XLS (see the GFPM User Manual (Zhu et al. 2008a)). The data must be sorted by the code of the exporter, then by the code for the importer.

The sum of exports from each country in BILATERALTRADE.XLS must equal the total exports in WORLD.XLS. For example, the sum of Canadian exports to Mexico, USA, Chile, China, Japan, Australia and the rest of the world (ROW) must equal total Canadian sawnwood exports; 5 6120 thousand m³ in the example (Figure 4).

8 Adding/removing countries and commodities

8.1 Removing countries

To remove countries, delete “y” in the “Select” column of the “CountryList” sheet of C:\GFPM\CALIBRATION.XLS. For example, to remove Angola and Benin, delete the “y” in the “Select” column for these two countries. GFPM will not calibrate data for these two countries and the final WORLD.XLS will not include them.



	A	B	C	D	E	F	G
1	Select	GFPM Code	Country Name	FAO Country Code	WDI Country Code		
2	y	a0	Algeria		4 DZA		
3		a1	Angola		7 AGO		
4		a2	Benin		53 BEN		
5	y	a3	Botswana		20 BWA		
6	y	a4	Burkina Faso		233 BFA		
7	y	a5	Burundi		29 BDI		
8	y	a6	Cameroon		32 CMR		
9	y	a7	Cape Verde		35 CPV		
10	y	a8	Central African Republic		37 CAF		
11	y	a9	Chad		39 TCD		
12	y	b0	Congo, Republic of		46 COG		
13	y	b1	Côte d'Ivoire		107 CIV		
14	y	b2	Djibouti		72 DJI		
15	y	b3	Egypt		59 EGY		
16	y	b4	Equatorial Guinea		61 GNQ		
17	y	b5	Ethiopia		238 ETH		

8.2 Removing commodities

To remove commodities, delete “y” in the “Select” column of the “commodityList” sheet in C:\GFPM\CALIBRATION.XLS. For example, to remove “othIndRound”, delete the “y” in the “Select” column for this commodity. GFPM will not calibrate data for this commodity in any country, and the final WORLD.XLS will totally exclude this commodity.

No commodity should be removed without full recognition of the effect on the representation of the entire forest sector.

	A	B	C	D	E	F	G	H
	Select	Commodity Code	Commodity Name	Final Product	Raw Material	Manufactured	Recycled	
2	y	80	Fuelwood	1	1	0	0	
3	y	81	IndRound	0	1	0	0	
4		82	OthIndRound	1	1	0	0	
5	y	83	Sawnwood	1	0	1	0	
6	y	84	Plywood	1	0	1	0	
7	y	85	ParticleB	1	0	1	0	
8	y	86	FiberB	1	0	1	0	
9	y	87	MechPlp	0	0	1	0	
10	y	88	ChemPlp	0	0	1	0	
11	y	89	OthFbrPlp	0	1	0	0	
12	y	90	WastePaper	0	1	0	0	
13	y	91	Newsprint	1	0	1	1	
14	y	92	PWPaper	1	0	1	1	
15	y	93	OthPaper	1	0	1	1	
16								
17	Note:							
18	1) Final Product:	1 final product or demanded product, 0 otherwise						
19	2) Raw Material:	1 raw material or supplied product, 0 otherwise						
20	3) Manufactured:	1 manufactured product, 0 otherwise						

8.3 Replacing or adding countries

To replace a country by another, change the country name, its FAO country code, and its WDI (World Bank Indicator) country code in the “CountryList” sheet in C:\GFPM\CALIBRATION.XLS. Select this country with a “y”. Also modify the country name lists in all sheets of C:\GFPM\input\InputData_Blank.xls to make them the same as in the “CountryList” sheet.

To add countries, modify the “CountryList” sheet of C:\GFPM\CALIBRATION.XLS by adding “y” in the “Select” column if the countries to be added already exist in the current list. Otherwise, add the countries to the list with their GFPM, FAO, and WDI county codes. The new GFPM country codes must be of the same form, but not duplicate the code of other countries, and the list of GFPM country codes after changing or adding countries must be in ascending order.

After modifying the “CountryList” sheet, also change all sheets of C:\GFPM\input\InputData_Blank.xls to add model parameters for each replacing and added country. The country lists on these sheets should be the same as that of the selected countries in the “CountryList” sheet.

If the replaced or added countries are not within the default list of 180 countries in GFPM but are within the downloaded data files in C:\GFPM\input\inputFiles folder, delete the file C:\GFPM\input\inputFiles\ProcessedRawData.xls, or save it with other name, to force GFPM to retrieve the raw data from the downloaded FAO and World Bank data files in the C:\GFPM\input\inputFiles folder. If these data files do not contain the required data, update them by re-downloading or directly modifying the downloaded file. In that case, GFPM will automatically produce a new ProcessedRawData.xls.

8.4 Adding commodities

This requires several manual steps and an understanding of the relationship among GFPM commodities.

First, modify the “CommodityList” sheet of C:\GFPM\CALIBRATION.XLS. The new commodity must be inserted at the beginning of the list, before “Fuelwood” (code 80), with commodity code 79. Another commodity would be inserted above it with the code 78, and so on, down to commodity code 10. For each commodity, indicate if it is a final product, a raw material, a manufactured product, or a recycled product.

Second, add a sheet in C:\GFPM\input\InputData_Blank.xls and give it the name of the new commodity. Insert for this new commodity the same data as for existing commodities such as sawnwood or newsprint.

Third, complete rows and columns in the “InputOutput” sheet of C:\GFPM\input\Calibrate_Blank.xls as for existing commodities.

Fourth, download the required data from FAO or other sources and save the data in the same format as other files containing data for other commodities. The file name should be the same as the commodity name and is stored in the folder C:\GFPM\input\InputFiles like the other data files. GFPM will detect the newly added data files and produce a new ProcessedRawData.xls.

9 References

- BUONGIORNO, J.; LIU, C-S; TURNER, J. 2001: Estimating international wood and fiber utilization accounts in the presence of measurement errors. *Journal of Forest Economics* 7(2): 101-124
- BUONGIORNO, J.; ZHU, S-S, ZHANG, D.; TURNER, J.A.; TOMBERLIN, D. 2003. *The Global Forest Products Model (GFPM): Structure, Estimation, and Applications*. Kluwer Academic Press, San Diego.
- BUONGIORNO, J. and S. Zhu. 2012. Using the Global Forest Products Model (GFPM version 2012). Staff Paper Series #74. Department of Forest Ecology and Management, School of Natural Resources, College of Agricultural and Life Sciences, University of Wisconsin-Madison, USA. <http://fwe.wisc.edu/facstaff/Buongiorno/book/GFPM.htm>

10 Mathematical formulation

10.1 Data smoothing

When smoothing is specified in the calibration menu, the raw data are smoothed with a 3-year moving average:

$$S_t = \frac{1}{3}(R_{t-1} + R_t + R_{t+1}) \quad \text{for } t = t_B - 2 \text{ to } t_B$$

where S_t is the smoothed data in year t , R_t is the raw data, t_0 is the first year of data and t_B is the base year for which the GFPM is calibrated.

10.2 Static calibration

The static calibration calibrates the GFPM for a particular base year. Estimates of the I-O coefficients for a particular country and year are obtained with goal programming, conditional on the trade data and on prior bounds on the I-O coefficients. The method minimizes a function of the difference between estimated and reported production, and of the difference between estimated consumption and consumption implied by the prior I-O coefficients. In the following formulation all the variables refer to a specific country and year.

Objective function:

$$\min Z = \beta \sum_i (Y_i^+ + Y_i^-) w_i + (1 - \beta) \sum_i \sum_j (Y_{ij}^+ + Y_{ij}^-) (w_i w_j)^{1/2} \quad [1]$$

Deviation of estimated from reported production:

$$Y_i - q_i + Y_i^- - Y_i^+ = 0 \quad \forall i \quad [2]$$

Deviation of estimated from expected input:

$$Y_{ij} - a_{ij} Y_j + Y_{ij}^- - Y_{ij}^+ = 0 \quad \forall i, j \quad [3]$$

Material balance:

$$Y_i - \sum_j Y_{ij} + m_i - x_i = 0 \quad \forall i \in R \quad [4.1]$$

$$Y_i - \sum_j Y_{ij} + m_i - x_i \geq 0 \quad \forall i \in F \quad [4.2]$$

Feasible range of input i for output j :

$$Y_j a_{ij}^L \leq Y_{ij} \leq Y_j a_{ij}^U \quad \forall i, j \quad [5.1, 5.2]$$

Feasible range of total inputs for output j (current inputs are 4 fibers):

$$Y_j a_j^L \leq \sum_i Y_{ij} \leq Y_j a_j^U \quad \forall j \quad [6.1, 6.2]$$

Feasible post-consumer recovery:

$$\sum_j (Y_j - \sum_j Y_{ij} + m_j - x_j) r_{ij}^L \leq Y_i \leq \sum_j (Y_j - \sum_j Y_{ij} + m_j - x_j) r_{ij}^U \quad \forall i \quad [7.1, 7.2]$$

Feasible total manufacturing cost:

$$c_j^L Y_j \leq w_j Y_j - \sum_i Y_{ij} w_i \leq c_j^U Y_j \quad \forall j \quad [8.1, 8.2]$$

Input-output coefficient after solving [1] to [8]:

$$A_{ij} = \frac{Y_{ij}}{Y_j} \quad \forall i, j \quad [9]$$

Sets and input data:

- i, j : Products
- F : Set of final products
- R : Set of raw materials or intermediate products
- β : weight of official data vs. prior input-output data.
- w_i : local price of product i .

q_i, m_i, x_i : reported data on production, imports, and exports.

a_{ij}^L, a_{ij}^U : lower, upper bound on input i per unit of output j .

$a_{ij} = (a_{ij}^L + a_{ij}^U) / 2$: expected input i per unit of output j .

a_j^L, a_j^U : lower, upper bound on total input per unit of output j .

r_{ij}^L, r_{ij}^U : lower, upper bound on recycling of product j into product i .

a_j^L, a_j^U : lower, upper bound on unit manufacturing cost of output j .

Choice variables, all non-negative:

Y_i : estimated production of product i .

Y_i^+, Y_i^- : estimated production above, or below, reported production of product i .

Y_{ij} : estimated input i in output j .

Y_{ij}^+, Y_{ij}^- : estimated input above, or below, input implied by prior input-output coefficients.

Other variables:

A_{ij} : computed I-O coefficient.

10.3 Dynamic calibration

Dynamic calibration with smoothed or unsmoothed data (see data smoothing procedure above) follows the following steps:

- 1) A static calibration is performed for each year t_{B-2} to t_B to get preliminary I-O coefficients, A_{ijt} , with the method described in section 10.2.
- 2) Each final base-year I-O coefficient A_{ijtB} is the average of the preliminary I-O coefficients for the years from t_{B-2} to t_B if there is at least one preliminary coefficient. If all the preliminary I-O coefficient are missing, then there is no I-O coefficient entry for this commodity of this country.
- 3) The corresponding calibrated production, imports, exports, and prices data are also averaged over t_{B-2} to t_B .
- 4) The manufacturing costs are calculated based on the final I-O coefficients and the price data. If the manufacturing cost is negative, for wood products the I-O coefficient is reduced by 1% steps until the manufacturing cost is larger than 0.1, for paper products the I-O coefficient of the most expensive input is reduced and the coefficient of the cheapest input is increased by 1% steps until the manufacturing cost is larger than 0.1.
- 5) The intermediate and raw materials production are calculated based on the final I-O coefficients and the consumption of final products resulting from step 3).

- 6) The waste paper recovery rates are calculated based on the final I-O coefficients, and the consumption of waste paper and production of paper and paperboard resulting from step 3).