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# BioSAMs for the EU Member States

*Constructing Social Accounting Matrices with a detailed disaggregation of the bio-economy*

Alfredo J. Mainar Causapé

*Editor:* George Philippidis

*Collaborator:* Arnaldo Caivano

Joint Research Centre

EUR 29235 EN

**Contact information**
Name: Alfredo J. Mainar Causapé
Address: c/ Inca Garcilaso 3, Edificio Expo, 41092 Seville, Spain
Email: alfredo.mainar-causape@ec.europa.eu
Tel.: +34 95 44 88313

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# Contents

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***Authors***

**Alfredo J. Mainar Causapé** is with the Joint Research Centre (JRC.D.4, Seville).

**George Philippidis** is with the Joint Research Centre (JRC.D.4, Seville).

**Arnaldo Caivano** is with the Joint Research Centre (JRC.D.4, Seville).

## Abstract

The bio-based economy will be crucial in achieving sustainable development, covering all ranges of natural resources. In this sense, it is very relevant to analyse the economic links between the bioeconomic sectors and the rest of the economy, determining their total and decomposed impact on economic growth. One of the major problems in carrying out this analysis is the lack of information and complete databases that allow analysis of the bioeconomy and its effects on other economic activities. To overcome this issue, highly disaggregated (in biobased and agriculture sectors) Social Accounting Matrices of the 28 European Union member states (and one EU28 aggregate) have been estimated. This report presents this set of Social Accounting Matrices, called BioSAMs, describing its specific structure and the basis for its estimation.

# 1 Introduction

Bioeconomy comprises several economic sectors, academic disciplines and areas of policy. It encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bio-energy. In this way, Bioeconomy are grouped in different sectors of the economy that produce, process, and re-used renewable biological resources (agriculture, forestry, fishing, chemicals, food and bio-based materials and bio-energy). It is therefore of great interest to analyse the possible impacts of sectoral policies, at national or regional level, as well as cross-sectoral policies related (environment, climate change, the circular economy, waste, industrial policies, innovation and regional policies, etc.), to deal with societal challenges such as increasing food demand or climate change.

In this context of growing relevance and interest in the analysis of Bioeconomy, both at academic level (McCormick and Kautto, 2013; Fritsche and Iriarte, 2014 M'barek et al., 2014; Philippidis et al., 2014) and political and institutional level (Bell et al., 2018; EC, 2012; EC, 2014), a major barrier to analyse the activities of the Bioeconomy is the lack of available data. More specifically, in the framework of the standard National Accounts, Bioeconomy activities are generally represented as broad sectoral aggregates (i.e. agriculture, food processing, forestry, fisheries, wood, pulp) or even subsumed within their parent sectors (for example, chemical industries, clothing, energy). In a first attempt to solve this problem, the Joint Research Centre (JRC) of the European Commission launched an ambitious project to identify the significant primary agricultural activities for the year 2000: The estimate of a Social Accounting Matrix (SAM) by Member State, dubbed "AgroSAM", with a specific breakdown of the primary sector for each Member State for the year 2000 (Müller et al., 2009). Subsequently, the database was updated to a 2007 AgroSAM (Philippidis et al. 2014), using statistical analyses to derive the structural patterns within the bio-based products sector for groups of Member States of the EU.

Continuing this research line, this report presents a new set of SAMs specifically designed for the study of the Bioeconomy and natural resources, referred to as the BioSAMs. The study maintains the sectoral breakdown of the agricultural and agro-food industries used in the AgroSAMs, whilst providing explicit representation of the current uses of biomass in the areas of bioenergy, bio-chemicals and bio-based industries. Also, the BioSAMs not only capture the inter-industry and final demand relations inherent within the input-

output (IO) tables, but also record details of the links between factors and institutions which complete the full circular flow ([1]) within an economic system.

To the best of our knowledge, this is currently the most complete multisectorial database that exists with detailed coverage on the bioeconomy sectors and their links with the rest of activities and institutional sectors (Households, Government, Corporations, ...), both for the EU as an aggregate and for each of its 28 Member States.

([1]) More specifically, input-output tables do not detail the generation of institutional incomes through the interaction between institutional and factor accounts, which in turn, funds institutional expenditures on product markets.

# 2 Social Accounting Matrices. Concept and general issues.

A SAM is the reference database for all Computable General Equilibrium (CGE) modellers. A SAM is a comprehensive and economy-wide database recording data on all transactions between economic agents in an economy over a certain period of time. The scientific value of the SAM is twofold: firstly, it represents a complete but intuitive structural snapshot picture of the economy under consideration and secondly, provides data for economic modelling (multi-sectorial linear models or the more complex CGE models). A SAM extends the traditional Input-Output (IO) tables([2]), not by using of satellite accounts, but in an integrated way and in the same table or matrix SAMs use a more disaggregated income and expenditure structure reflecting the integration of the links of the institutional sectors with productive activities, commodities (goods and services) and intermediate inputs as well as themselves. To achieve this aim, the main sources are statistical systems of National Accounts, together with socio-economic statistical operations, such as household budget surveys and similar, labour force surveys or those dealing with the behaviour of the foreign sector and trade.

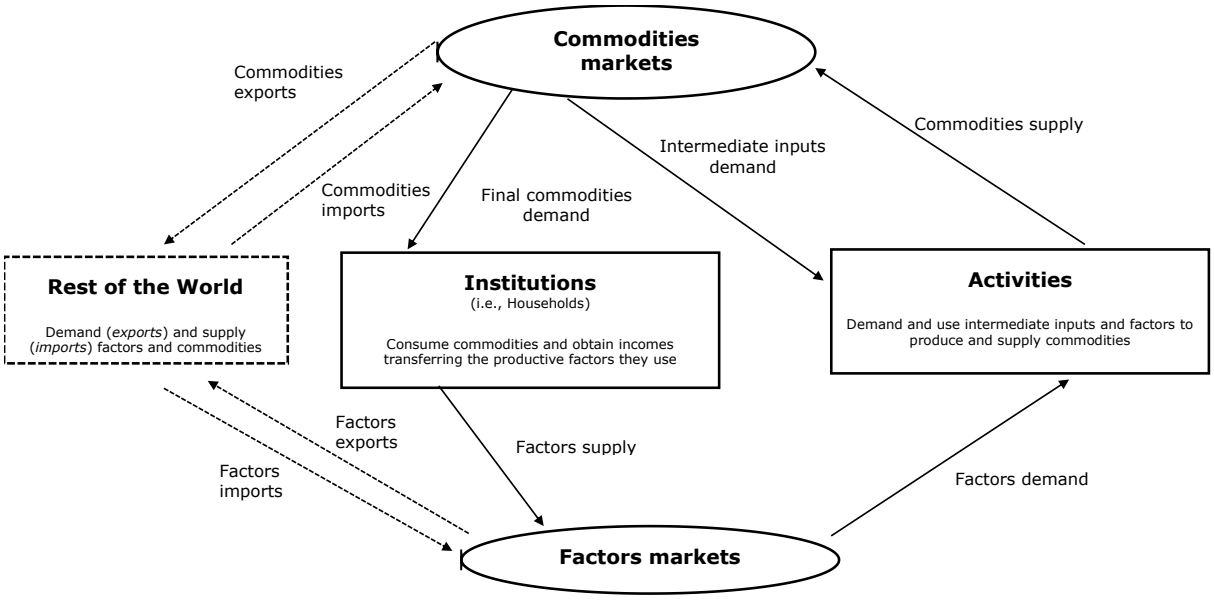
The concept of a SAM begins with Stone (1947), whose pioneering work includes most of the conventions which would later be adopted by economic and statistical organisations developing this tool. Pyatt and Thorbecke (1976) subsequently formalised the concept of a SAM which paved the way for its use as a formal framework for economic analysis and planning (see also Pyatt and Round, 1985) in areas such as employment, poverty, growth and income distribution, trade, etc. Furthermore, through the inclusion of data on households' behaviour taken from the National Accounts, a SAM also captures macro transactions of an economic system based on micro level transfers between all agents in the economy (Pyatt and Round, 1985; Reinert and Roland-Holst, 1997). Indeed, the structure of income distribution within an economy can also be captured by disaggregating the households using socio-economic characteristics (e.g. income level, rural-urban division, etc.).

The underlying foundation of a SAM is the concept of the circular flow of income. The concept of the 'circular-economy' or 'circular-flow' is represented ([3]) in Figure 1.

([2]) Input-output analysis primary aim is to provide a tool to analyse the production side of the economy, focussing on the intermediate input requirements and final outputs of industries. In a sense, the Social Accounting Matrices are an extension of the Input-Output analysis, but even though the traditional Input-Output framework has served as a key tool of economic analysis (Leontief, 1936), providing a useful description, explanation and analysis of multi-sectorial relations, the usefulness of many of these analyses is limited in the attempt to reflect the complete behaviour of the economic system, since it does not incorporate all economic transactions in the system (the circular flow). To overcome this limitation, one preferred option is to build a SAM.

([3]) The circular flow is actually more complicated, encompassing multiple transactions between institutions (savings, direct taxes, transfers, etc.) other flows as taxes on commodities or activities. In principle, however, the basics of the circular flow remain.

**Figure 1.** The circular flow (simple version)




*Source:* Own elaboration

In this way, the objective of closing the circular flow of income is explicit, as a SAM reflects the full process of production, trade, income generation and its redistribution between institutional sectors (Pyatt and Round, 1985; Pyatt and Thorbecke, 1976). This allows one, assuming a savings-investment accounts balance and the households budget constraint (implicit by definition in the SAM), to perform a reliable analysis of the distribution of wealth and income. It should, however, be noted that some problems of I-O frameworks are still present in the SAMs, most notably the use of coefficients and fixed prices for inputs and finished products.

Notwithstanding, the estimation of a SAM contributes itself to the study of any economic system, since it collects in detail most of a country's macroeconomic (and even microeconomic) transactions. But its usefulness as a database is enormous, both in the direct application of multi-sector linear models (multiplier analysis) and as a basis for the calibration of sophisticated CGE models. It is also flexible in its structure, its geographical coverage (national, regional, multi-regional, etc.) and time frame, allowing its use in the analysis of multitude of economic issues.

The structure of the SAM database is represented by a square matrix in which each account (representative of an activity, commodity, factor or institutional sector) is represented by a row and a column. Each cell shows the payment from the column account to the row account. Therefore, "receipts" or incomes to an account are represented by rows and "expenditures/payments" by accounts by columns. As a result of the double entry bookkeeping system of accounting for each account in a SAM, its total revenues correspond exactly to the total payments, and, as a result, the total of each row corresponds to the corresponding column.

Typically, a Social Accounting Matrix has six basic groups of accounts:

— Activities or Commodities (or both, separated)

— (Production) Factors

— (Private) Institutions - Households and Corporations/Enterprises-

— Government (public institution)

— (Combined) Capital accounts

— Accounts for the Rest of the World.

The final dimensions of the matrix are determined by the level of disaggregation of these six basic groups. Figure 2 shows the basic structure of a standard SAM and illustrates the complexity of the works necessary to compile it ([4]). It should also be noted that the concepts and assumptions underlining a SAM are flexible and many alternative structures are feasible.

([4]) The general characteristic of this structure, as well as specific issues of its definition and composition can be found in European Commission (2013), Eurostat (2008a), Mainar et al. (2018) and Miller and Blair (2009).

**Figure 2.** A Social Accounting Matrix (SAM) standard structure

| | **Commodities** | **Margins** | **Activities** | **Factors** | **Households** | **Enterprises / Corporations** | **Government** | **Savings-Investment** | **Rest of the World** | ***Total*** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Commodities (C)** | | **$T_{C,M}$** Transaction costs (trade / transport) | **$T_{C,A}$** Intermediate (inputs) consumption | | **$T_{C,H}$** Household consumption | | **$T_{C,G}$** Government expenditure | **$T_{C,S-I}$** Investment and stock changes | **$T_{C,RoW}$** Exports | *Demand* |
| **Margins (M)** | **$T_{M,C}$** Transaction costs (trade / transport) | | | | | | | | | *Margins* |
| **Activities (A)** | **$T_{A,C}$** Domestic production | | | | | | | | | *Gross output / Production (activity income)* |
| **Factors (F)** | | | **$T_{F,A}$** Remuneration of factors / Factor income | | | | | | **$T_{F,RoW}$** Factor income from RoW | *Factor income* |
| **Households (H)** | | | | **$T_{H,F}$** Factor income distribution to households | ***($T_{H,H}$)*** *(Inter Households transfers)* | **$T_{H,E}$** Distribution of corporations income to households | **$T_{H,G}$** Government transfers to households | | **$T_{H,RoW}$** Transfers to Households from RoW | *Household income* |
| **Enterprises / Corporations (E)** | | | | **$T_{E,F}$** Factor income distribution to enterprises | | | **$T_{E,G}$** Government transfers to enterprises | | **$T_{E,RoW}$** Transfers to Enterprises from RoW | *Enterprise income* |
| **Government (G)** | **$T_{G,C}$** Net taxes on products | | **$T_{G,A}$** Net taxes on production | **$T_{G,F}$** Factor income to Government / Factor taxes | **$T_{G,H}$** Direct Household taxes / Transfers to Government | **$T_{G,E}$** Direct Enterprise taxes / Transfers to Government | | | **$T_{G,RoW}$** Transfers to Government from RoW | *Government income* |
| **Savings-Investment (S-I)** | | | | ***($T_{S-I,F}$)*** *(Depreciation)* | **$T_{S-I,H}$** Household savings | **$T_{S-I,E}$** Enterprise savings | **$T_{S-I,G}$** Government savings | ***($T_{S-I,S-I}$)*** *(Capital accounts transfers)* | **$T_{S-I,RoW}$** Capital transfers from RoW (Balance of Payments) | *Savings* |
| **Rest of the World (RoW)** | **$T_{RoW,C}$** Imports | | | **$T_{RoW,F}$** Factor income distribution to RoW | **$T_{RoW,H}$** Household transfers to RoW | **$T_{RoW,E}$** Corporations income to Row | **$T_{RoW,G}$** Government transfers to RoW | | | *Payments to RoW* |
| ***Total*** | *Supply* | *Margins* | *Costs of production activities* | *Expenditure on factors* | *Household expenditure* | *Enterprise expenditure* | *Government expenditure* | *Investment* | *Incomes from RoW* | |

*Source:* Mainar et al. (2018).

## Activities and Commodities (goods and services)

The Activity accounts represent the agents carrying out the production of Commodities, representing goods and services which are not factors of production. The SAM flows can be valued at production costs in the accounts of Activities and at market prices (including indirect taxes on raw materials and transaction costs or margins) in the Commodities accounts. The sum of values of Activities is the domestic production (at production prices). When one adds imports, net taxes on products and margins, the total supply of commodities (at purchaser's prices) is obtained. Supplied commodities are sold domestically or exported.

The Activity accounts columns detail the cost structures in production and payments to factors. More specifically, these column cells show the use of Commodities as intermediate inputs, and primary factor demands (i.e., labour, capital, etc., quantified by salaries, wages, mixed income, rents, interest, etc.). The amount of such remuneration to the factors, together with taxes paid and less subsidies received on production, results in the value added by Activities. For the Activity accounts rows, the cell entries show the value of the Commodities produced, identifying the commodities made by each Activity. Usually, only incomes to the activity accounts from the sale of commodities are recorded.

The Commodities column accounts collect the domestic production by Activities, imports (Rest of the World accounts) and the payment of taxes -including VAT ([5])- or the receipt of subsidies on domestic and imported products (from the Government account). Thus, Commodities account supply is valued at purchaser's prices. By rows, the Commodities accounts record the intermediate consumption (by Activities) and the final demand consumption of institutional sectors (Household and Government) as well as investments and exports.

Regarding margins, in a SAM, trade flows (national and international) are associated with the transaction costs (trade and transport margins). For each product (goods or services), the SAM shows the costs associated with imports, margins, and the marketing of exports (i.e. each product incorporating trade and transport costs).

## Factors

The production factors consist essentially of capital and labour, although others may be added, such as land or other natural resources. The production factors receive income by transferring them to productive activities and to the Rest of the World. These incomes (wages, rent, etc.) are distributed (as expenditure by columns) to the owners of the factors of production: domestic institutional sectors (Households – as labour income and

([5]) Value Added Tax (VAT) is a tax on (final demand) commodities and NOT a tax on value added

distributed profits-, incorporated business enterprises –as non-distributed profits- and Government – as taxes and payment for owned resources-), and the Rest of the World ([6]).

## Households

Families/Households receive income from the Factors account on domestic or foreign markets (as owners of labour, capital, land and natural resources) as well as transfers from Government, Enterprises, the Rest of the World and (sometimes) other households. Household incomes from Enterprises are, in essence, distributed profits (and sometimes direct transfers), receiving from Government mostly direct transfers. Payments from abroad come usually from labour services rendered (capital services are most often paid to enterprises).

These revenues are allocated to the consumption of commodities (goods and services, marketed and valued at purchase prices including margins and taxes), the payment of direct taxes (income taxes, etc.) and transfers to other institutions (domestic and foreign, including other groups of households when disaggregated). The remainder (or the need for private borrowing, if applicable) is computed as savings (negative, if applicable). In any case, the difficulty in verifying data on savings by households can often result in estimates being calculated as a residual (as saving/dissaving).

Traditionally, SAM estimation has followed the Representative Household Group (RHG) approach, supposing different household groups, each represented by an account in the SAM. With the use of a single private household account, the maintained hypothesis here is that all individual households of a specific RHG are affected in the same average manner by a policy shock,

## Corporations

Corporations, such as Households, receive payments related to the transfer of property (i.e., non-labour factors only, since the labour factor can only supply natural persons, represented by households) and income by transfers from other institutions. Those revenues are used in the payment of direct taxes (on profits, as the corporation tax), transfers to other institutions or converted into savings. Although corporations refer to businesses, they do not consume raw materials or inputs such as activities because they represent the 'institutional' component of the productive sector).

([6]) See Pyatt (1991) and Defourney and Thorbecke (1984).

## Government

The Government accounts refer to the Public Administration as an institutional sector. Its share as "productive activity" (public corporations) and marketed goods and services resulting from its activities are recorded in the respective accounts of Activities and Commodities. Incomes of Government are intended for the acquisition of goods and services (consumption demand of public services), transfers to other institutional sectors (households and corporations) in the form of benefits or subsidies, current transfers to other countries (e.g., development assistance or international aid). The difference between income and expenditure is shown as savings (negative in the case of the public deficit).

## Saving-Investment (capital combined accounts)

The row entries in this account record the savings generated by the domestic institutional sectors, both by private households and the public sector, as well as transfers of either positive or negative capital from abroad (accounts of Rest of the World, balance on the capital account). The corresponding columns reflect Gross Fixed Capital Formation (GFCF) and changes in stock inventories in the accounts of Commodities.

## Rest of the World

The Rest of the World account includes as income, the value of imports of goods and services (Commodities), payments to the factors of production from abroad and transfers from the domestic institutions to institutional sectors elsewhere. Foreign sector accounts expenditures are the purchase of goods and services (exports), payments to national factors of production used abroad and transfers recorded from other economies. The balance reflects the surplus or deficit with the Rest of the World.

# 3 EU 28 BioSAMs 2010

Usually, 'traditional' biobased activities are typically represented within broad sector aggregates (i.e., agriculture, food processing, forestry, fishing, wood, pulp) or even subsumed within parent industries (e.g., chemical sector, wearing apparel, energy). AgroSAMs (Philippidis et al., 2014) solve this issue for agriculture sectors, but there still exists a lack of representation regarding other biobased sectors. A key scientific development of the BioSAMs is that they maintain the detailed agri-food sector detail inherent within the AgroSAMs (Philippidis et al., 2014), whilst incorporating further sector splits to capture additional sources of biomass and biobased applications.

The elaboration of the BioSAMs consists of two basic stages, subdivided into several steps, each of which is repeated systematically for each MS. Finally, an aggregate EU 28 BioSAM was obtained from this country level SAMs

## 3.1 Estimation of standard SAMs for the 28 Member States

For the reference year 2010, the first stage is the design of standard SAMs which are consistent with the macro-magnitudes of each EU MS. These standard SAMs were built using statistical data from Eurostat following a two-step procedure for each country. First, a matrix containing aggregates for the main sub-matrices of the SAM is estimated using official macro-magnitudes. These auxiliary matrices are called MacroSAM and are estimated with values extracted from the Non-financial Annual Sector Accounts (Eurostat, 2016a). These accounts provides values paid and received, aggregate and by institutions, for the main macro-variables of the economy. Table 1 shows the definition and mapping of institutions (Eurostat - SAM) and Table 2 shows Macro-magnitudes used to build the MacroSAMs ([7]).

These data are used for aggregate production, supply and demand, primary factors (labour and capital), taxes and institutional accounts (i.e., Household, Government, Corporations and Rest of the World). It is important to note that those cells relating links between institutions which are marked in red (forming part of the so-called *closure matrix*) require an additional (bi-proportional) RAS (McDougall (1999) estimation process to be populated, always in coherence with aggregate data row and column targets. Table 3 illustrates the result of this first step

([7]) MacroSAMs don't include Margins.

**Table 1.** Mapping of institutional sectors

| **Eurostat classification of sectors:** | **SAM accounts** |
|---|---|
| Total economy (S.1) | Total |
| Non-financial corporations (S.11) | Enterprises / Corporations |
| Financial corporations (S.12) | |
| General government (S.13) | Government |
| Households (S.14) | Households |
| Non-profit institutions serving households (S.15) | |
| Rest of the World (S.2) | Rest of the World |

*Source*: Own elaboration

**Table 2.** Macro-magnitudes used to build MacroSAMs

| ***Aggregates used in activities/commodities, factors and taxes accounts*** | ***Aggregates used in estimation of closure matrix*** |
|---|---|
| Output | Final consumption expenditure |
| Intermediate consumption | Compensation of employees |
| Final consumption expenditure | Taxes on production and imports |
| Gross capital formation | Subsidies |
| Exports of goods and services | Property income |
| Imports of goods and services | Current taxes on income, wealth, etc. |
| Taxes on production and imports | Net social contributions |
| Subsidies | Social benefits other than social transfers in kind |
| Taxes less subsidies on products | Adjustment for the change in pension entitlements |
| Saving, gross | Other current transfers |
| Current external balance | Operating surplus and mixed income, gross |
| Compensation of employees | External balance of goods and services |
| Operating surplus and mixed income, gross | Saving, gross |
| | Current external balance |

*Source*: Own elaboration

**Table 3.** Spanish MacroSAM in 2010 (million Euros)

| | Activities | Commodities | Labour | Capital | TLS-A | TLS-C | Households | Corporations | Direct taxes | Goverment | I-S | RoW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activities** | | 2,038,315 | | | | | | | | | | |
| **Commodities** | 1,048,402 | | | | | | 618,755 | | | 221,715 | 254,549 | 275,847 |
| **Labour** | 541,475 | | | | | | | | | | | 1,187 |
| **Capital** | 445,879 | | | | | | | | | | | |
| **TLS-A** | 2,559 | | | | | | | | | | | |
| **TLS-C** | | 91,000 | | | | | | | | | | |
| **Households** | | | 542,334 | 164,208 | | | | 71,303 | | 174,439 | | 14,708 |
| **Corporations** | | | | 254,901 | | | 40,997 | | | 15,748 | | 26,684 |
| **Direct taxes** | | | | | | | 79,871 | 20,288 | | | | 433 |
| **Goverment** | | | | 26,770 | 2,559 | 89,456 | 143,096 | 9,691 | 100,592 | | | 8,310 |
| **I-S** | | | | | | | 69,462 | 183,276 | | -40,168 | | 41,979 |
| **Rest of the World** | | 289,953 | 328 | | | 1,544 | 14,812 | 53,771 | | 8,740 | | |

Note: TLS stands for *Taxes less subsidies*: -A, on production; -C, on products

*Source*: Own elaboration

In the second stage, the MacroSAM structure is extended, by opening up the aggregate accounts to represent specific activities and commodities and obtaining, as a result, the standard SAMs. The procedure of opening up these submatrices in the MacroSAM is facilitated by entering information from the 2010 Supply-and-Use Tables (SUT) (Eurostat, 2016b).[8]

The SUT is a matrix by industry and product describing production processes and the transactions in products of the national economy. They show the structure of the costs of production and the value added generated; and the flows of goods and services produced within the national economy and with the rest of the world (see Figure 3).

**Figure 3.** Abbreviated scheme of Supply and Use tables

| ***Use table*** | ***Activities*** | **Consumption** | | **Gross Capital formation** | **Exports** |
|---|---|---|---|---|---|
| | | **Households** | **Government** | | |
| ***Products / Commodities*** | | | | | |
| **Compensation of employees** | | | | | |
| **Operating surplus and mixed income** | | | | | |
| **Other taxes less other subsidies on production** | | | | | |

| ***Supply table*** | ***Activities*** | ***Imports*** | | **Taxes less subsidies on products** | **Margins** |
|---|---|---|---|---|---|
| ***Products / Commodities*** | | | | | |

*Source*: Own elaboration

[8] It should be noted that the aggregates from the Supply and Use tables of Eurostat are broadly consistent with the

The Supply table is used to populate:

- Sub-matrix $T_{A,C}$ (domestic production)
- Imports
- Taxes less subsidies on products
- Margins

Meanwhile, the Use table provides values for

- Submatrix $T_{C,A}$ (Intermediate Consumption)
- Submatrix $T_{F,A}$ (Labour and Capital remuneration)
- Household and Government Final Consumption
- Gross Capital Formation
- Exports
- Taxes less subsidies on production

Activities and products/commodities in the SUT follow the classifications of Eurostat NACE Rev. 2 (Statistical classification of economic activities in the European Community, revised version 2) (Eurostat, 2008b) and the Classification of Products by Activity (CPA) (Eurostat 2008c), respectively, so the initial standard SAM use this classification (see Table A1).

Balanced standard SAMs are obtained by correcting (in some cases) minor differences in the allocation of concepts included in the SUT (e.g. consumption by residents abroad, payments to labour and indirect taxes). The first stage is completed by mapping and aggregating certain accounts (both, activities and commodities) to the classification of activities employed in the well-known Global Trade Analysis Project (GTAP) databases (Aguiar et al., 2016). The reason for this is to permit subsequent use in later steps (see BioSAM construction below) of additional secondary data on detailed primary agricultural, biofuel and biochemical activities which adheres to the GTAP classification (in particular to calculate the technical coefficients for bioenergy and biochemical related activities). Table 4 shows the classification of activities and commodities in the final estimated standard SAMs.

**Table 4.** Activities and commodities classification in standard SAMs

| | |
|---|---|
| Agriculture | Machinery and equipment nec |
| Forestry | Manufactures nec |
| Fishing | Electricity and gas |
| Coal | Water |
| Food industry | Construction |
| Textiles, wearing, leather,… | Trade |
| Wood products | Transport nec |
| Paper products, publishing | Water transport |
| Petroleum, coal | Air transport |
| Chemical, rubber, plastic products | Communication |
| Mineral products nec | Financial services nec |
| Metals | Insurance |
| Metal products | Business services nec |
| Motor vehicles and parts | Recreational and other services |
| Transport equipment nec | Public Administration, Defence, Education, Health |
| Electronic equipment | Dwellings |

*Source*: Own elaboration

## 3.2 Estimation of BioSAMs

Once the standard SAMs are estimated, the final major stage is their transformation into BioSAMs, using additional sources of secondary data. This stage consists of two main steps:

- **Disaggregating 'Agriculture' and 'Food' accounts.**
  To perform this split of agricultural activities (including livestock activities and products) and food industry activities, two main additional databases are used:
  - The *Common Agricultural Policy Regionalised Impacts* (CAPRI) modelling system database (Britz and Witzke, 2014) serves as a main source. To exploit the information from this database for the national scale ([9]) (called *CoCo* -Complete and Consistent Data Base-), the transformation described in Müller et al. (2009) to obtain AgroSAMs is also followed here in order to obtain updated values to 2010. From the adapted data of CAPRI, information for intermediate and final consumption (households, government, investment…) was obtained for agricultural commodities and the production coefficients and

(9) This database doesn't include data for Croatia, so values for this country were estimated using its aggregates from Eurostat and the CoCo average neighbourhood values as proxies.

value added of agricultural activities. Examining Figure 2, this allows for the agricultural splits from the submatrices $T_{C,-}$, $T_{-C}$ , $T_{A,-}$ and $T_{-,A}$.

- The *Economic Accounts for Agriculture (EAA)* from Eurostat (Eurostat, 2016c) provides additional balances and checks. More specifically, this data is used as a check for aggregate values and serves as proxy for extrapolation in case of data gaps or inconsistencies in specific activities and/or countries. Moreover, this data gives information for very disaggregated crops and livestock activities on production, taxes and subsidies, and aggregate agriculture values of output, intermediate consumption, gross and net value added, gross fixed capital formation (GFCF), compensation of employees, other taxes and subsidies on production, net operating surplus or net mixed income, property income and net entrepreneurial income in current prices.

The final disaggregation of agriculture sector is showed in Table 5.

**Table 5.** Agriculture, livestock and food industry activities and commodities classification in BioSAMs

| | |
|---|---|
| Paddy rice | Bovine cattle, live |
| Wheat | Sheep, goats, horses, asses, mules and hinnies, live |
| Barley | Swine, live |
| Grain maize | Poultry, live |
| Other cereals | Other animals, live and their products |
| Tomatoes | Raw milk |
| Other vegetables | Meat of bovine animals, fresh, chilled, or frozen |
| Grapes | Meat of swine, fresh, chilled, or frozen |
| Fruits and nuts | Meat of sheep, goats, and equines, fresh, chilled, or frozen |
| Rapeseeds | Meat and edible offal of poultry, fresh, chilled, or frozen |
| Sunflower seed | Vegetable oils and fats |
| Soya seed | Olive oil |
| Olive for the oil industry | Oil-cakes |
| Other seed for the oil industry | Dairy products |
| Sugar beet | Rice, milled or husked |
| Fibre plants | Processed sugar |
| Potatoes | Prepared animal feeds |
| Live plants | Other food products |
| Fodder crops | Wine |
| Tobacco | Other beverages and tobacco |
| Other crops | |

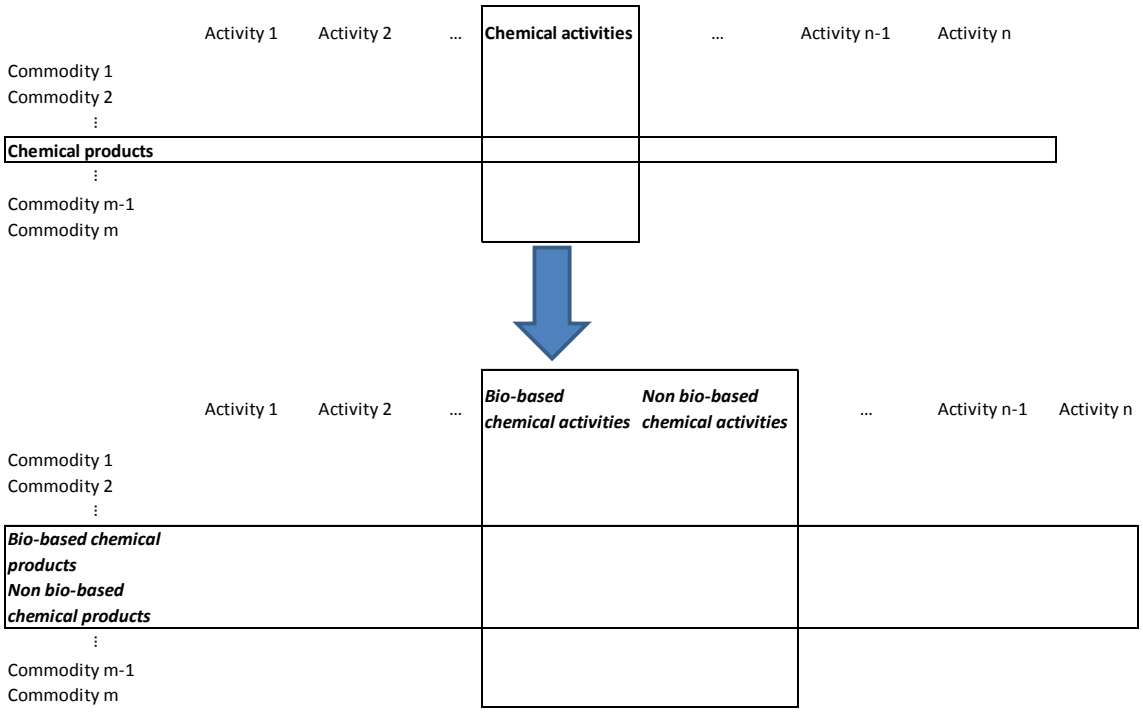
*Source*: Own elaboration

- **Disaggregating other biobased sectors**

  In this step, the separation of new bioenergy and bioindustry sectors from their parent industries is done. For example, the disaggregation of the chemical sector into biobased and non-biobased sectors in submatrix $T_{C,A}$ is illustrated in Figure 4. More specifically, the splits are:

  - 'Biochemicals' and 'Biofuels' (4 types) are split from 'Chemicals' ([10])
  - 'Energy crops' (Plantations) are disaggregated from 'Forestry'
  - 'Pellets' are extracted from 'Wood products'
  - 'Bioelectricity' is taken from 'Electricity and gas'.

**Figure 4:** Disaggregation example in submatrix $T_{C,A}$




*Source*: Own elaboration

For bioenergy and bioindustry sectors, the Modular Applied General Equilibrium Tool (MAGNET) (Woltjer et al., 2014) model database of interindustry flows and the data on employment and turnover available in the European Commission (JRC, 2017) is employed. The MAGNET database provides the technical coefficients for these industries, which with the addition of Eurostat data on labour (Eurostat 2016d) and JRC specific bioeconomy datasets (JRC, 2017), allows for the splits of the submatrices ($T_{C,-}$, $T_{-C}$ , $T_{A,-}$ and $T_{-,A}$) for biobased sectors (activities and commodities). Table 6 shows this final disaggregation.

([10]) Also, Fertilizer products are split here.

**Table 6.** Non agriculture biobased activities and commodities classification in BioSAMs

| |
|---|
| Forestry |
| Plantations (energy crops) |
| Wood products |
| Pellets |
| Biogasoline |
| Biodiesel |
| 2nd generation biofuel – biochemical pathway fuels (eth) |
| 2nd generation biofuel – thermal pathway fuels (ft_fuel) |
| Biochemicals |
| Bioelectricity |
| Textiles, wearing apparel and leather |

*Source*: Own elaboration

The resulting unbalanced BioSAMs are corrected by eliminating discrepancies between the accounts which arise when reconciling different sources of data. To ensure the smooth adjustment of the BioSAM cells, subject to cell targets for activities and products for which statistical information is available as well as the macroeconomic targets, row and sum (RAS) and Cross Entropy methods are employed (McDougall, 1999; Robinson et al., 2001).

The final result is a set of 28 MS BioSAMs for 2010, which contains 171 accounts, including 80 activity/commodity accounts (see Table 7). There are 21 accounts for cropping activities, six for livestock and their products, 14 for food processing (including processed animal feed and oilcake feed by-product from biodiesel), three biomass supply accounts (forestry, energy crops and pellets), five for bioenergy (first–generation bioethanol and biodiesel, second-generation biochemical- and thermochemical biomass conversion technologies, and bioelectricity), three other bioindustrial accounts (textiles, wood and biochemical) and one fishing account. The remaining 27 sectors/commodities cover natural resources (three accounts covering coal mining, fossil fuels and raw minerals), manufacturing (ten accounts), energy (one composite account for electricity and gas) and services (13 accounts). In addition, the BioSAM contains two production factors (labour and capital), one account for trade and transportation margins and three tax accounts (taxes and subsidies on production and consumption and direct taxes). Finally, there is a single row and column account corresponding to the transactions involving each of the private household; corporate activities, central government, investments-savings and the rest of the world.

In Annex 2 can be found the way to download the complete BioSAMs database.

**Table 7.** BioSAMs accounts

| ***Activities / Commodities*** | | |
|---|---|---|
| Paddy rice | Minning | Motor vehicles and parts |
| Wheat | Meat of bovine animals | Transport equipment nec |
| Barley | Meat of swine | Electronic equipment |
| Grain maize | Meat of sheep, goats, and equines | Machinery and equipment nec |
| Other cereals | Meat and edible offal of poultry | Manufactures nec |
| Tomatoes | Vegetable oils and fats | Electricity and gas |
| Other vegetables | Olive oil | Bioelectricity |
| Grapes | Oil-cakes | Water |
| Fruits and nuts | Dairy products | Construction |
| Rapeseeds | Rice, milled or husked | Trade |
| Sunflower seed | Processed sugar | Transport nec |
| Soya seed | Prepared animal feeds | Water transport |
| Olive for the oil industry | Other food products | Air transport |
| Other seed for the oil industry | Wine | Communication |
| Sugar beet | Other beverages and tobacco | Financial services nec |
| Fibre plants | Textiles, wearing apparel and leather | Insurance |
| Potatoes | Wood products | Business services nec |
| Live plants | Pellets | Recreational and other services |
| Fodder crops | Paper products, publishing | Public Administration, Defense, Education, Health |
| Tobacco | Petroleum, coal | Dwellings |
| Other crops | Chemical, rubber, plastic products (non-biobased) | |
| Bovine cattle, live | Biogasoline | |
| Sheep, goats, horses, asses,… (live) | Biodiesel | |
| Swine, live | 2nd generation biofuel – biochemical pathway fuels (eth) | |
| Poultry, live | 2nd generation biofuel – thermal pathway fuels (ft_fuel) | |
| Other animals, live and their products | Fertilizers | |
| Raw milk | Biochemicals | |
| Forestry | Mineral products nec | |
| Plantations | Metals | |
| Fishing | Metal products | |

| |
|---|
| ***Margins*** |
| ***Labour*** |
| ***Capital*** |
| ***Taxes less subsidies on production*** |
| ***Taxes less subsidies on products*** |
| ***Households*** |
| ***Enterprises/Corporations*** |
| ***Direct taxes*** |
| ***Government*** |
| ***Investment-Savings*** |
| ***Rest of the World*** |

*Source*: Own elaboration

# 4 Conclusions

In this report, a new dataset has been presented: a set of SAMs specifically designed for the study of the Bioeconomy and natural resources, dubbed 'BioSAMs'. This database addresses an important deficit of quantitative data for disaggregated biobased activities, particularly within the framework of a single consistent economy-wide dataset.

As a starting point, the MacroSAMs have been estimated subject to a series of macroeconomic target values, whilst maintaining a strict coherence with the aggregate economic values for demand, supply, production and income distribution. The subsequent disaggregation of the accounts within the SAM not only captures the intermediate and final demand transactions, but also record details of the links between the production factors and institutional accounts which complete the full circular flow within an economic system.

Employing the SAMs as a basis, the BioSAMs present a highly disaggregated sectoral breakdown of the agricultural and agro-food industries, whilst providing explicit representation of the current uses of biomass in the areas of bioenergy, bio-chemicals and bio-based industries. To the best of our knowledge, this is currently the most complete multisectorial database that exists for each of the EU member states, with detailed coverage on the bioeconomy sectors and their links with the rest of the economic activity accounts and the institutional accounts (e.g., Households, Government, Corporations).

It is expected that this database should be the starting point for the multisectoral analysis of the bioeconomy from different points of view: as a description of its structure, as a basis for the application of linear models or as a basis for the calibration of more complex CGE models. In addition, it can be used, complemented with additional data, in the detailed analysis of key topics such as the creation of employment and value added, growth, sustainable use of resources, environmental impacts, etc.

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# Annexes

## **Annex 1.** Products and activities used in initial standards SAMs

**Table A1.** Products and activities used in initial standards SAMs

| Products | Activities |
|---|---|
| Products of agriculture, hunting and related services | Crop and animal production, hunting and related service activities |
| Products of forestry, logging and related services | Forestry and logging |
| Fish and other fishing products; aquaculture products; support services to fishing | Fishing and aquaculture |
| Mining and quarrying | Mining and quarrying |
| Food, beverages and tobacco products | Manufacture of food products; beverages and tobacco products |
| Textiles, wearing apparel, leather and related products | Manufacture of textiles, wearing apparel, leather and related products |
| Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials |
| Paper and paper products | Manufacture of paper and paper products |
| Printing and recording services | Printing and reproduction of recorded media |
| Coke and refined petroleum products | Manufacture of coke and refined petroleum products |
| Chemicals and chemical products | Manufacture of chemicals and chemical products |
| Basic pharmaceutical products and pharmaceutical preparations | Manufacture of basic pharmaceutical products and pharmaceutical preparations |
| Rubber and plastic products | Manufacture of rubber and plastic products |
| Other non-metallic mineral products | Manufacture of other non-metallic mineral products |
| Basic metals | Manufacture of basic metals |
| Fabricated metal products, except machinery and equipment | Manufacture of fabricated metal products, except machinery and equipment |
| Computer, electronic and optical products | Manufacture of computer, electronic and optical products |
| Electrical equipment | Manufacture of electrical equipment |
| Machinery and equipment n.e.c. | Manufacture of machinery and equipment n.e.c. |
| Motor vehicles, trailers and semi-trailers | Manufacture of motor vehicles, trailers and semi-trailers |
| Other transport equipment | Manufacture of other transport equipment |
| Furniture and other manufactured goods | Manufacture of furniture; other manufacturing |
| Repair and installation services of machinery and equipment | Repair and installation of machinery and equipment |
| Electricity, gas, steam and air conditioning | Electricity, gas, steam and air conditioning supply |
| Natural water; water treatment and supply services | Water collection, treatment and supply |
| Sewerage services; sewage sludge; waste collection, treatment and disposal services; materials recovery services; remediation services and other waste management services | Sewerage, waste management, remediation activities |
| Constructions and construction works | Construction |
| Wholesale and retail trade and repair services of motor vehicles and motorcycles | Wholesale and retail trade and repair of motor vehicles and motorcycles |
| Wholesale trade services, except of motor vehicles and motorcycles | Wholesale trade, except of motor vehicles and motorcycles |
| Retail trade services, except of motor vehicles and motorcycles | Retail trade, except of motor vehicles and motorcycles |
| Land transport services and transport services via pipelines | Land transport and transport via pipelines |
| Water transport services | Water transport |
| Air transport services | Air transport |

**Table A1 (cont)**. Products and activities used in initial standards SAMs (2/2)

| Products | Activities |
|---|---|
| Warehousing and support services for transportation | Warehousing and support activities for transportation |
| Postal and courier services | Postal and courier activities |
| Accommodation and food services | Accommodation and food service activities |
| Publishing services | Publishing activities |
| Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services | Motion picture, video, television programme production; programming and broadcasting activities |
| Telecommunications services | Telecommunications |
| Computer programming, consultancy and related services; Information services | Computer programming, consultancy, and information service activities |
| Financial services, except insurance and pension funding | Financial service activities, except insurance and pension funding |
| Insurance, reinsurance and pension funding services, except compulsory social security | Insurance, reinsurance and pension funding, except compulsory social security |
| Services auxiliary to financial services and insurance services | Activities auxiliary to financial services and insurance activities |
| Real estate services excluding imputed rents | Real estate activities excluding imputed rents |
| Imputed rents of owner-occupied dwellings | Imputed rents of owner-occupied dwellings |
| Legal and accounting services; services of head offices; management consultancy services | Legal and accounting activities; activities of head offices; management consultancy activities |
| Architectural and engineering services; technical testing and analysis services | Architectural and engineering activities; technical testing and analysis |
| Scientific research and development services | Scientific research and development |
| Advertising and market research services | Advertising and market research |
| Other professional, scientific and technical services and veterinary services | Other professional, scientific and technical activities; veterinary activities |
| Rental and leasing services | Rental and leasing activities |
| Employment services | Employment activities |
| Travel agency, tour operator and other reservation services and related services | Travel agency, tour operator reservation service and related activities |
| Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services | Security and investigation, service and landscape, office administrative and support activities |
| Public administration and defence services; compulsory social security services | Public administration and defence; compulsory social security |
| Education services | Education |
| Human health services | Human health activities |
| Residential care services; social work services without accommodation | Residential care activities and social work activities without accommodation |
| Creative, arts, entertainment, library, archive, museum, other cultural services; gambling and betting services | Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities |
| Sporting services and amusement and recreation services | Sports activities and amusement and recreation activities |
| Services furnished by membership organisations | Activities of membership organisations |
| Repair services of computers and personal and household goods | Repair of computers and personal and household goods |
| Other personal services | Other personal service activities |
| Services of households as employers; undifferentiated goods and services produced by households for own use | Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use |
| Services provided by extraterritorial organisations and bodies | Activities of extraterritorial organisations and bodies |

*Source:* Own elaboration from Eurostat 2016b

## **Annex 2.** On-line resources.

The 2010 Bio-SAM's of EU Member States is available on the public website "EC agro-economic portal DataM". Links can be also accessed with the QR codes listed in this annex.

**Figure A1.** QR code – DataM URL

https://datam.jrc.ec.europa.eu


*Source:* JRC, 2018.

### Bulk download

Using DataM, users can make a bulk download of the 28 SAM's in a ZIP file (Dataset_JRC_-_BioSAMs_for_the_EU_Member_States_-_2010.csv) containing an homonymous CSV file. The hyperlink for the direct bulk download is in Figure A2.

**Figure A2.** QR Code – direct bulk data download

https://datam.jrc.ec.europa.eu/datam/perm/od/2bf5e568-dacb-422a-a4f0-05ee62ad30c6/download/dataset.zip


*Source:* JRC, 2018.

In the bulk download, the SAM is presented in a standard flat format as CSV file with header row. Conceptually, it contains a column for the Member State, a column for the spending agent, a column for the receiving agent and a column for the value in Millions of Euros. See figure A3.

**Figure A3.** Bulk download of the matrix in flat table format

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Year | Country | Country - | Receiving Agent | Receiving | Spending Agent | Spending | Value | UOM |
| 2 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (activity) | A_ETH | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | 11.12774 | MILLION EUROS |
| 3 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Air transport (activity) | A_AIR TRA | 0.002984 | MILLION EUROS |
| 4 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Barley (activity) | A_BARL | 0.007715 | MILLION EUROS |
| 5 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Biodiesel (activity) | A_BIOD | 0.025173 | MILLION EUROS |
| 6 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Biogasoline (activity) | A_BIOG | 3.5E-06 | MILLION EUROS |
| 7 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Bovine cattle, live (activity) | A_LCAT | 0.011319 | MILLION EUROS |
| 8 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Business services nec (activity) | A_BUSINE | 0.249619 | MILLION EUROS |
| 9 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Chemical, rubber, plastic products (non-biobased) (activity) | A_CHEM | 5.33182 | MILLION EUROS |
| 10 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Communication (activity) | A_COMMU | 0.005748 | MILLION EUROS |
| 11 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Construction (activity) | A_CONSTI | 0.903312 | MILLION EUROS |
| 12 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Dairy products (activity) | A_DAIR | 0.049991 | MILLION EUROS |
| 13 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Dwellings (activity) | A_DWELLI | 0.008282 | MILLION EUROS |
| 14 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Electricity and gas (activity) | A_ELECTRI | 0.010591 | MILLION EUROS |
| 15 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Electronic equipment (activity) | A_ELECTR | 0.212897 | MILLION EUROS |
| 16 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Fertilizers (activity) | A_FERT | 0.014481 | MILLION EUROS |
| 17 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Fibre plants (activity) | A_FIBR | 9.66E-06 | MILLION EUROS |
| 18 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Financial services nec (activity) | A_FINANC | 0.031684 | MILLION EUROS |
| 19 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Fishing (activity) | A_FISHIN | 0.000314 | MILLION EUROS |
| 20 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Fodder crops (activity) | A_FODD | 0.039686 | MILLION EUROS |
| 21 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Forestry (activity) | A_FOREST | 0.00444 | MILLION EUROS |
| 22 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Fruits and nuts (activity) | A_FRUI | 0.003604 | MILLION EUROS |
| 23 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Government | GOVERME | 1.486894 | MILLION EUROS |
| 24 | 2010 | Austria | AT | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | C_ETH | Households | HOUSEHO | 3.263242 | MILLION EUROS |

*Source:* DataM, provided by the European Commission – Joint Research Centre. Dataset: JRC - BioSAMs for the EU Member States - 2010, accessed on 22/05/2018.

In fact, the file contains also columns for the codes internally used in GAMS for the agents, the Year (always 2010) and the Unit of Measurement (always EUR Millions). These extra columns help for using the data in modelling tools, and for characterizing this file among other SAM's that are published by JRC.

## Interactive download

DataM includes also a function for interactive download, which allows filtering the only part of interest of the datasets and to preview results on the screen (for example, to download only the SAM of a given Member State). Find the direct link for the SAM in the figure A4.

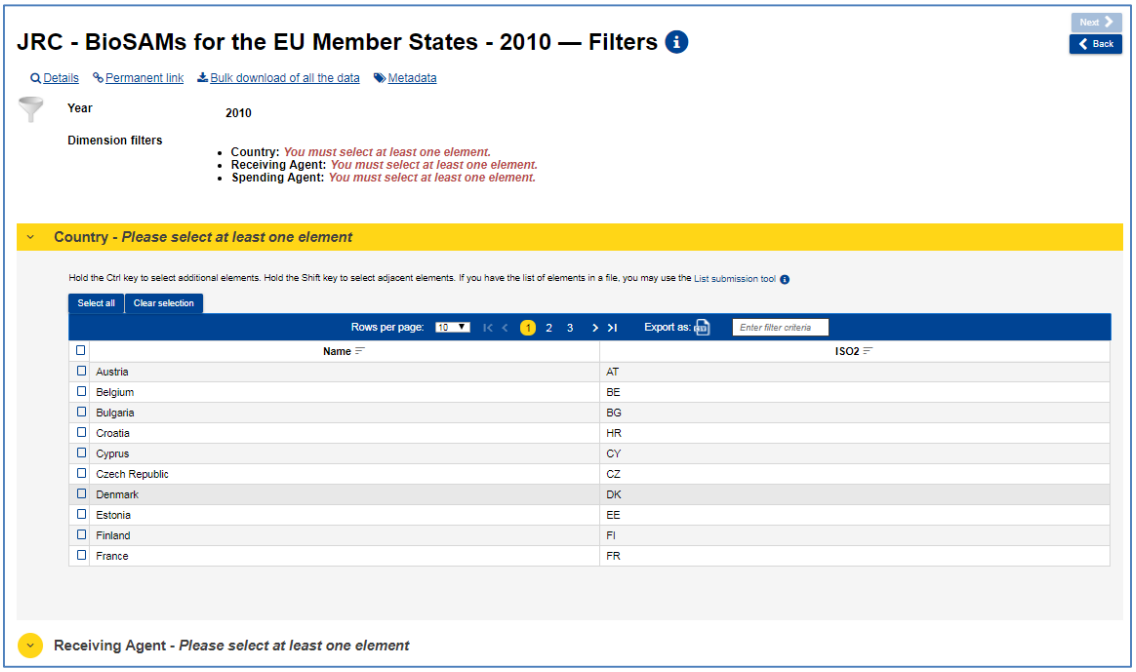
**Figure A4.** QR Code – direct link to the data warehouse page of the dataset

https://datam.jrc.ec.europa.eu/datam/perm/od/2bf5e568-dacb-422a-a4f0-05ee62ad30c6


*Source:* JRC, 2018.

The link gives access to the screen in the figure A5.

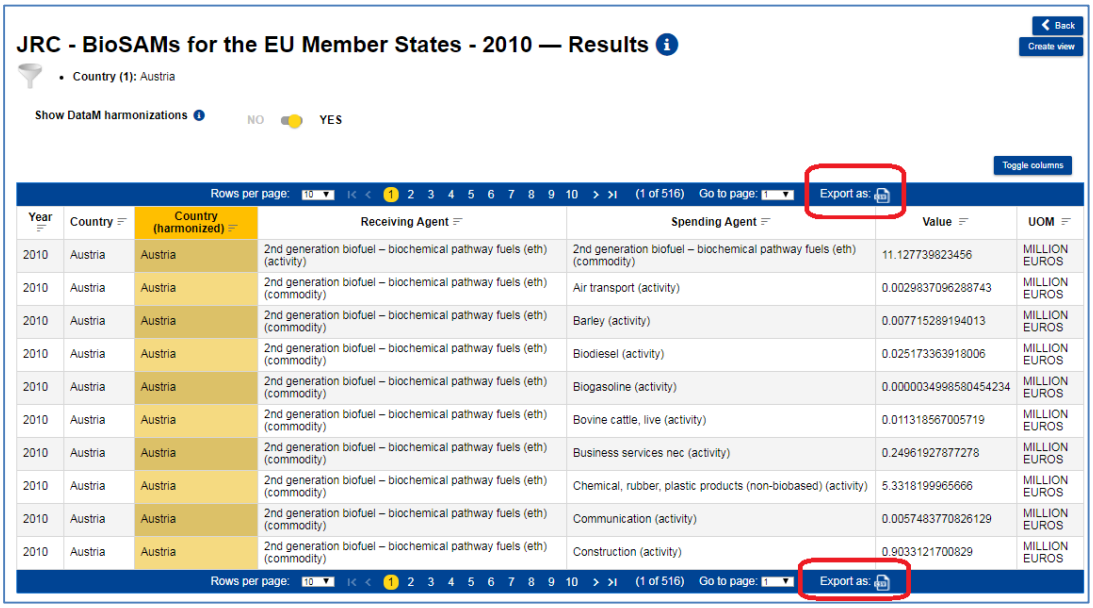
**Figure A5.** Data warehouse page of the EU BioSAMs 2010




*Source:* DataM, JRC, 2018.

After specifying some filtering and pushing on the "Next" button, the data is visualised on the screen, see figure A6.

**Figure A6.** Visualising the SAM on the screen




*Source:* DataM, JRC, 2018.

The "export as CSV" option would produce a file similar to the one obtained in the bulk download, but only with the records reflecting the selection operated. See figure A7.

**Figure A7.** Exporting only part of the SAM in flat format

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Year | Country | Country (harmonized) | Receiving Agent | Spending Agent | Value in JRC - BioSAMs for the EU Member States - 2010 | UOM | Provider |
| 2 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (activity) | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | 11.12773982 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 3 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Air transport (activity) | 0.00298371 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 4 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Barley (activity) | 0.007715289 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 5 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Biodiesel (activity) | 0.025173364 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 6 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Biogasoline (activity) | 3.49986E-06 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 7 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Bovine cattle, live (activity) | 0.011318567 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 8 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Business services nec (activity) | 0.249619279 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 9 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Chemical, rubber, plastic products (non-biobased) (activity) | 5.331819997 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 10 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Communication (activity) | 0.005748377 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 11 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Construction (activity) | 0.90331217 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 12 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Dairy products (activity) | 0.049991259 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 13 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Dwellings (activity) | 0.008282162 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 14 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Electricity and gas (activity) | 0.010590985 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 15 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Electronic equipment (activity) | 0.212897154 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 16 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Fertilizers (activity) | 0.014481268 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 17 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Fibre plants (activity) | 9.65854E-06 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 18 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Financial services nec (activity) | 0.031684155 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 19 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Fishing (activity) | 0.000313763 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 20 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Fodder crops (activity) | 0.039685709 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 21 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Forestry (activity) | 0.004440044 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 22 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Fruits and nuts (activity) | 0.003604413 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 23 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Government | 1.486893805 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |
| 24 | 2010 | Austria | Austria | 2nd generation biofuel – biochemical pathway fuels (eth) (commodity) | Households | 3.263242203 | MILLION EUROS | JRC - BioSAMs for the EU Member States - 2010 |

*Source:* DataM, provided by the European Commission – Joint Research Centre. Dataset: JRC - BioSAMs for the EU Member States - 2010, accessed on 22/05/2018.

## Interactive dashboard

Finally, users may explore and analyse the data through an interactive dashboard placed in the "Model inputs, baselines and social accounting matrices (SAMs)" visualisation section of the website (Figure A8).

**Figure A8.** QR Code – direct link to the interactive dashboard

https://datam.jrc.ec.europa.eu/datam/mashup/BIOSAMS_EU_2010

*Source:* JRC, 2018.

The interactive dashboard allows users to undertake their own analysis of the dataset.

It consists of a number of sheets that allow analysing data from different perspectives.

**Figure A9.** Navigating within the sheets


*Source:* DataM, JRC, 2018.

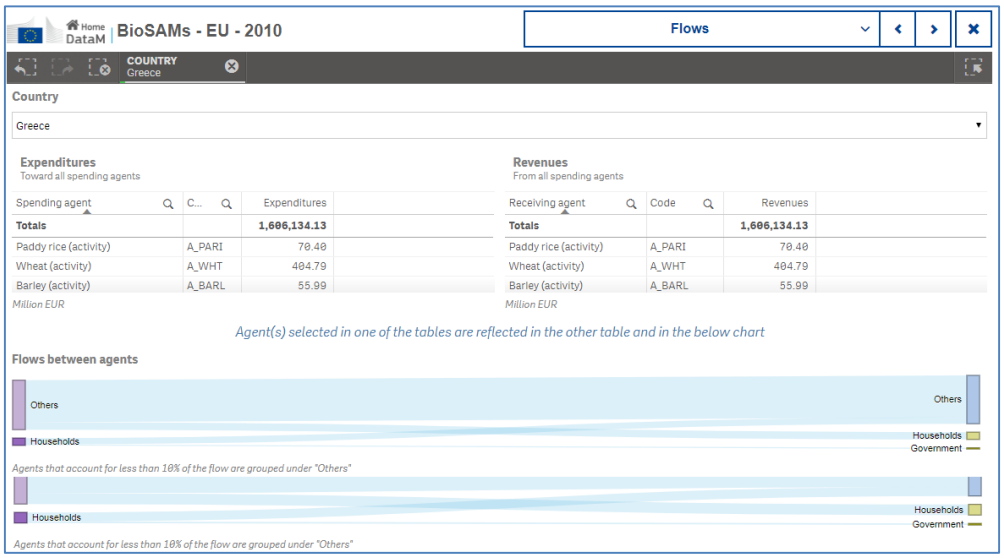
Each sheet consists of a screen with a number of different visualisations (tables, charts and maps) and some filtering boxes.

The key strength of the tool is that all these visualisations are interactive and interrelated. This allows users to study the data by means of simple mouse gestures.

The DataM visualisation framework is quite intuitive; some basic guidelines to facilitate its use will follow.

All DataM dashboards are similar to the example shown in Figure A10.

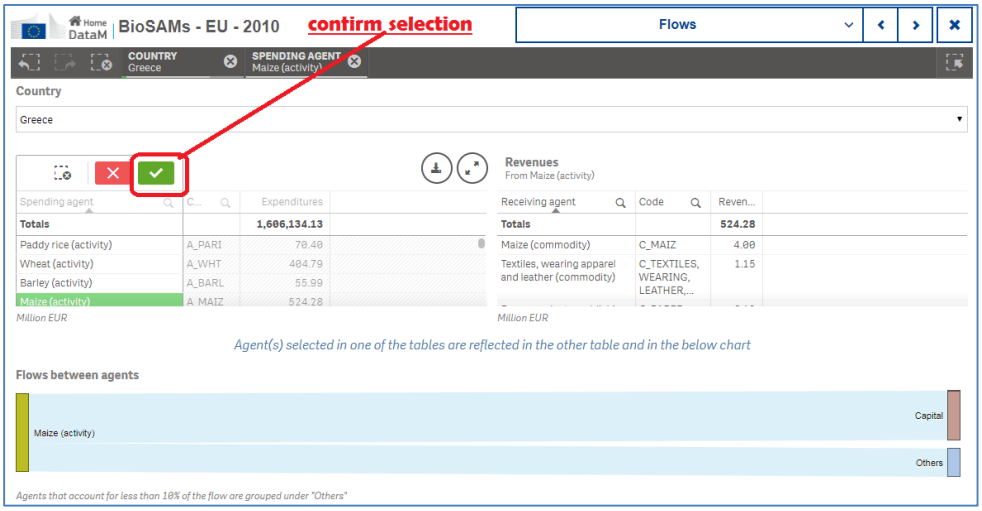
**Figure A10.** A generic dashboard




*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAM's EU Member States - 2010, accessed on 22/05/2018.

By clicking on any visualisation, for example by clicking on "Maize (activity)" in the left table by spending agent, all the visualisations are recalculated using data concerning only the expenditures from maize activity.

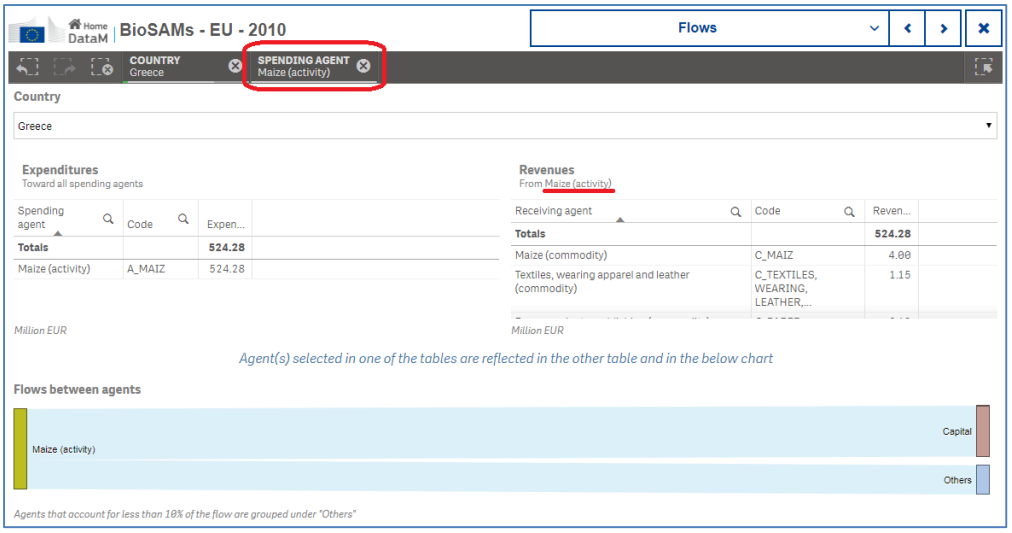
**Figure A11.** Making an interactive selection




*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAM's EU Member States - 2010, accessed on 22/05/2018.

For example, in Figure A12 the right table now shows all the agents that receives from Maize activity (and in Greece, in the specific case) and the below diagram illustrates these flows.

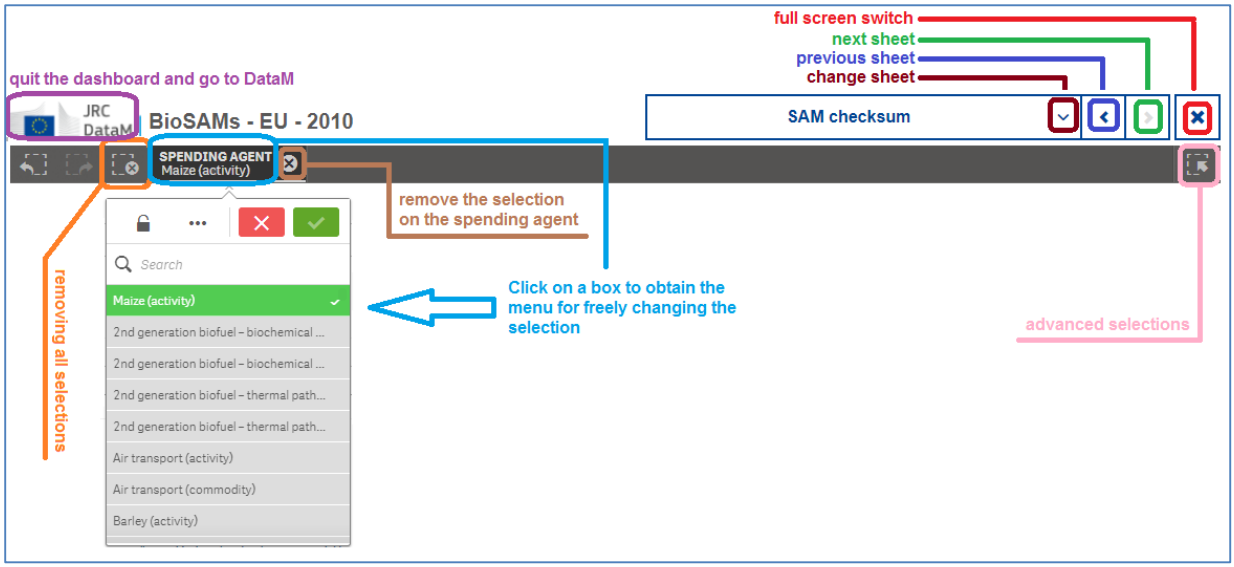
**Figure A12.** Result of an interactive selection




*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAM's EU Member States - 2010, accessed on 22/05/2018.

The currently active selections are always shown in the dark-grey bar at the top. Selections can be cancelled or changed as explained in figure A13.

**Figure A13.** Instructions to change selections



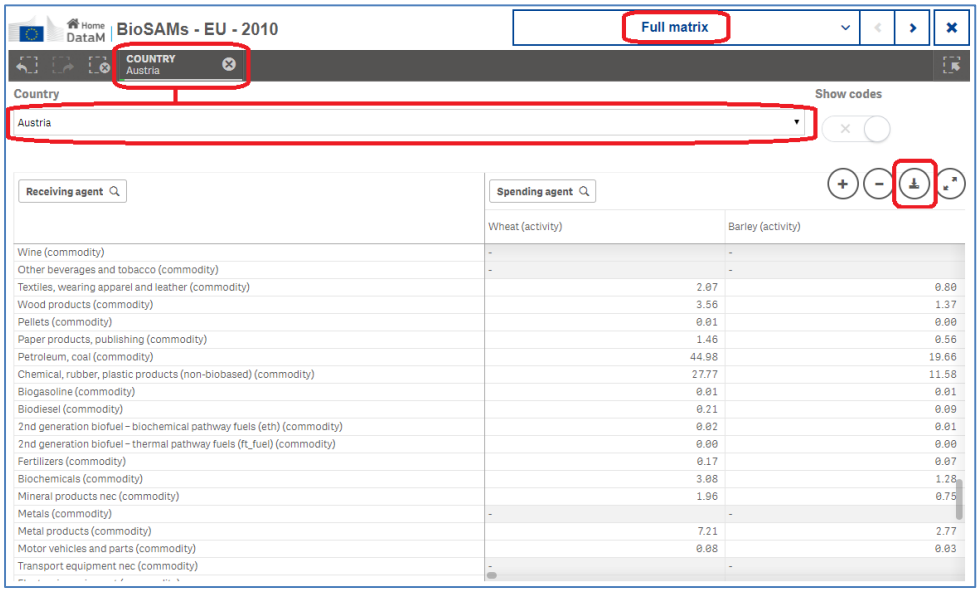

*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAM's EU Member States - 2010, accessed on 22/05/2018.

## Downloading the traditional matrix

From the "Full matrix" sheet of the interactive dashboard, users can visualize and make the download in "xlsx" format of the SAM in traditional sparse-matrix aspect, one

Member State at time. To see the matrix you need to select one Member State with the menu highlighted in figure A14, which, in the specific example is used to select Austria.

**Figure A14.** How to download the SAM in traditional matrix format for one country

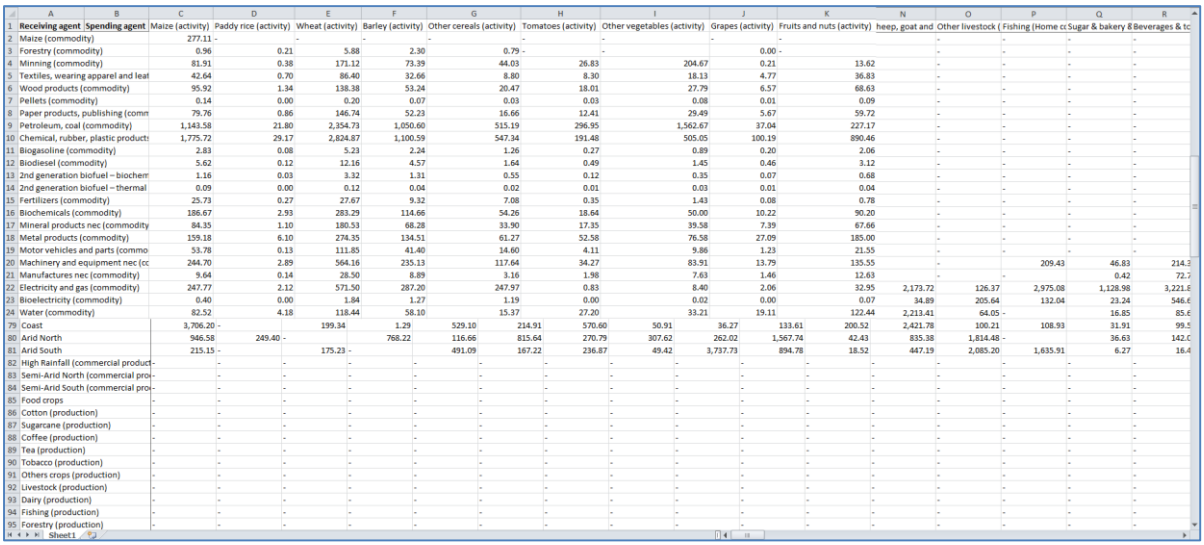



*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAM's EU Member States - 2010, accessed on 22/05/2018.

The download icon at the top-right corner of the chart (see figure A14), which is visible when passed over with the mouse; allow the data for the chart to be downloaded. The "+" and "-" icons allow to expand the matrix in case there are nested dimension (for this pivot table, these buttons do not have any effect), whereas the last icon on the right is to show the chart in full-screen mode.

See the aspect of the downloaded file in figure A15.

**Figure A15.** Traditional matrix outcome

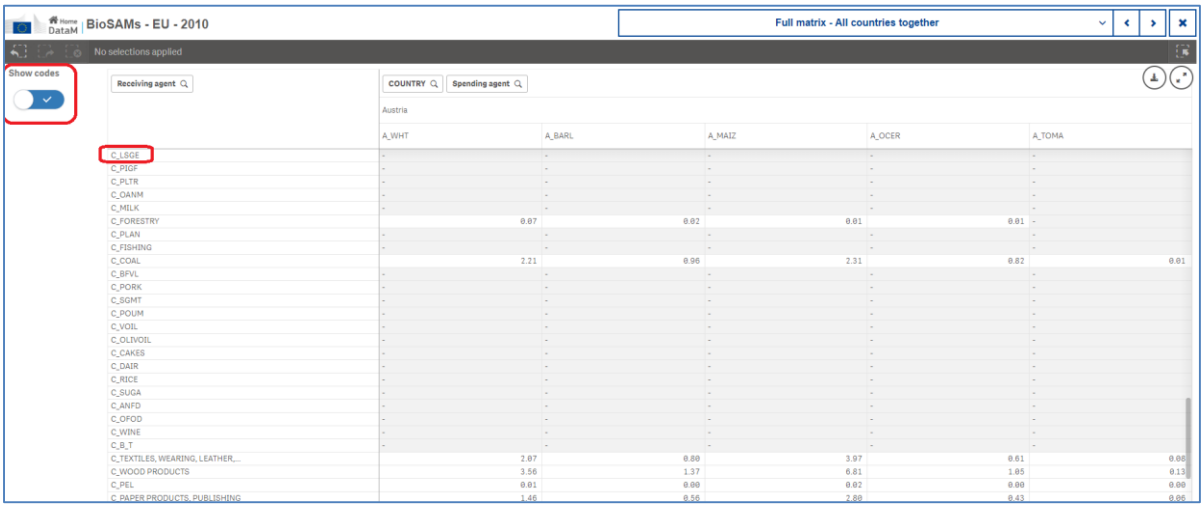


| Receiving agent | Spending agent | Maize (activity) | Paddy rice (activity) | Wheat (activity) | Barley (activity) | Other cereals (activity) | Tomatoes (activity) | Other vegetables (activity) | Grapes (activity) | Fruits and nuts (activity) | heep, goat and | Other livestock ( | Fishing (Home c | Sugar & bakery & | Beverages & tc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maize (commodity) | | 277.11 | - | - | - | - | - | - | - | - | | | | | |
| Forestry (commodity) | | 0.96 | 0.21 | 5.88 | 2.30 | 0.79 | - | - | 0.00 | - | | | | | |
| Minning (commodity) | | 81.91 | 0.38 | 171.12 | 73.39 | 44.03 | 26.83 | 204.67 | 0.21 | 13.62 | | | | | |
| Textiles, wearing apparel and leat | | 42.64 | 0.70 | 86.40 | 32.66 | 8.80 | 8.30 | 18.13 | 4.77 | 36.83 | | | | | |
| Wood products (commodity) | | 95.92 | 1.34 | 138.38 | 53.24 | 26.47 | 18.01 | 27.79 | 6.57 | 68.63 | | | | | |
| Pellets (commodity) | | 0.14 | 0.00 | 0.20 | 0.07 | 0.03 | 0.03 | 0.08 | 0.01 | 0.09 | | | | | |
| Paper products, publishing (comm | | 79.76 | 0.86 | 146.74 | 52.23 | 16.66 | 12.41 | 29.49 | 5.67 | 59.72 | | | | | |
| Petroleum, coal (commodity) | | 1,143.58 | 21.80 | 2,354.73 | 1,050.60 | 515.19 | 296.95 | 1,562.67 | 37.04 | 227.17 | | | | | |
| Chemical, rubber, plastic product | | 1,775.72 | 29.17 | 2,824.87 | 1,100.59 | 547.34 | 191.48 | 505.05 | 100.19 | 890.46 | | | | | |
| Biogasoline (commodity) | | 2.83 | 0.08 | 5.23 | 2.24 | 1.26 | 0.27 | 0.89 | 0.20 | 2.06 | | | | | |
| Biodiesel (commodity) | | 5.62 | 0.12 | 12.16 | 4.57 | 1.64 | 0.49 | 1.45 | 0.46 | 3.12 | | | | | |
| 2nd generation biofuel – biochem | | 1.16 | 0.03 | 3.32 | 1.31 | 0.55 | 0.12 | 0.35 | 0.07 | 0.68 | | | | | |
| 2nd generation biofuel – thermal | | 0.09 | 0.00 | 0.12 | 0.04 | 0.02 | 0.01 | 0.03 | 0.01 | 0.04 | | | | | |
| Fertilizers (commodity) | | 25.73 | 0.27 | 27.67 | 9.32 | 7.08 | 0.35 | 1.43 | 0.08 | 0.78 | | | | | |
| Biochemicals (commodity) | | 186.67 | 2.93 | 283.29 | 114.66 | 54.26 | 18.64 | 50.00 | 10.22 | 90.20 | | | | | |
| Mineral products nec (commodity | | 84.35 | 1.10 | 180.53 | 68.28 | 33.90 | 17.35 | 39.58 | 7.39 | 67.66 | | | | | |
| Metal products (commodity) | | 159.18 | 6.10 | 274.35 | 134.51 | 61.27 | 52.58 | 76.58 | 27.09 | 185.00 | | | | | |
| Motor vehicles and parts (commo | | 53.78 | 0.13 | 111.85 | 41.40 | 14.60 | 4.11 | 9.86 | 1.23 | 21.55 | | | | | |
| Machinery and equipment nec (cc | | 244.70 | 2.89 | 564.16 | 235.13 | 117.64 | 34.27 | 83.91 | 13.79 | 135.55 | | | 209.43 | 46.83 | 214.3 |
| Manufactures nec (commodity) | | 9.64 | 0.14 | 28.50 | 8.89 | 3.16 | 1.98 | 7.63 | 1.46 | 12.63 | | | | 0.42 | 72.7 |
| Electricity and gas (commodity) | | 247.77 | 2.12 | 571.50 | 287.20 | 247.97 | 0.83 | 8.40 | 2.06 | 32.95 | 2,173.72 | 126.37 | 2,975.08 | 1,128.98 | 3,221.8 |
| Bioelectricity (commodity) | | 0.40 | 0.00 | 1.84 | 1.27 | 1.19 | 0.00 | 0.02 | 0.00 | 0.07 | 34.89 | 205.64 | 132.04 | 23.24 | 546.6 |
| Water (commodity) | | 82.52 | 4.18 | 118.44 | 58.10 | 15.37 | 27.20 | 33.21 | 19.11 | 122.44 | 2,213.41 | 64.05 | - | 16.85 | 85.6 |
| Coast | | 3,706.20 | - | 199.34 | 1.29 | 529.10 | 214.91 | 570.60 | 50.91 | 36.27 | 133.61 | 200.52 | 2,421.78 | 100.21 | 108.93 | 31.91 | 99.5 |
| Arid North | | 946.58 | 249.40 | - | 768.22 | 116.66 | 815.64 | 270.79 | 307.62 | 262.02 | 1,567.74 | 42.43 | 835.38 | 1,814.48 | - | 36.63 | 142.0 |
| Arid South | | 215.15 | - | 175.23 | - | 491.09 | 167.22 | 236.87 | 49.42 | 3,737.73 | 894.78 | 18.52 | 447.19 | 2,085.20 | 1,635.91 | 6.27 | 16.4 |
| High Rainfall (commercial product | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Semi-Arid North (commercial pro | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Semi-Arid South (commercial pro | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Food crops | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cotton (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sugarcane (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Coffee (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tea (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tobacco (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Others crops (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Livestock (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dairy (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Fishing (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Forestry (production) | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAMs – EU - 2010, accessed on 22/05/2018.

JRC, especially in the modelling tools, uses codes for identifying the agents. By toggling the "Show codes" switch, the column and row headings of the SAM are changed from agent names to agent codes. See figure A16.

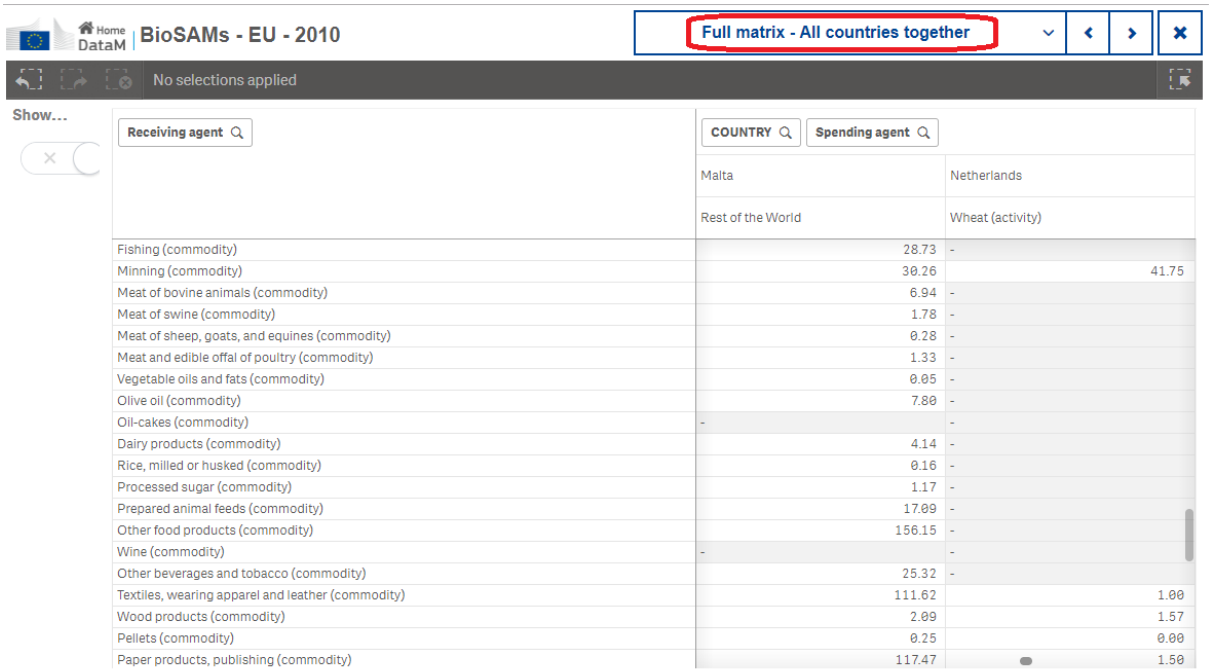
**Figure A16.** Downloading a SAM with codes




*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAMs – EU - 2010, accessed on 22/05/2018.

Finally, from the "Full matrix - All countries together" sheet of the interactive dashboard, users can visualize and make the xlsx download of the SAM for all Member States in one shot. See figure A17.

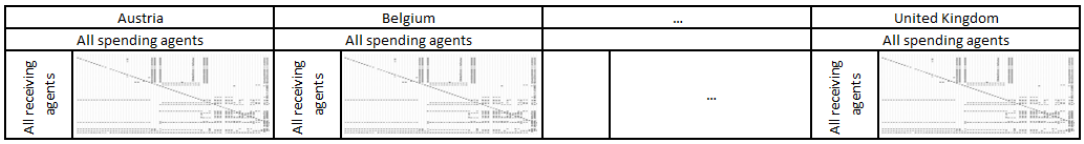
**Figure A17.** How to download the SAM in traditional matrix format – All countries




*Source:* DataM, provided by the European Commission – Joint Research Centre. Dashboard: BioSAMs – EU - 2010, accessed on 22/05/2018.

In the xlsx outcome, SAMs are put one after the other as in Figure A18, (sorted by the ISO code of the 28 Member States).

**Figure A18.** Structure of a multi-SAM download




*Source:* JRC, 2018.

## Open data portals

In the period subsequent to the publication of this report, following pages will[11] be gradually activated on relevant open data portals, enabling to easily find this dataset on the web:

1. On the JRC Data Catalogue: https://data.jrc.ec.europa.eu/dataset/2bf5e568-dacb-422a-a4f0-05ee62ad30c6
2. On the EU Open Data Portal: https://data.europa.eu/euodp/data/dataset/2bf5e568-dacb-422a-a4f0-05ee62ad30c6
3. On the European Data Portal: https://www.europeandataportal.eu/data/en/dataset/http-data-europa-eu-2bf5e568-dacb-422a-a4f0-05ee62ad30c6

## List of abbreviations and definitions (annex)

| | |
|---|---|
| CSV | Comma separated value |
| GAMS | General Algebraic Modeling System |
| DataM | JRC data portal of agro-economic modelling |
| QR | Quick response |
| SAM | Social Accounting Matrix |
| XLSX | Microsoft Excel file format |

[11] The time necessary for the activations of these services is beyond the control of the authors.

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