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System for Environmental and Agricultural Modelling;
Linking European Science and Society

Developing Country impacts – Evaluating case studies

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General information

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Executive summary

This deliverable evaluates the case studies that are part of Task 3.8. Our main focus is on developing country impact analysis. This focus reflects the stress in the DOW on developing countries. Task 3.8 however has a slightly broader goal of analyzing the third country impacts of EU agricultural policies. According to the first deliverable of Task 3.8 (PD 3.8.1) we will also assess the competitiveness of EU agriculture vis-à-vis EU's main competitors within Task 3.8. For completeness we devote limited space to indicating the available data for this competitiveness assessment, restricted to the GTAP component of this assessment. For mote details on the way in which the competitiveness of EU agricultural policy will be assessed we refer to PD 3.8.3, discussing the linking of CAPRI and GTAP which will be instrumental for this assessment.

The aim of this deliverable is two-fold. As outlined in the description of work (DOW) it evaluates the developing country case study for Mali. In the case of Mali detailed data are available, due to past research projects of CIRAD. Mali, however, may not necessarily be representative of all developing countries in terms of its key features, nor in terms of data availability. The focus of Task 3.8 is on developing a general methodology for analyzing impacts on developing countries. This methodology should be applicable in different countries with generally available data. Apart from describing the data available for Mali we thus also make an inventory of data available for other developing countries. This will allow us to develop a methodology for the Mali-case, as planned for in the project proposal, while assuring that the methodology may also be applied elsewhere by aligning the methodology with publicly available data for developing countries.

We start with a short discussion of the GTAP model to indicate the coverage and indicators available at the global level. An overview of the coverage of GTAP may also be important for selecting case study countries. Linking to the global level model is easier if the case study country is represented as such in the GTAP database, as opposed to being part of an aggregate. In the latter case, of which the Mali case study is an example, it is harder to link the global changes to a case study country. Coverage as a single country in the GTAP database is also important for the development of national level CGE models in case there is no more detailed Social Accounting Matrix (SAM) available. In such an instance the SAM included in GTAP may provide a consistent starting point for the modelling work.

The main part of the report is devoted to describing the different model elements for analyzing the impact on developing countries, their data requirements and the type of indicators supplied by each of the models.

National level CGE models have a similar role as CAPRI for the analysis of the changes in Europe. The national CGE models will be based on a model template developed at the World Bank (MAMS). Apart from a well-developed starting point this link also provides support in terms of estimating model parameters and model development. A national Social Accounting

Matrix (SAM) is required to develop a CGE model. IFPRI has made several SAMs available, and as suggested above the GTAP database provides a set of (aggregated) SAMs as well. CIRAD is in the process of completing a SAM for Mali, which will allow application of a CGE model for Mali.

Poverty is a key aspect of assessing the impact on developing countries. Micro-simulation models, linked to the national level CGE models, will be adopted for assessing the poverty impacts. Micro-simulation models rely upon household expenditure surveys, preferably in combination with census data to assure national coverage of the analysis. The World Bank provides a set of household level surveys suitable for micro-simulation analysis. Census data are publicly available only for a limited set of countries. Most countries however perform census on a more or less regular basis and these may be obtained by contacting national statistical bureaus. In the case of Mali a 1985 national level census is available, as well as a set of household surveys.

As in the case of the analyses for Europe assessing the impact on agricultural sustainability is a key point in the developing country analysis. This will be addressed through a tropical version of the FSSIM model which will yield a similar set of sustainability indictors as derived from the European FSSIM models. Data requirements for developing a FSSIM model are not only high but also entail a set of data not collected on a regular basis by international institutions. In the case of Mali sufficient agricultural data are available and are currently used to develop a FSSIM model for the cotton area.

By starting from a broader perspective on the developing country analysis we assure that the specific model components used for the Mali case study can be used in other settings as well. The model components will be developed in a modular framework to accommodate the absence of a specific dataset in different settings. Based on our inventory the farm level data required to develop a FSSIM model appears to be most limiting factor for applying the methodology elsewhere. Another concern is the variation in the years in which data are collected. This implies that even if all required dataset are available for a specific country, we will need to reconcile data from different years.

Overall we may conclude that Mali will be a valuable case to study the implementation of the methodology, posing mainly challenges in terms of linking to the GTAP model which does not distinguish Mali as a separate country. In terms of the other datasets Mali appears representative for the data availability in developing countries thus providing good testing ground for the methodology development.

Specific part

1 Motivation

Task 3.8 focuses on the third country impacts of EU's agricultural policies. This analysis has two main objectives (see for more detail PD 3.8.1 outlining the conceptual framework of Task 3.8):

(i) *Agricultural competitiveness:* EU agricultural policies may affect the international competitiveness of European agricultural producers, which through changes in international trade flows affects EU agricultural production;

(ii) *Poverty and sustainability in developing countries:* EU agricultural policies, through international trade, affect livelihoods and natural resource use in developing countries, which may conflict with, or support EU's development and environmental policies.

These two objectives are addressed with different methodologies. The first objective requires an insight in changes in international trade flows related to EU agricultural policies. This is addressed by linking CAPRI (allowing detailed modelling of EU agricultural policies) and GTAP (allowing detailed modelling of international trade flows). This linking of models to assess the competitiveness of EU agriculture is discussed in PD 3.8.3 and will not be further addressed here.

We focus this deliverable on the second objective of Task 3.8, analyzing the impact of EU agricultural policies on developing countries. This objective is addressed by developing models linking macro-level policies or changes (like changes in international trade) to micro-level assessment of the poverty and sustainability impacts. This structure is based on a similar logic as applied in the EU focussed analysis of SEAMLESS: a national level model is linked to farm household models to analyze production impacts.

There are two major differences with the EU focussed analysis in SEAMLESS. First of all, agriculture is of much greater economic importance (in terms of employment, GDP and generation of foreign exchange) in developing countries. This implies that a (partial) agricultural model, like CAPRI, does not suffice since it ignores economy-wide impacts of changes in the agricultural sector. Secondly, assessing the poverty impacts of EU agricultural policies in developing countries requires one to account for both rural and urban households. In the case of EU export subsidies, for example, urban consumers in developing countries may benefit from cheap imported food whereas rural farm households are harmed by reduced prices for their agricultural output. Given these considerations we opt for using national level computable general equilibrium (CGE) models for developing countries. These models cover the entire national economies, allowing an assessment of interactions between agricultural and other sectors and allowing an assessment of the interests of both rural and urban households.

The aim of this deliverable is two-fold. As outlined in the description of work it evaluates the developing country case study for Mali. In the case of Mali detailed data are available, due to past research projects of CIRAD. Mali, however, is not necessarily representative of all developing countries in terms of key features, nor in terms of data availability. The focus of Task 3.8 is on developing a general methodology for analyzing impacts on developing countries. This methodology should be applicable in different countries and therefore cannot rely upon the wealth of data available for Mali. Apart from describing the data available for Mali we therefore also make an inventory of data available for other developing countries.

This will allow us to develop a methodology for the Mali case study (as planned in the project proposal), while assuring that the methodology can be applied elsewhere by aligning the methodology with available data for developing countries.

This deliverable is structured as follows. Chapter 2 focuses on GTAP, the global model used in SEAMLESS. GTAP is not only used to assess the competitiveness of EU agriculture, it also serves as the link between the EU and developing countries. The availability of country data in GTAP may play a role in selecting case studies. We therefore shortly outline the model structure and describe the countries and sectors present in the GTAP database. In Chapter 3 we switch attention to developing country models. We outline the three model components (national level CGE model, micro-simulation models and farm household models), discussing for each component the model structure, data requirements and indicators that may be derived from the analysis. Based on the data requirements identified in Chapter 3, Chapter 4 makes an inventory of available data. We focus on data that are available in public domain from secondary sources, *i.e.* without relying on own data-collection efforts. In the case of Mali more detailed data are available, due to past research efforts. Chapter 5 discusses the available data for Mali and makes a comparison with the general available data discussed in Chapter 4. The more detailed data available for Mali could allow an assessment of the methodology by comparing the results for Mali when using data of similar level of detail as available for other countries, to results with more detailed data. Such a comparison would give an indication of the additional value of using very detailed data. Chapter 6 concludes.

2 Global links

The international competitiveness of the EU is determined by its export prices relative to those of other countries. To asses these relative prices one needs to model international trade, which in SEAMLESS is done through a combination of CAPRI and GTAP, discussed in PD 3.8.3. Apart from contributing to an assessment of the competitiveness of EU agriculture, GTAP also serves to link EU policy changes to developing countries. In this context we shortly discuss the structure, data and indicators that may be derived from GTAP.

2.1 GTAP for global analyses

The Global Trade Analysis Project (GTAP) model is a computable general equilibrium (CGE) model. The main property of general equilibrium models is their coverage of entire economy, which contrasts with partial equilibrium models covering only a limited number of sectors (*e.g.* agricultural sector models like CAPRI).

CGE models aim at determining equilibrium prices and quantities on (interrelated) sets of markets. CGE models are firmly established within mainstream economics, with behavioural response of suppliers and buyers derived from optimising assumptions. Given a description of the production technology, the supplier chooses a combination of inputs such that costs are minimised for a given level of output. Given a description of consumer preferences, the buyer determines the preferred consumption bundle maximizing its utility for a given budget.

GTAP is a comparative static, multi-sector, and multi-region general equilibrium model. Each country (or region consisting of multiple countries) is described within the same structural model. A single regional household to which the income of factors, tariff revenues and taxes are assigned represents the consumer side. It is assumed that this regional household allocates its income to three expenditure categories: private household expenditures, government expenditures and savings.

In each country or region a representative producer for each sector takes production decisions. These decisions are based in profit maximization through choosing inputs of labour, capital, and intermediates to produce a single sector output. Producers can substitute primary factors for each other. In the case of crop production, farmers also make decisions on land allocation. Intermediate inputs are produced domestically or imported, while primary factors cannot move across countries.

Internationally traded commodities are assumed to be distinguished according to the region of origin. Using this so-called Armington assumption implies that, for example, wheat imported from the US is different from wheat imported from the EU, and trade flows in both varieties have their own price tag. A great advantage of the Armington assumption is that it allows us to model bilateral trade flows and bilateral trade policies. This feature plays a key role in assessing the impact of trade preferences vis-à-vis developing countries.

2.2 GTAP – Coverage and indicators

A key asset of the GTAP consortium is the GTAP database on which virtually all current quantitative WTO analyses are based. These analyses are not necessarily based on the GTAP model, many institutions use the data in conjunction with their own model. In this section we discuss the most recent public version of the GTAP database to indicate the available data.

2.2.1 GTAP regions

The most recent (public) version of the GTAP database includes data for 87 countries or regions. Table 2.1 presents the 69 single countries included in the database, while Table 2.2 presents the individual countries included in each of the 18 aggregated regions.

The table of the aggregated regions provides a good perspective on the differing detail in which various regions of the world are covered. Some of the large aggregates in terms of countries contain mainly island economies of limited economic size (Rest of Free Trade Area of the Americas, Rest of Oceania and Rest of the Caribbean). Other aggregates contain mainly countries previously treated as a single country (Rest of Europe, Rest of former Soviet Union).

Table 2.1: Individual countries in the GTAP database

Individual countries			
Albania	Finland	Malta	Sweden
Argentina	France	Mexico	Switzerland
Australia	Germany	Morocco	Taiwan
Austria	Greece	Mozambique	Tanzania
Bangladesh	Hong Kong	Netherlands	Thailand
Belgium	Hungary	New Zealand	Tunisia
Botswana	India	Peru	Turkey
Brazil	Indonesia	Philippines	Uganda
Bulgaria	Ireland	Poland	United Kingdom
Canada	Italy	Portugal	United States
Chile	Japan	Romania	Uruguay
China	Korea	Russian Federation	Venezuela
Colombia	Latvia	Singapore	Vietnam
Croatia	Lithuania	Slovakia	Zambia
Cyprus	Luxembourg	Slovenia	Zimbabwe
Czech Republic	Madagascar	South Africa	
Denmark	Malawi	Spain	
Estonia	Malaysia	Sri Lanka	

As far as the analysis of the impact on developing countries is concerned the lumping of the majority of African countries in the Rest of Sub-Saharan African region is cause for concern. This lumping together is a direct result of the limited data availability for African countries. The first implication is that Mali, which has been chosen as a case study in SEAMLESS, is included in this aggregate with a wide variety of other countries. The GTAP data thus do not allow us to discern the impact of EU's policies on Mali separately from the impact on other

African countries. A more general implication is that there are limited possibilities for analysing the impact on individual African economies, due to lack of data.

Table 2.2: Individual countries associated with the aggregated GTAP regions

Region	*Individual countries in region*
Central America	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama
Rest of Andean Pact	Bolivia, Ecuador
Rest of East Asia	Macau, Mongolia, Democratic People's Republic of Korea
Rest of EFTA	Iceland, Liechtenstein, Norway
Rest of Europe	Andorra, Bosnia and Herzegovina, Faroe Islands, Gibraltar, Macedonia, Monaco, San Marino, Serbia and Montenegro
Rest of Former Soviet Union	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
Rest of Free Trade Area of the Americas	Antigua & Barbuda, Bahamas, Barbados, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Virgin Islands, U.S.
Rest of Middle East	Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Yemen
Rest of North Africa	Algeria, Egypt, Libya
Rest of North America	Bermuda, Greenland, Saint Pierre and Miquelon
Rest of Oceania	American Samoa, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia, Nauru, New Caledonia, Norfolk Island, Northern Mariana Islands, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna
Rest of Southern African Development Community	Angola, Congo, Mauritius, Seychelles
Rest of South African Customs Union	Lesotho, Namibia, Swaziland
Rest of South America	Falkland Islands (Malvinas), French Guiana, Guyana, Paraguay, Suriname
Rest of South Asia	Afghanistan, Bhutan, Maldives, Nepal, Pakistan
Rest of Southeast Asia	Brunei Darussalam, Cambodia, Laos, Myanmar, Timor Leste
Rest of Sub-Saharan Africa	Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, **Mali**, Mauritania, Mayotte, Niger, Nigeria, Reunion, Rwanda, Saint Helena, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, Sudan, Togo
Rest of the Caribbean	Anguilla, Aruba, Cayman Islands, Cuba, Guadeloupe, Martinique, Montserrat, Netherlands Antilles, Turks and Caicos, Virgin Islands (British)

In terms of methodology applied in SEAMLESS it implies that for the Mali case study we need to devise a strategy for linking a country that is part of a (rather diverse) regional aggregate to GTAP. The preferred option would be to separate Mali from the other countries. Depending on the compatibility of national level SAM (needed for the national level CGE, see next Chapter) with the structure of the GTAP SAMs, it may be possible to introduce Mali

as a separate country. In case this cannot be accomplished one has to assume countries with the regional aggregate of Mali to be homogeneous and apply the changes in relative prices etc. from GTAP to the national level CGE models.

Devising a way of dealing with the Mali case will benefit the general applicability of the methodology developed in SEAMLESS, which will need to be designed to deal with countries that are part of regional aggregate as well as with countries that are a separate country in the GTAP database.

2.2.2 GTAP sectors

The GTAP database includes 58 sectors, covering the whole of the economy. These sectors include 12 primary agricultural sectors and 8 food processing sectors (Table 2.3). Coverage of the whole economy comes at the expense of a detailed representation of the various sectors. In the case of agriculture the 12 primary sectors present rather rough aggregates compared to the more detailed modelling of agricultural production in CAPRI.

Table 2.3: Sectors in the GTAP database

Agricultural, forestry and mining		Manufacturing and services	
Primary agriculture		*Manufacturing*	
1	Paddy rice	27	Textiles
2	Wheat	28	Wearing apparel
3	Cereal grains nec	29	Leather products
4	Vegetables, fruit, nuts	30	Wood products
5	Oil seeds	31	Paper products, publishing
6	Sugar cane, sugar beet	32	Petroleum, coal products
7	Plant-based fibers	33	Chemical, rubber, plastic products
8	Crops nec	34	Mineral products nec
9	Bovine cattle, sheep and goats, horses	35	Ferrous metals
10	Animal products nec	36	Metals nec
11	Raw milk	37	Metal products
12	Wool, silk-worm cocoons	38	Motor vehicles and parts
		39	Transport equipment nec
Resource extraction		40	Electronic equipment
13	Forestry	41	Machinery and equipment nec
14	Fishing	42	Manufactures nec
15	Coal		
16	Oil	*Services*	
17	Gas	43	Electricity
18	Minerals nec	44	Gas manufacture, distribution
		45	Water
Food Processing		46	Construction
19	Bovine meat products	47	Trade
20	Meat products nec	48	Transport nec
21	Vegetable oils and fats	49	Water transport
22	Dairy products	50	Air transport
23	Processed rice	51	Communication
24	Sugar	52	Financial services nec
25	Food products nec	53	Insurance

26 Beverages and tobacco products	54 Business services nec
	56 Recreational and other services
	57 Public Administration, Defense, Education, Health
	58 Dwellings

The strength of GTAP lies not with providing a detailed assessment of the impact on agriculture, but in providing an economy-wide perspective on policy changes. The implication is that the international competitiveness of EU agriculture can only be addressed in terms of the aggregate sectors in Table 2.3 if the analysis is done with GTAP. This provides the rationale for linking GTAP to CAPRI, to exploit the agricultural detail provided by CAPRI and the economy-wide coverage of GTAP.

As a final note we need to stress that although the GTAP data cover the 58 sectors in the 87 regions, this level of disaggregation is not possible in an applied model. As a rule of thumb a model of 20 by 20, *i.e.* 20 regions and 20 sectors can still be solved. With a smaller number of regions a larger number of sectors can be included in the model, and vice versa. In practice the limits on the dimensions of the model are not overly restrictive. Most research questions focus on a limited number of countries or sectors and can be addressed with a smaller than 20 by 20 model.

2.2.3 GTAP indicators

Being designed for modelling international trade, the main strength of GTAP is to assess international competitiveness of countries. Being strongly embedded in economic theory, GTAP furthermore allows an assessment of the aggregate welfare impacts of (trade) policies, providing a concise summary statistic of the impact of a policy on an economy.

A change in the competitiveness of a country following a (trade) policy can be most directly be measured by a change *price ratio* of in the (border) prices of agricultural imports relative to domestic prices. A change in relative prices of different producers will induce a change in trade flows, which can be measured by a change in *trade balance* (value of exports – value of imports) or by *self sufficiency* (the domestic share in total use of a good). The modelling of *bilateral trade flows* furthermore allows an analysis of changes in trade flows with different regions. Next to changes in trade flows the change in *agricultural value added* is of importance. Value added is the return to the factors of production (land, labour and capital) from which farm households earn their income. Of these the return to land provides the strongest indication of a change in returns in agriculture, since in GTAP only agricultural sectors make use of land. Labour and capital are also used in other sectors of the economy, and their returns are thus determined by both agricultural and non-agricultural sectors.

The before-mentioned indicators allow an assessment of the international competitiveness of agriculture (and other sectors) for each of the countries or regions in the applied model. Note that being a general equilibrium model, GTAP can assess both the direct impacts of a change in policy on the agricultural sector, as well as the indirect effects on the rest of the economy. For example, changes in prices of land, labour and capital affect consumer income, expenditures and thus demand for (agricultural) goods. Changes in prices of primary agricultural goods furthermore affect other sectors using these goods as inputs, like the food processing industry. These indirect effects are captured in the equilibrium prices and trade flows mentioned above. To understand the mechanisms behind the equilibrium outcomes one needs to disentangle the different (direct and indirect) effects of a policy change. The

interactions between different parts of the model complicate such an analysis of the main drivers of the aggregate impact of a policy.

CGE based analyses of policy changes commonly focus on the *equivalent variation* (EV), a concise measure of the macroeconomic impacts of a (policy) change. The EV measures the change in income equivalent to the proposed policy change. It thus measures the amount of income that should be given to (or taken away from) households to attain a welfare equivalent to the welfare occurring with (policy) change coming into effect. If a policy change results in a positive EV, this number represents the additional income that could be generated if the policy were implemented. If total EV is positive the winners could potentially compensate the losers. Apart from this general conclusion on the potential for compensation the EV does not take distributive issues into account.

The EV provides a summary statistics of the total effect of different drivers of welfare changes. In order to disentangle the contribution of different drivers to this total effect the EV can be decomposed into different elements. Two drivers always play an important role in determining the overall impact in a CGE model: allocative efficiency and terms of trade. The *allocative efficiency* effects relate to distortions induced by taxes. The removal of import tariffs, as envisioned by the WTO negotiations, reduces distortions, allows factors of production (land, labour and capital) to move to their most efficient use. Increased efficiency translates into lower prices, promoting expansion of supply and demand which increases welfare. The *terms of trade effect* is a macro-economic phenomenon related to the balance of payments. The balance of payments measures the inflow of money from exports and investments and the outflow of money through imports and savings. Although some adjustments occur in savings and investments, the major adjustments occur in imports and exports. These adjustments are driven by changes in prices of imports and exports relative to those of competitors. The terms of trade effects measures the welfare impacts of these changes in trade flows, which tend to be significant in most models. Depending on the type of shock to the model other drivers may come into play, like for example the impact of technical change or increased employment on aggregate welfare.

3 Modelling the impact on developing countries

Whereas GTAP offers much in terms of analyzing the international competitiveness of (EU or developing country) production, it does not contribute much in terms of analyzing poverty or sustainability in developing countries. We therefore will develop national CGE models for developing countries and link these to (farm) household models to assess the micro impacts in terms of poverty and sustainability.

For the national level models we cannot rely upon developing a tropical version of CAPRI. As discussed in the introduction, the importance of agriculture in developing country economies requires a consideration of interactions with other economic sectors. Furthermore the assessment of poverty and possibly diverging interests of rural and urban households requires a model that includes non-agricultural sectors as well. We therefore opt for a national level CGE model for developing countries. The development of such a CGE model does not need to start from scratch. There has been a recent surge in CGE models aimed at analyzing the poverty impacts of international trade reform and of domestic policies (discussed in Section 3.1) on which we can build for SEAMLESS.

Although the national level CGE model can provide more detail on a developing country economy than possible with GTAP, a detailed assessment of changes in the distribution of incomes and poverty requires additional analyses, which will be done through micro-simulation models. Section 3.2 presents a short discussion of these models.

While the micro-simulations provide an insight in the poverty impacts, they do not allow us to assess the sustainability impacts of policies. We therefore link the national CGE model to farm household models to study the impact on agricultural production and sustainability. The farm household models used in developing countries will be comparable to the ones used for the European analyses (discussed in Section 3.3). We will furthermore employ a similar link of the farm household models to the CGE model as used to link the farm household models to CAPRI in the EU analysis.

Section 3.4 concludes by outlining the role of the different model components in the developing country analysis and their data requirements. The latter provides the link to Chapter 4 which provides an inventory of the available data for developing countries.

3.1 National level CGE models for developing countries

With the current WTO negotiations labelled as the “Doha development round”, the impact of international trade policies on poverty in developing countries has become a major part of the ex-ante analyses of a possible Doha agreement. This concern for development and poverty in particular has led to as surge in models analyzing how macro-level changes in the international trading system affect poor households in developing countries. These recent modelling developments provide a fruitful basis for developing the national level CGE models in SEAMLESS, which need to link the transmission of EU agricultural policies through international trade to household level impacts in developing countries.

3.1.1 Key model features

There is a strong convergence in the structure of applied CGE models used in policy analysis. Although applied models do vary considerably in terms of the number and type of sectors or

households distinguished, these variations do not affect the analytical structure of the models. In terms of variations across applied models there is a discussion regarding the macro-economic adjustment mechanisms. This discussion boils down to different view points of neoclassical and Keynesian economists on the way in which the economy adjusts to external shocks (for a discussion see Taylor and Anim, 2006). This discussion is highly relevant for policy analysis since assumptions on the macro-economic adjustment mechanisms have a strong impact on the model outcomes. In terms of structure of the CGE model, however, the different views do not require different model equations but amount to differences in opinion on which variables are exogenous and which are endogenous in the model. Differences in applied CGE analyses are thus related to the amount of disaggregation of different parts of the model (including different functional forms) and in the variables that are exogenous or endogenous. Differences are not related to fundamentally different model structures.

In the context of SEAMLESS we therefore searched for a general CGE model template that can serve as the basis for the national level CGE models. Researchers at IFPRI have developed such a CGE template (Löfgren, Harris *et al.*, 2002). Based on this IFPRI model the World Bank has recently developed MAMS (MAquette for MDG Simulations). The model is tailored to analyzing policies required for achieving the MDGS and implemented in a growing number of countries. The model is well-suited to analyzing poverty issues (which forms a main focus of the MDGs) with features that are especially relevant in a developing country setting: transaction costs and home consumption of (agricultural) output. Furthermore, being part of a larger effort of implementing the model in various countries (mostly by local researchers) the model is well documented and designed to be flexible enough for different settings by separating data from the model code (Lofgren and Diaz-Bonilla, 2006).

Being a CGE model MAMS shares a lot of features with the structure of GTAP. Production decisions are taken by a representative producer for each sector based on cost minimization, consumption decisions are taken by households based on utility maximization. The structure of MAMS is driven by the available data. It can thus incorporate as many production sectors and households as there is data available. Given the rather generic CGE structure we do not further discuss the structure of MAMS, apart from two non-standard features resulting from its orientation towards developing countries: *transaction costs* and *home consumption*. The model allows the user to specify costs related to market transactions. These costs can be considerable in developing countries because of lacking physical and institutional infrastructure. As a result producers may be effectively isolated from markets, which has far reaching implications for the extent to which they respond to policies. Another effect of imperfectly functioning markets is that home consumption of produced goods becomes important. This implies that part of the production will not reach the market (affecting the functioning of markets) and that producing households have access to their own food (affecting the assessment of poverty and food security).

In the context of SEAMLESS we intend to use the static component of MAMS, to remain in line with the comparative static analyses done with GTAP and the farm household models. It should be noted that MAMS has a dynamic module allowing the user to either solve the model recursively period by period, or to solve for a specific time horizon in a single pass (allowing forward looking behaviour). Basing the national CGE models on MAMS thus allows a relatively easy switch to dynamic analysis if desired in future analyses.

3.1.2 Data required

Being a CGE model, application of MAMS requires a Social Accounting Matrix (SAM) describing the entire economy being studied. The SAM provides the majority of the data needed to calibrate the model parameters. In addition to the SAM, data on elasticities need to

be collected. As with other CGE models the functioning (and feasibility in terms of solutions) of the model strongly depends on a set of elasticities that describe the responsiveness of production, import an consumption to price changes. Ideally these elasticities are econometrically estimated. In most applied CGE models, however, data limitations result in the use of guesstimated elasticities combining estimates (for other countries or products) with expert knowledge on the economy being studied.

MAMS is being implemented in a variety of countries with elasticities deemed appropriate by the country-teams implemented the model. This provides use with a range of elasticities on which we can build. In addition, there are a number of literature review studies which provide further guidance in case econometric estimation is not possible [Annabi, 2003 #1144\ provides a discussion of estimating the elasticities for the most often used functional forms as well as providing a review of elasticities from the literature].

3.1.3 Indicators provided

Being a CGE model MAMS will yield similar indicators a specified with GTAP (discussed in Section 2.2.3) at country level. The main difference is the disaggregation of results, which is determined by the level of disaggregation of the SAM on which the model is based. Assuming that more sectors distinguished by GTAP are included in the national model, we can address changes in production and trade at more detail than possible in GTAP. Furthermore, with multiple households the national model allows a first assessment of the distributional impacts of policies not permitted by the single household used in GTAP.

3.2 Micro-simulation models for poverty assessment

Key interests for developing countries are the distributional and poverty impacts of policies. For example, EU export subsidies reduce food prices in global markets. This benefits consumers of food, while reducing incomes of farmers. To assess the impact of policies on the distribution of income and on poverty a detailed account is needed of the differential impact across households. Recent increased availability of survey data has created a surge in micro-simulation models that exploit the full heterogeneity available in survey data.

3.2.1 Key model features

The definition of the Millennium Development Goals has renewed the interest in quantitative poverty analysis. Heterogeneity of households plays a crucial role in poverty assessments, which has led to a surge in the use of micro-simulation models. The key characteristic of micro-simulation models is the use of actual survey observations (usually the analysis is performed for several thousands of households). This allows one to include heterogeneity missed by models with representative households. The origins of micro-simulation methods are traced to Orcutt (1957). Despite these early origins of micro-simulation models, representative agent models still dominate the literature. Apart from micro-simulation models developed in the 1970s for analyzing distributive effects of taxes and welfare schemes, the idea of using individual observations in simulation models did not catch on until poverty studies in the late 1990s (Cogneau and Robilliard, 2000). Current analyses of a potential Doha agreement increasingly rely upon a combination of CGE and micro-simulation analyses to trace poverty impacts.

Static micro-simulation models can be divided in two groups: micro-accounting models and behavioral models. *Micro-accounting models* define household income by source (skilled/unskilled labor, land, capital, transfers/taxes) and identify household expenditures by different categories of goods. A counterfactual is then analyzed by changing income earned from the different sources and/or prices of goods consumed and analyzing the change in household income and/or consumption through a set of poverty indicators (discussed in Section 3.23). Micro-accounting models are suited for analyzing marginal changes since they assume that household decisions on income and expenditures remain the same. These models are relatively easy to implement since they do not require one to define household behavior. This also implies that they only capture first-order effects, *i.e.* the way in which changes in the external environment impact the household if the household would not change its behavior.

Most policy changes make non-marginal changes to the household environment. These changes are better addressed by *behavioral micro-simulation* models that do account for (part) of the changes in household behaviour following a change in the external environment. The applied models are based on econometrically estimated household models, and can be estimated either in reduced form (generally a rather a-hoc specification putting all variables deemed relevant as explanatory variables) or through a structural model (a set of equations describing causal relationships). Although the structural model is preferable from an analytical point of view, these models are haunted by identification problems.

In several recent poverty analyses the shocks applied to the micro-simulation models are generally derived from CGE models. Often a top-down approach is followed, in which change in returns of labour and prices of consumption goods from the CGE model are applied to the micro-simulation model without feed-back. More sophisticated analyses apply consistency checks on the combination of micro-simulation and CGE model, requiring the aggregated response of the households from the micro-simulation model to be in line with the findings of the CGE model (see for example Robilliard and Robinson, 2006).

As an alternative to the top-down linking of CGE and micro-simulation models there is a growing literature incorporating large numbers (typically several thousands) of households in a national CGE model (see for example Fofana, Cockburn *et al.*, 2006). These models can still be solved because of strong limitations on the interactions between households. Typically only consumption decisions are household-specific. Each household then has a fixed endowment of (skilled and unskilled) labour, land and capital. Production decisions are still taken by a single representative producer for each sector. These decisions result in factor prices, transferred to household income based on the initial factor endowments. The households then decide on their consumption using fixed expenditure shares. Summing the expenditures over all households results in total demand for each good, which needs to be balanced with the availability of goods (through production or trade). Since households cannot change their factor endowments nor influence production decisions there is no interaction between the household components and the remainder of the model. This keeps the dimensions of the model in check but the resulting model also does not yield more than can be obtained by a top-down linking of the CGE model and a micro-accounting model. A combination of a CGE model with a behavioural micro-simulation model that includes decisions on income generation would be more informative, by allowing households some changes in their income generation.

There is an exception to the above sketched model. Cogneau and Robilliard (2000) developed a model for Madagascar in which households also take both consumption and production decisions. This implies that the dimensions of their model increase dramatically. They keep the model solvable by strongly limiting the number of sectors, having only a single agricultural sector.

Within the context of SEAMLESS we are interested in both poverty and sustainability issues in developing countries. Limiting the CGE model to a single agricultural sector appears to restrictive given our research interests. Integration of a large number of households without interaction with the rest of the model does not yield more than a linked CGE micro-simulation framework. We therefore opt for having separate CGE and micro-simulation models in the developing country analysis. With such a linked structure a single representative household in the CGE model would suffice since the micro-simulation model would capture household heterogeneity. However, having different types of households in the national CGE model is informative, for example if users only demand a rough idea of the distribution of impacts across households. Several households also allows production decisions to be household-specific, to account for market imperfections that may elicit different production responses from different types of households. One key distinction we need to be made is between rural and urban households. Depending on the detail in a national level SAM more household types may be distinguished. Detailed distributional analyses are then provided by linking the representative households to sets of micro-simulation models.

3.2.2 Data required

Micro-simulation models rely on household survey data, possibly coupled with census data to establish a representative national level representativeness. At the minimum one needs household data on income (preferably by source, *i.e.* whether stemming from type of labour (education), land, capital and transfers/taxes) and expenditures. In case one opts for a behavioural micro-simulation model more data (preferably panel data) are required to estimate the parameters of the behavioural equations. For poverty assessments we furthermore need a poverty line, *i.e.* a definition of which households are poor. The World Bank has a well-known international poverty line of 1 dollar a day. Most countries have a national poverty line, while it is also possible to define a poverty line on the basis of expenditures needed to obtain a minimum number of calories.

3.2.3 Indicators provided

The strength of micro-simulation models is their ability to show the diverse impact of policies across households. In order to assess the poverty impacts a variety of indicators is available. The most well-known set of indicators is the Foster-Greer-Thorbecke (FGT) set of poverty measures, consisting of (*i*) the poverty headcount (the percentage of poor people); (*ii*) the poverty gap (the amount of money needed to lift the poor above the poverty line) and (*iii*) a measure of the severity of poverty focusing on the poorest of the poor. In addition to (absolute) poverty, policy-makers are often concerned with the distribution of income. An often used measure is the Gini-index providing a summary statistic of the equality of the income distribution.

3.3 Farm household models for developing countries

The micro-simulation models are an important tool for household-level poverty assessments. It does however not shed a light on the impacts of (EU) policies on the sustainability of agricultural production in developing countries. The national level CGE model may provide some insight in the impact on agricultural production, but only at an aggregate level. We therefore employ tropical versions of the farm household models used in the EU-focussed

analyses in SEAMLESS to get a detailed assessment of the changes in agricultural production.

The farm household models used for developing countries are shaped in accordance with the farm household models used in the European analysis. Some modifications are made to reflect tropical production systems. We shortly discuss the main features of the farm household models followed by a discussion of data required and indicators provided by the farm household models.

3.3.1 Key model features

The farm level model is of the FSSIM type and is an adaptation of the model developed by SEAMLESS for Europe. It is currently applied to Koutiala and Sikasso, two provinces of the cotton area. Its objective function consists of a utility function that includes a mean variance framework to deal with farmers' risk aversion. The model is subject to the usual land and labour constraints but also to capital and rotation constraints. It includes grain consumption by the family, an important aspect of production in developing countries. Grain is provided by home grown production or by purchase on the local market at a higher price. The model is being validated for the farm typology developed by CMDT in the cotton area. Activities are standard crop rotations with several levels of intensification and various types of soils. Current focus is made on manure use as fertilizer and manure production by livestock.

3.3.2 Data required

First a farm typology has to be drawn to distinguish the various types of farms. In developed countries farm structure is essential to distinguish farms. Land availability is usually the main distinguishing factor. In Africa, where land is abundant, land per worker is usually homogenous. What makes a difference is the use of animal draft, livestock owned, the enrolment in export crops schemes or the access to irrigated land

Data requirements for farm models are high and diverse. The major activities have to be described first in terms of labour and cash requirement for the major periods, and second in terms of economic return. In most cases the variability of return has to be described to take into account the importance of climate variability and agricultural prices instability. A calendar with the key limiting factors has to be established to determine the major constraints of the farm. Then the farm endowment in terms of land, labour and capital has to be established for the major type of farms.

3.3.3 Indicators provided

Farm level models can produce a large array of indicators regarding economic and environmental performance. The economic performance can be summarized in terms of utility, profit, consumption, and factor productivity. Dual values of constraints provide useful information about factor productivity. Dual values of non optimal activities provide also some useful information about what is needed to make an activity competitive. Of course farm models deal with a single farm and therefore take prices as given, not providing information about prices (which is the reason for linking the farm household model to the CGE model which accounts for price-formation). Farm level models can calculate indicators such as erosion, pesticides use and toxicity, land conversion, organic matter and nutrient balance at different scales. These indicators are relatively easy to produce and have been produced in Mali in the past by various studies.

3.4 The role of the different model components

This chapter discussed different model components for analyzing the impacts in developing countries. To summarize this discussion Figure 4.1 provides a schematic outline of the different model components, focussing on their interrelations and role in the analysis.

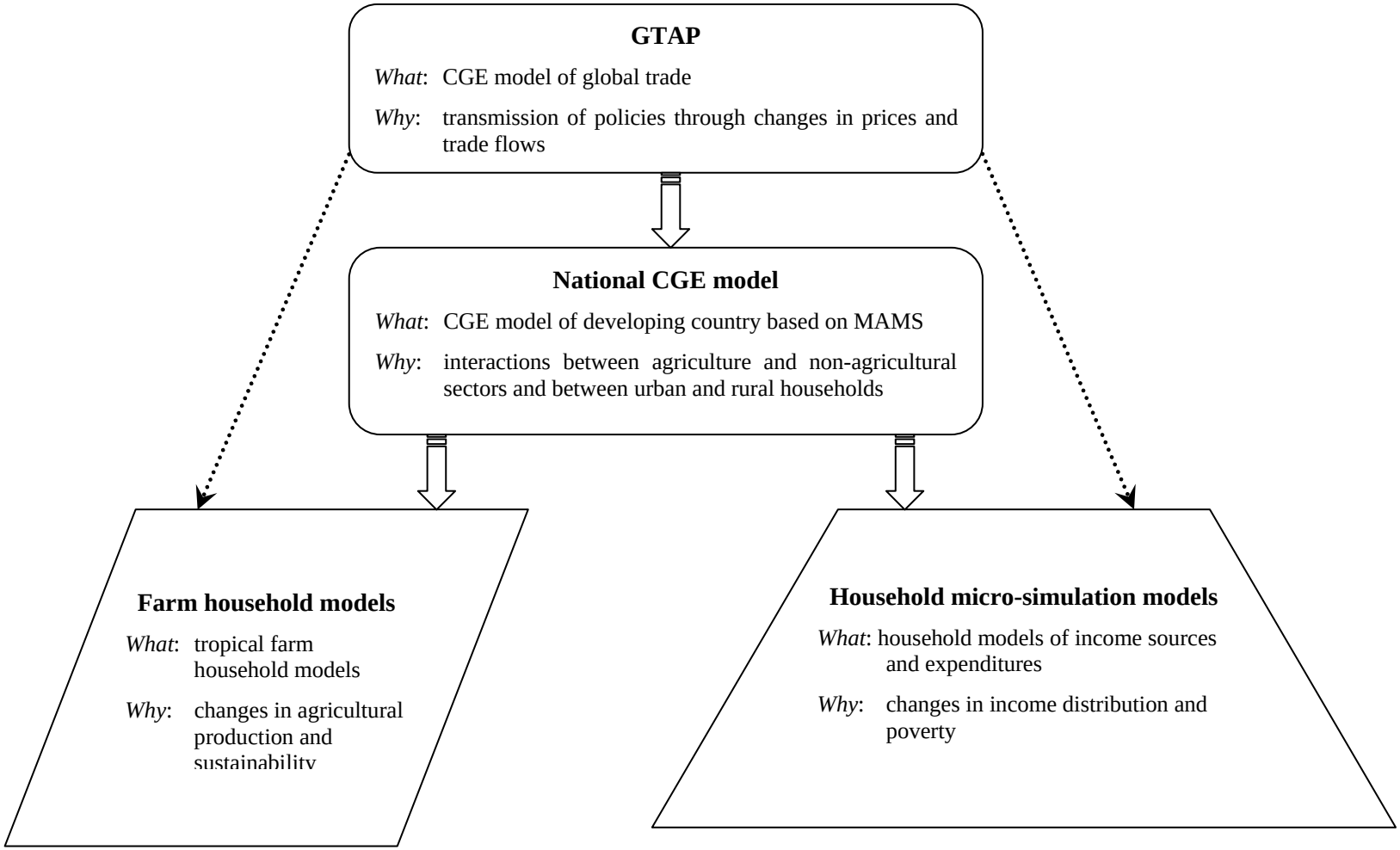
The linking of models is done in a modular fashion. This allows use of a subset of models. In the case of developing countries this modular approach is important from a data availability point of view. In many countries only limited amounts of data are available. We therefore prefer a modelling approach which is flexible enough to deal with a varying availability of data. In case no household surveys are available, for example, the micro-simulation analyses could be omitted from the study. In figure 4.1 we also indicated alternative pathways of analysis in case there is no national level CGE model. Results from GTAP may then be used in a top-down fashion in the farm household and/or micro-simulation models. Since GTAP is more aggregated in terms of sectors and households the transmission of results to the micro models will be a more rough approximation than obtained with a national CGE model.

There may be an overlap between the micro-simulation models and the farm household models if the first covers farm households as well. The farm household models are constructed for representative households, but could be employed as behavioural mciro-simulation models if implemented for each rural household for which data are available (see for example Kuiper and Ruben, 2006). Comparison with the findings of the micro-simulation models that focus on consumption expenditures and factor earnings could provide an insight in the importance of behavioural responses of agricultural household models that are generally ignored in micro-simulation models.

In order to apply the three models specific for developing countries we need an extensive set of data. The national level CGE model requires a SAM, preferably distinguishing a wide variety of agricultural sectors to facilitate linking to the farm household models. Different representative households would aid a first assessment of distributional and poverty, but is not necessary for the micro-simulation models. The micro-simulation models require household survey data, preferably panel data to allow identification of the parameters of a structural model. Household survey data may also benefit the estimation of elasticities for the national level CGE model that can not be derived from the SAM.

Farm level data are more complicated to obtain. World Bank like surveys contain income and expenditures and national agricultural surveys include only yields, area and in some cases some structural data regarding equipment or input use but in a very aggregated manner. While national level data are usually enough to estimate farm endowment, modellers have to use specific survey to get the labour and input requirement of the activities and their respective yields. Such surveys are usually region specific. Several surveys are required to be able to model a whole country.

Figure 1: Outline of model components and their role in developing country analysis



4 Available public data for developing country analysis

The previous chapter outlined the different model components to assess the impacts of policies on developing countries. Given these model components different types of data are needed to apply the methodology: social accounting matrices (SAMs); household surveys; census data; Regional surveys for farm models (FSSIM).

When looking for publicly available data we focussed on data that are available for a set of countries with a similar structure. Basing the methodology on such data sets assures that the methodology can be applied in various countries. It should be noted that for individual countries additional data could be available that would enrich the analysis. The datasets identified in this chapter should therefore be seen as the minimum data requirements for applying the methodology. We start by providing a short description of the publicly available data, concluded by an overview by country of available data.

4.1 Social accounting matrices

The national CGE model requires a SAM. This is not a technical requirement (one can solve a CGE model without constructing a SAM), but it provides strong checks on the internal consistency of the data used in the model. The SAM is also an important source of model parameters. Constructing a SAM is a time consuming affair, but fortunately more and more SAMs have been made publicly available.

IFPRI provides a rich public database[1] containing a large number of SAMs for developing countries. This effort is related to the earlier mentioned development of a CGE template, on which the MAMS model is founded. Although having roughly the same structure, the SAMs differ in the amount of detail in terms of (agricultural) sectors and number of households. Typically rural and urban households are distinguished, with some further disaggregation made in some cases (for example small and large farmers or rich and poor households).

A potential concern with these data is that most SAMs are from the mid 1990s. This may be rather outdated from a policy-perspective. There are however methods to update SAMs using more recent national account data (see for example Robinson, Cattaneo *et al.*, 2000). These methods maintain the general structure of the economy as given by the initial SAM. They are therefore not able to address any changes in the structure of the economy.

Next to the SAMs, IFPRI also publishes a large number of household level surveys. These surveys are hard to compare since they are designed for a specific research project. This in contrast with the more or less standardized household surveys of the World Bank (see Section 4.2). We therefore do not discuss the IFPRI household data further. In case of a particular case study it is worthwhile to check the availability of additional IFPRI data.

[1] Supplied via http://www.ifpri.org/data/data_menu.asp. Data need to be requested but are supplied free of charge.

4.2 Household surveys

The micro-simulation models are based on household surveys. These surveys also are an important input for the farm household models. Our aim is to identify publicly available datasets that are consistent across countries to allow the SEAMLESS methodology to be applied in a variety of developing countries. In terms of consistency across countries the Living Standard Measurement Study (LSMS) surveys coordinated by the World Bank appear to be the best source of data, although there are differences in emphasis between surveys.

The LSMS surveys are multi-topic welfare surveys, geared towards measuring and analyzing poverty. They collect information on household expenditures and income, health, education, employment, agriculture, the ownership of assets such as housing or land, access to services, and social programs. The availability of several rounds of surveys for the several countries provides a rich dataset to track changes over time. The LSMS surveys tend to have large sample sizes, covering in many cases several thousands of households, which makes them suitable for micros-simulation models.

Many household surveys conducted in developing countries are based on the LSMS framework. In case for a specific country no formal LSMS surveys are available it may well be that surveys with a comparable structure are conducted in the context of individual research projects.

4.3 Census data

Census data are important for assessing the representativeness of household surveys and for generalizing results from household surveys to a national level. Census data cover a large part of the population and are therefore expensive to collect. They are thus infrequently done, generally with an interval of ten years. The data are collected by national statistics offices. A limited number of them are made available through internet through the Integrated Public Use of Microdata Series (IPUMS-International) project[2].

The data cover a limited number of developing countries. They are rich in demographic detail (household size, education etc) and do indicate whether households are urban or rural. The also contain (limited) information on migration and employment. There are generally no data on land holdings which would be important for up-scaling the results of the farm household models.

In terms of generalizing the results of the farm household models to the national level one would ideally use agricultural census data. These are not directly available through the internet. The statistical department of the FAO however coordinates agricultural censuses through its World Census of Agriculture Programme. Through their website summary statistics and contact information can be obtained[3]. According to this overview 147 countries have done at least one agricultural census during the 1980-2000 period.

[2] Minnesota Population Center. Integrated Public Use Microdata Series-International: Version 2.0. Minneapolis:University of Minnesota, 2006 (www.ipums.org/international). Users need to register but data are supplied free of charge.

[3] FAO: http://www.fao.org/es/ess/census/wcares/default.asp

4.4 Agro-ecological zone data

Differences in agricultural potential are an important aspect of the farm household models. These models are preferably based on a detailed inventory of the natural resource endowments of farm households, but such detailed data are generally not available. The FAO however has been working on compiling a database of agro-ecological zones (AEZs), providing at least a rough assessment of the limitations posed by water availability and temperature. For each of these AEZs data are collected on harvested area and yield for a number of (tropical) crops.

In the context of a GTAP project on modelling green house gas emissions work has been done on updating and checking the AEZ data for internal consistency. The resulting dataset contains data for 159 countries updated to 2001 (the reference year of the GTAP version 6 database). These data are available for download at the GTAP website[4]. For each of the countries their endowments in terms of 18 different AEZs is provided, as well as harvested area and yield by AEZ for the following crops (if cultivated): barley, cassava, cotton, groundnuts, maize, millet, oil palm, others, potato, pulses, rapeseed, rice, rye, sorghum, soy, sugar beet, sugarcane, sunflower and wheat.

These AEZ data could be useful for up-scaling the results of the farm household models to the national level. If this is the case it may be useful to distinguish these different AEZs in the modelling of land in the national CGE model to facilitate the link to the farm household models.

4.5 Identifying data availability by country

So far we have discussed the availability of data by type. To apply the methodology in a specific country all types of data need to be available. An overview of the data by country is provided for Africa (Table 4.1), Asia (Table 4.2) and South America (Table 4.3).

Comparing the data availability across continents we find only three countries for which all types of data are available from the sources identified in this chapter: Brazil, South Africa and Vietnam. The picture for specific case studies is less bleak than suggested by this limited number of countries for a complete set of data. We limited the assessment to data reported to be available by the various international organizations. This overview is not complete, since data are often collected by local organizations. Most countries, for example, have census data available although only for a limited number of countries they are directly available through internet.

The most limiting source of data appears the household survey data. Despite the efforts of the World Bank to make these data available, still significant gaps in country coverage exist. Although research projects may collect similar data as included in the SLMS surveys, these tend to use a smaller sample size than used by the World Bank coordinated surveys. This may especially limit the possibilities for the micro-simulation models (depending on a large number of households). Given the current attention given to quantifying the progress towards reaching the MDGS one may expect more surveys to become available in the near future.

[4] GTAP Resource 1900 *Towards An Integrated Land Use Database for Assessing the Potential for Greenhouse Gas Mitigation* by Lee, Huey-Lin, Thomas Hertel, Brent Sohngen and Navin Ramankutty https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1900.

Table 4.1: Available data in some African countries

	SAM		Household	Census		AEZ
	GTAP V6	*National*	**surveys (LSMS)**	*General*	*Agricultural*	
Côte d'Ivoire	-	-	1985-87	-	-	2001
Egypt	-	1997	-	-	1981-82, 1990, 1999-2000	2001
Ghana	-	-	1987/88, 1991/92, 1998/99	-	-	2001
Kenya	-	2001	-	1989, 1999	1977-1979	2001
Malawi	2001	1998	-	-	1980-81, 1993	2001
Morocco	2001	1994	1991	-	1996	2001
Mozambique	2001	1994-95	-	-	1999-2000	2001
South Africa	2001	1933, 1998, 1999, 2000	1993	1996, 2001	1993, 2002	2001
Tanzania	2001	1992, 1998-2001	1993	-	1995, 2003	2001
Uganda	2001	1999	-	-	1991	2001
Zambia	2001	1995, 2001	-	-	1990	2001
Zimbabwe	2001	1991	-	-	-	2001

Table 4.2: Available data in some Asian countries

	SAM		Household	Census		AEZ
	GTAP V6	*National*	**surveys (LSMS)**	*General*	*Agricultural*	
Bangladesh	2001	1993-94	-	-	1977, 1983-84, 1996	2001
China	2001	-	1995, 1997	1982	1997	2001
India	2001	-	1997-98	-	1981, 1991, 2001	2001
Indonesia	2001	1995	-	-	1983, 1993, 2003	2001
Nepal	-	-	1996	-	1982, 1992, 2002	2001
Pakistan	-	-	1991	-	1980, 1990, 2000	2001
Papua New Guinea	-	-	1996	-	-	2001
Thailand	2001	1998	-	-	1978, 1993, 2003	2001
Timor Leste	-	-	2001	-	-	-
Vietnam	2001	1997	1992/93, 1997/98	1989, 1999	1994, 2001	2001

Table 4.3: Available data in some South American countries

	SAM		Household	Census		AEZ
	GTAP V6	*National*	**surveys (LSMS)**	*General*	*Agricultural*	
Argentina	2001	2000	-		1998, 2002	2001
Bolivia	-	1996	-		1984-1988	2001
Brazil	2001	1995-1996	1996/97	1960, 1970, 1980, 1991, 2000	1980/85, 1996	2001
Chile	2001	1996	-	1960, 1970, 1982, 1992, 2002	1975-76, 1997	2001
Colombia	2001	1997	-	1964, 1973, 1985, 1993	1988, 2001	2001
Costa Rica	-	1997	-	1963, 1973, 1984, 2000	-	2001
Ecuador	-	-	1994, 1995, 1998	1962, 1974, 1982, 1990, 2001	1999-2000	2001
El Salvador	-	2000	-	-	-	2001
Guatamala	-	-	2000	-	1979, 2003	2001
Guyana	-	-	1992/93	-	1981. 1989, 2000	2001
Honduras	-	1997	-	-	1993	2001
Jamaica	-	-	1988-2000	-	1978-79	-
Mexico	2001	1996	-	-	1991	2001
Nicaragua	-	-	1993, 1998/99, 2001	-	2001	2001
Panama	-	-	1997, 2003	-	1981, 1990, 2001	2001
Paraguay	-	1998	-	-	191, 1991	2001
Peru	2001	1994	1985, 1991, 1994	-	1994	2001
Uruguay	2001	1995	-	-	1980, 1990, 2000	2001
Venezuela	2001	-	-	1971, 1981,1990	1997	2001

Apart from the availability of data there is also a timing issue, as becomes clear from the years in Table 4.1 through 4.3 data are collected at different points in time. This implies that data need to be updated to a single year before the models can be applied. Although econometric techniques do exist for linking different datasets, these techniques will fail to capture any structural changes that may have occurred. Whether this poses a serious limitation of the analysis will depend on the specific country being studied.

5 Large economic surveys in Mali

There a several large scale database available for Mali that can be used to build large scale models such as sectoral models, Social accounting Matrices and Computable General Equilibrium models within the SEAMLIS IF framework. Data have been gathered by the Malian national statistical institute (DNSI = Direction National de la Statistique et Informatique) with technical help and funding from international institutions.

The sampling procedures are based on the population census of 1987 for Mali. All surveys use stratification. In this report we describe first briefly the source of the data from ministries, then the major surveys, then we detail the objectives and methods of the major household surveys and finish with a few secondary surveys that can be used for alternative purpose.

5.1 The statistics from the ministries

Several ministries have a statistical service responsible of collecting and formatting data.

- Agriculture
- Transport
- Public work and housing
- Mines, hydraulic and energy
- Public health
- Social action and women promotion

In these services statistics are usually linked to planning activities. The quality of the data is unequal but has been improved over the years. It remains difficult to build a proper accounting system and to build a SAM with these data. The consistency check imposed by the matrix structure of the SAM reveals where the information is missing or incomplete, requiring additional data or knowledge of the economy to arrive at a balanced SAM.

5.2 The major large scale surveys

The major household surveys realized in Mali are the following: EBC 1988/89; EMCES 1994 ; EDS I and II and the annual agricultural survey ("enquête agricole de conjuncture"). The annual agricultural survey (EAC) is discussed in Section 5.3 together with other sources of data for the farm household model. In terms of general household data the following surveys are available:

1) EBC *(Enquête Budget Consommation)*: Survey upon Household budget, 2800 consumption units;
2) EMCES (*L'Enquête Malienne de Conjoncture Economique et Sociale*): "World Bank like" survey to measure adjustment programs impact, 9496 households;
3) EDMC 1996 (*Enquête sur les Dépenses des Ménages de la Capitale*): Survey about household expenses in the capital Bamako, 1008 households in Bamako;

4) EAC (*L'enquête Agricole de Conjoncture*): Crop area and yields, since 1964 whole country;
5) EDS (*Enquête Démographique et de Santé (EDS I and II):* Focused on reproductive health , 9000 women 3000 men;
6) PDSES (*Profil Démographique, Socio Economique et Sanitaire*): CILSS and INS have regrouped data from several sources to compare performances of several Sahelian countries;
7) EIM (*Enquête à Indicateurs Multiples*): Survey multiple indicators about reproductive health, 5000 households;
8) ESI (*Enquête Secteur Informel*): Survey about the informal sector, 10222 households;
9) EMEP (*Enquête Malienne d'Evaluation de la Pauvreté*): World Bank /DNSI, 2001;
10) EPAM (*Enquêtes Permanentes Auprès des Ménages*): since 1998 continuous, Agence Nationale pour l'Emploi (ANPE);
11) RGPH (*Recensement Général de la Population et de l'Habitat*): 1998, DNSI.

Table 5.1 summarizes the main features of the different surveys. The main surveys are discussed in some more detail in the following sections.

Table 5.1: Overview of available large scale surveys for Mali

		Type	*Year*	*Scale*	*Area*	*Sample size*	*Source*
1	EBC	Consumption budget	1988/89	HH	Country	2800	
2	EMCES	Socio economic	1994	HH	Country	9496	BM/DNSI
3	EDMC	Consumption	1996	HH		1800	
4	EAC	Agriculture	1999 onward	Farm	Country	2445	DNSI, CPS/agmin
5	EDS	Health		Women	Country	9000	
6	PDSES	Economic profile		-	Country	-	
7	EIM	Reproductive health		HH		5000	
8	ESI	Informal sector		HH	Country	10222	
9	EMEP	Poverty		HH	Country	7500	BM/DNSI
10	EPAM	Employment		HH	Country	4200	ANPE/AFRISTAT
11	RGPH	Population Census	1987 1998	Individuals	Country	All	DNSI

Source: authors

5.2.1 Enquête budget consommation (EBC) 1988/89

The *Enquête Buégétaire de Consommation* (EBC) is a survey on consumption budgets. Before the first EBC there have been a large number of household surveys in Mali but most surveys were regional and focussed on food consumption and nutrition:

- The *enquête de la mission socio-économique au Soudan* (enquête MISOES 1957-1958) is the only source of information before Independence focussing on household consumption;
- The *enquêtes du centre de développement de l'OCDE* (1977-1978);
- The *enquêtes de l'Office Malien du Bétail et de la viande* (OMBEVI 1974 et 1975);
- The *enquêtes de l'Office Régional pour l'alimentation et la nutrition en Afrique* (ORANA 1976, 1978 et 1979) ;
- The *bilans des disponibilités alimentaires de la FAO sur la période 1975-1977* ;
- The *enquête sur les dépenses des ménages urbains* (DNSI 1985-1986).

The 1988/89 EBC is the first household survey realized at the national level in Mali. It includes household budgets, food consumption and nutritional aspects. More specific objectives were:

- evaluation of demand functions;
- budget coefficient;
- household incomes;
- self consumption (especially agricultural households) ;
- estimation of crop and livestock production;
- food balance;
- analysis of food intake by children (below 2 years).

5.2.2 Enquête Malienne de Conjoncture Economique et Sociale EMCES (enquêtes prioritaires)

The *Enquête Malienne de Conjoncture Economique et Sociale* (EMCES) aims to analyse the social aspects of Structural Adjustment. Programs (World Bank like *enquêtes prioritaires*)

The specific objectives were:

- determine the social and economic conditions of the households,
- measure their living standard;
- measure the impact of macro economic policies on the population;
- compare key socioeconomic indicators between countries.

These indicators are supposed to provide policy makers with the necessary information to identify the groups at risk, groups that will be targeted by assistance programs and appropriate measure within social policies.

11 sections: household characteristics, housing, access to services, employment, migration, agriculture, non ag activities, expenses, incomes, belongings, anthropometry and vaccinations

5.2.3 Enquête sur les dépenses des ménages de la capitale (EDMC)

Establish the structure of expenses for goods and services, to propose the proper weighting system to construct a price index for the harmonized consumption within UEMOA countries.

5.3 Agricultural surveys

There is one large national agricultural database and several database for the cotton area which covers almost half of the agricultural area of Mali. The detailed data for the cotton areas are used to develop the tropical version of the FSSIM model.

5.3.1 Agricultural national survey (L'enquête agricole de conjoncture (EAC))

The objective of the EAC is to collect information about the national production for national accounting, food security and credit requirement. The EAC is the traditional annual agricultural survey realized since 1964. It mainly includes yields and area per crop. The aggregation produces the regional and national statistics about production. The data also includes the farm gate prices at harvest time (October, November, December) for the major crops. Also livestock per farm and their respective prices are collected.

Since 1986 the data includes information about future production. Since 1991 the data includes also grain stocks at the farm level. The idea is to establish the grain deficit or surplus at the end of the harvest around October with the objective to reduce food insecurity and to provide credit for the banking sector.

Until the end of the seventies the data is considered to be of poor quality due to relatively poor financing and inadequate technical training. The data is now better. The interviews are made in sedentary and transhumant communities in rural areas as well as in secondary urban areas. The sampling respects administrative boundaries as well as agro-climatic boundaries. All cropping and animal activities are investigated except crops of irrigated areas managed by Parastatal (*Organismes de Développement Rural* such as *Office du Niger*, *Office Riz Ségou*, *Office Riz Mopti*, etc...).

Table 5.2: Sample distribution of the annual agricultural survey (EAC)

Regions	*SE sample*	*Farm number*
Kayes	65	325
Koulikoro	82	410
Sikasso	100	500
Ségou	113	565
Mopti	99	495
Tombouctou	24	120
Gao	17	85
Total	500	2500

Traditional households are distinguished from modern farms. Periurban areas (urban centers) are excluded. Also the region of Kidal is excluded because its production is very marginal. The sample distribution by region is organized is presented in Table 5.2.

Two Directions are involved in the agricultural survey : the Direction Nationale de la Statistique et de l'Informatique (DNSI) and the Direction Nationale de l'Appui au Monde Rural (DNAMR). Ground work is organized by the Directions Régionales du Plan et de la Statistique (DRPS), the Directions Régionales de l'Appui au Monde Rural (DRAMR) and the various Offices de Développement Rural (ODR) under the umbrella of the *Ministère du Développement Rural*.

5.3.2 Monitoring and evaluation of Cotton sector by CMDT (Bases de données Suivi Evaluation)

This very detailed survey is being used by SEAMLESS to calibrate the FSSIM model to the Koutiala and Sikasso provinces which are part of the cotton area of Mali . There are two databases for the plot level and another at the farm level.

Databases at the plot level:

- DB monitoring and evaluation CMDT Plot level 97-98 to 01-02 (Nb Obs = *12 829*);
- DB monitoring and evaluation CMDT Plot level 02-03 (Nb Obs= *4 262*);

These two databases were aggregated in one DB monitoring and evaluation CMDT Plot level 97-98 to 02-03.

The FSSIM exercise (Simien 2006) was made using data for the regions of Koutiala and Sikasso. The data available for these two regions is also available for the rest of the cotton producing regions. As such the database is representative of a good half of the agricultural land of Mali. For the drier par of the country the project will have to rely on other more limited databases and for some coefficients the project will have to extrapolate the coefficients from case studies (villages or subregions). However agriculture in the drier part of the country is less complex with much less options. It requires less data and less level of intensification For the very specific *office du Niger* region, where most irrigated rice is produced, several surveys are available (see below).

For the FSSIM simulation the following choices were made:

- Only two regions Sikasso and Koutiala were kept (Nb Obs=*7 554*);
- For the rotations, we used the database from 97-98 and 99-00 (Nb Obs= *3 304*);
- DB monitoring and evaluation CMDT Plot level;
- Current crop and the ones of the 3 previous years;
- Cropping system (dates and quantities: seeding, ploughing, weeding, fertilization, pesticide application);
- Crop yields.

Databases at the farm level:

- DB monitoring and evaluation CMDT farm 97-98 à 01-02 (Nb Obs = *14 551*);
- DB monitoring and evaluation CMDT farm 02-03 (Nb Obs= *2 480*);

These two database were aggregated in one DB monitoring and evaluation CMDT Farm 97-98 to 02-03. Only the regions of Sikasso and Koutiala were selected (Nb Obs=*5 026*). The resulting database includes: Population; Equipment; Livestock; Land use; and Labor.

Producer prices database (Bases de données sur les prix aux producteurs)

This database reports monthly producer prices by region, sold quantities of grain (rice, maize, millet, sorghum) from 92-93 to 02-03 (Nb Obs= *421*)

Also EIER (SEP/ESPGRN) produced a monthly producer price from 1999 to 2003 for maize, millet, Sorghum, peanut, for Koutiala, Bougouni and Kadiolo which corresponds to the cotton area.

5.3.3 Surveys from Institut d'Economie Rurale

1) Poverty in Office du Niger, area 2005 ;

2) ESPGRN Sikasso over cotton producing farms (around 80 farms over 10 years)

3) Project FSP/ECO10 of Office du Niger and cotton area, 2006. On going.

4) Production system dynamics in the CMDT area. On going.

Table 5.4 Small agricultural surveys in Mali

		Type	*Year*	*Scale*	*Area*	*Sample size*	*Source*
1	Poverty in office du Niger	Socio economic	2005	HH	Office du Niger		IER
2	ESPGRN	Socio economic	Since 1994 annualy	HH	Cotton area	80	IER/ESPGRN
3	FSP/ECO 10	Socio economic	On going	HH	Office du Niger		IER
4	Production system dynamics	Socio economic	On going	HH	Cotton area (CMDT)		IER
9	ME plot	Technical coefficient		Plot level	Sikasso Koutiala		CMDT
10	ME farm	Incomes		Farm	idem		CMDT
11							

5.3.4 Input price database (Bases de données prix intrants)

Database CMDT-DPA-SPAC, Price to farmers of input and equipment form 1995 to 2005 (58 elements)

5.3.5 Data sources for the SAM

Data used to construct the SAM (IER/CIRAD) come from

1) Comptes économiques du Mali (revised) from 1990 to 2003, partial results 2004 and previsions for 2005 made in June 2005, established by the Ministère du Plan et de l'Aménagement du Territoire through the Direction Nationale de la Statistique and Informatique (D.N.S.I).

2) provisional budgets, 2005 from the Direction Générale de la CMDT june 2005.

3) Evolution of custom income collected from 1996 to 2004 by the Ministère de l'Economie et des Finances through the sous-direction des recettes et des études of the Direction Générale des Douanes.

4) The *recensement des unités industrielles* 2003, results 2001-2002 volume 2 of the *Ministère de l'Industrie et du Commerce* through the *Cellule de Planification et de Statistique* (CPS) of the *Direction Nationale des Industries* (DNI). The Centre d'Analyse et de Formulation des Politiques de Développement (CAFPD).

5) L'Etude de définition du plan d'aménagement concerté sur la pêche au sein de l'UEMOA.

6) review of the fishing sector of the Union, report 1 by Commission de l'UEMOA août 2005.

7) Nomenclature NAEMA of UEMOA by AFRISTAT.

8) Evacuation and ginning of seed cotton at CMDT. Evaluation and prospect of Malian cotton by the *Direction Générale of CMDT*.

9) Database over cotton and rice sector by the Programme Economie des Filières of IER (ECOFIL/IER).

10) Enquête Malienne d'Evaluation de la Pauvreté (EMEP 2001) by DNSI[5].

11) Enquête Agricole de conjoncture (EAC) of the 2001-2002 ag campaign realized by the CPS of the Ministère de l'Agriculture.

12) The SAM 2001 constructed by K.NOUVE (2005).

13) The aggregated SAM of 1998 to 2002 built by M.S..KEITA and K.NUBUKPO (2005).
14) Input output tables (TES) 2002.

[5] Enquête « Living Standard Survey » exécutée par la DNSI et financée par la Banque Mondiale.

15) Ressources-Emplois table (1997 et 1998) of DNSI/AFRISTAT.

16) Agricultural statistics of Mali published by FAO.

17) The *Enquête Malienne de Conjoncture Economique et Sociale* (EMCES 1994) or Enquête Revenu of 1994.

18) The *Enquête Permanente auprès des Ménages* (EPAM 2004) of the Observatory of employment and formation of ANPE (*Ministère de l'Emploi et de la Formation Professionnelle*).

19) Report on the livestock sector (SADAOC, 2003).

20) Study over the competitiveness of various agricultural chains of Mali (mangos, beans, potatoes, tomatoes, sugar bean, sesame and cotton) N. GERGELY (2002).

21) Data over import/export and fruit production (office of external commerce of DNSI).

22) Annuaire 2001-2002 of CMDT.

23) Agricultural Politicies and regional development in Mali (11th session of the IER programme committee (Ministère de l'Agriculture).

24) National studies over fund transfers: case of Mali and link between migration and development (M.K. KEITA 2005).

5.4 Comparing data available for Mali to public databases

Sampling and the quality of the interviews vary widely between the surveys. Even the quality of the large surveys ran by the national statistic institute under the supervision of international institutions has to be checked carefully. Since SEAMLESS plans to use CGE models, microsimulations and farm models in Mali, the project will require several databases. For the CGE model a Social Accounting Matrix has recently been built by CIRAD. The necessary data for a CGE should be available before the end of 2006. For the consumption side the survey EMEP was used recently by CIRAD. Elasticities should be available soon.

Beside the national surveys there are a large number of smaller regional surveys that will be used to build farm models for the non-cotton regions. In addition World Bank like household surveys and a 1987 census are available for the micro-simulation analysis.

Overall Mali has had a large amount of surveys which is quite representative of the situation of most developing countries that have been peaceful in the last decade. It is a relevant country to implement the SEAMLESS methodology.

6 Conclusions

This deliverable evaluates the data needs for implementing the foreseen developing country analysis in SEAMLESS. The perspective of this deliverable has been broadened beyond the scope of the case-study in Mali to assure that the developed methodology can be implemented in the future in other countries as well.

We start with a short discussion of the GTAP model to indicate the coverage and indicators available at the global level. An overview of the coverage of GTAP may also be important for selecting case study countries. Linking to the global level model is easier if the case study country is represented as such in the GTAP database, as opposed to being part of an aggregate. In the latter case, of which the Mali case study is an example, it is harder to link the global changes to a case study country. Coverage as a single country in the GTAP database is also important for the development of national level CGE models in case there is no more detailed Social Accounting Matrix (SAM) available. In such an instance the SAM included in GTAP may provide a consistent starting point for the modelling work.

The main part of the report is devoted to describing the different model elements for analyzing the impact on developing countries, their data requirements and the type of indicators supplied by each of the models.

National level CGE models have a similar role as CAPRI for the analysis of the changes in Europe. The national CGE models will be based on a model template developed at the World Bank (MAMS). Apart from a well-developed starting point this link also provides support in terms of estimating model parameters and model development. A national Social Accounting Matrix (SAM) is required to develop a CGE model. IFPRI has made several SAMs available, and as suggested above the GTAP database provides a set of (aggregated) SAMs as well. CIRAD is in the process of completing a SAM for Mali, which will allow application of a CGE model for Mali.

Poverty is a key aspect of assessing the impact on developing countries. Micro-simulation models, linked to the national level CGE models, will be adopted for assessing the poverty impacts. Micro-simulation models rely upon household expenditure surveys, preferably in combination with census data to assure national coverage of the analysis. The World Bank provides a set of household level surveys suitable for micro-simulation analysis. Census data are publicly available only for a limited set of countries. Most countries however perform census on a more or less regular basis and these may be obtained by contacting national statistical bureaus. In the case of Mali a (dated) national level census is available, as well as a set of household surveys.

As in the case of the analyses for Europe assessing the impact on agricultural sustainability is a key point in the developing country analysis. This will be addressed through a tropical version of the FSSIM model which will yield a similar set of sustainability indicators as adapted from the European FSSIM models. Data requirements for developing a FSSIM model are not only high but also entail a set of data not collected on a regular basis by international institutions. In the case of Mali sufficient agricultural data are available and are currently used to develop a FSSIM model for the cotton area.

Given the extensive data requirements of FSSIM models a generally applicable methodology would need to address the issue of a lack of data to develop a FSSIM model. In these cases it may be worthwhile to try to attach sustainability indicators to the outcomes of the CGE model instead of attempting to build a FSSIM. To accommodate this possibility the national level CGE models will need to explicitly include the amount of land in area terms (which is for example not the case in standard GTAP models). This would allow one to address changes in production in terms of changes in areas of different crops, possibly with changing

input use (e.g. substitution of herbicides for labour). Combining changes in crop production with crop simulation models and/or expert knowledge could provide an aggregate indication of changes in key sustainability indicators (soil loss, water balances, soil organic content etc.). One promising source of data is the SAGE database which provides for 19 crops harvested areas and yields for 160 countries for 18 different agro-ecological zones. These data are being supplied as part of a GTAP project on modelling the impact of climate change. Incorporating these data in the national level CGE would facilitate a more aggregate sustainability assessment in case FSSIM models cannot be developed for a specific country but SAGE data are available. Actual implementing such an aggregate level assessment of sustainability will be highly case-specific, tailored to the most pressing sustainability issues of a specific country and accommodating any available data allowing an assessment of the impact of changes in agricultural production on sustainability indicators.

By starting from a broader perspective on the developing country analysis we assure that the specific model components used for the Mali case study can be used in other settings as well. The model components will be developed in a modular framework to accommodate the absence of a specific dataset in different settings. Based on our inventory the farm level data required to develop a FSSIM model appears to be most limiting factor for applying the methodology elsewhere. Another concern is the variation in the years in which data are collected. This implies that even if all required dataset are available for a specific country, we will need to reconcile data from different years.

Overall we may conclude that Mali will be a valuable case to study the implementation of the methodology, posing mainly challenges in terms of linking to the GTAP model which does not distinguish Mali as a separate country. This reflects the limited coverage of African economies in GTAP and is therefore representative of implementing the SEAMLESS framework in other African countries. Implementing the SEAMLESS methodology for other countries will require the use of farm data that are usually insufficient to validate farm models. However it is possible to make some assumptions, regarding for instance labour time required by the activities, to arrive at an operational model. In terms of the other datasets Mali appears as representative for the data availability in developing countries, thus providing good testing ground for the methodology development.

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Appendices

Sampling method of the databases

The following appendix describes for the mail surveys the sampling method.

EBC

Households are homogenous Food Units (*Unités Alimentaires*), which are defined by the food intake and by the expenses. The survey includes 8374 enumerative sections (*sections d'énumération SE*) by *arrondissement* (kind of small district) proportionally to the number of compounds within the *arondissement*.

The sampling plan is stratified at two degrees. The first degree the enumerative sections are taken from the master sample with a rate for each region and each strate. The sampling was done by "*cercle*" to allow to regroup the "*cercle*" by agro climatic zones. The size of the sample for the first degree includes 434 SE.

REGION	SE sample					Rate of sampling		
	(1)	(2)	(1)+(2)	(0)	Total	(1)	(2)	(0)
Kayes	6	4	10	48	58	1/2	2/3	1/4
Koulikoro	6	-	6	50	56	1/2	-	1/5,5
Sikasso	8	4	12	50	62	1/2	½	1/5
Ségou	5	7	12	60	72	1/2	½	1/6
Mopti	4	8	12	60	72	1/2	½	1/6,5
Tombouctou	4	8	12	30	42	1/2	½	1/3
Gao	2	4	6	30	36	1/2	½	1/3,5
Bamako	36	-	36	-	36	1/2	-	-
Total	71	35	106	328	434	1/2	½	1/5

(1) = Urban communal

(2) = Urban notn communal

(0) = Rural

(1) + (2) = Urban

For the second degree of the sampled food units are selected on the basis of an exhaustive list made by by SE with a stratification of three classes of workers per household (from 0 to 4 workers ; from 5 to 6 workers; 7 workers and more).

The number of the sampled food unit depends of the type of area. It is of 6 for the rural SE and 8 for the urban SE. Total number of food units is 2816.

Data entry was realized with a program in the C language and special software for data entry with 35 executables files.

10 for the questionnaire on food

13 for the questionnaire on budgets

12 for data annex (fiches de collecte n° 3,5,6,7 et 8)

EMCES

The EMCES includes a large number of subjects in relation within living conditions of the households such as incomes and expenses, education and employment, housing and equipment, agriculture, business and non farm activities, wealth, health and anthropometric measures for children less than 5 years old.

The EMCES covers 9496 households distributed at the whole national territory. The sampling plan is a stratified probabilistic sampling assuring the representativity of three large sets: Bamako the capital city, the other urban areas (*the communes*) and the rural sector. The survey was realised during 3 months in the fields within two consecutive phases:

i) The household enumeration and the collect of information. This enumeration consists in establishing a list of all households within the selected areas (or enumeration section). This list is used as the the base for the subsequent household sampling;

ii) The survey itself realised after the households are randomly picked. The questionnaires have been treated with a computer program and the results have been analyzed and prepared for publication.

Sampling plan

The sampling strategy elaborated in 1991 (with the technical help of Christopher Scott) was supposed to follow a two degree sampling. For the first degree the enumeration sections were selected (SE, the approximate area for one enumerator, 1 000 persons or 200 households) with proportional probability to the number of household within the SE in the 1987 census. In the selected SE, it is proposed an enumeration of the household at the period of the survey. For the second degree, a systematic selection of 20 households by SE is realized, on the basis of the previous enumeration.

However the SE were not picked in an undifferentiated way in the whole country. A stratification occurs whether the area is urban or rural and the regions, to take into account the necessity to get a minimal representativity of the analysis unit considered as the most important for the EMCES, which is the socio-economic activity (GSE) of the household head. The minimal representativity was fixed at 400 households, based upon experience in other African countries.

The sampling plan was established on the basis of 12 GSE coming from a crossing between occupation of the household head, the nature of the area (rural or urban) within the natural region. In February 1994 several modifications were made to the procedure. The questionnaire and some concepts were redefined.

How was the sample picked? The planned selection in the urban area (144 SE in Bamako, 130 in the other communes) was respected but the distinction between urban and rural areas is different within the EMCES, from the ones adopted in the population census of 1987. This one differentiated the urban areas by including urban areas of more than 5000 inhabitants as well as "*chef lieux de cercles*" that had less than 5000 inhabitants. Within the EMCES, the

urban sector is assimilated to the 6 communes of Bamako as well as the 13 other cities erected as "*communes*" (the smallest, Nioro, exceeded 17 000 habitants in 1987).

In rural areas (which are not *commune*), the DNSI wanted a representation of each administrative region and, within, each *cercle*, in proportion to the number of households of each unit: the number of SE in non communal sector which was fixed based on logistic and stratification constraints defined within the sampling plan (211 SE), these one were distributed according to the number of households in the region, and the *cercle*; the number of SE picked by *cercle* varies from 1 to 12.

Survey treatment

For the analysis of the results and the tabulation of the data several definitions were taken into account:

On the **geographical scale** we can distinguish the urban from the rural areas.

- in urban areas, Bamako was distinguished from the other urban areas;
- in the urban sector, 3 natural regions were distinguished:
    - . South and Ouest, including:
        - SIKASSO region and the cercles of Dioïla and Nara
        - the région of KAYES less the cercle Nioro
    - The *Fleuve* (Niger) , including:
        - the region of KOULIKORO less the *cercles* of Dioïla and Nara
        - the region of SEGOU less the *cercle* of Niono
        - the région of MOPTI less the *cercles* of Bandiagara, Koro , Bankass and Douentza
    - . The rest of the country including
        - the TOMBOUCTOU region
        - the GAO region
        - the *cercles* of Nioro, Nara , Niono , Bandiagara, Koro, Bankass et Douentza .
        - excluding of course the urban areas (meaning all the SE which « code arrondissement » is 91).

Within natural regions, rural and urban areas are not distinguished.

As such the table distinguishing the population or some components of the natural region and the residence area will include the following divisions:

- BAMAKO
- OTHER COMMUNAL AREAS
- RURAL SOUTH OUEST
- RURAL RIVER
- RURAL OTHER
- ALL RURAL AREAS

- ALL URBAN AREA
- WHOLE COUNTRIES.

Another important criterion to discriminate the results is the **socio economic group** (SEG) of the household head. Eleven were distinguished, as indicated earlier, established on the basis of a crossing of activities and natural regions and residence areas:

1 Wage workers of the public sector in urban area (code 12)

2 Wage workers of the private non agricultural sector in urban areas (code 14)

3 Independant non agricultural, Bamako (codes 5, 6, 8,)

4 Independant non agricultural, other *communes* (codes 5, 6, 8)

5 Independant traders, Bamako (codes 3, 4, 7)

6 Independant traders, other *communes* (code 3, 4, 7)

7 Other urban sector (code 1,2,9,10,11,13,15,16,17,18,19)

8 Independant agricultural, rural sector *Fleuve* South west (code 1,2)

9 Independant herders, rural sector *Fleuve* (code 1, 2)

10 Independant herders, rural sector, rest of the country (code 1, 2)

11 other rural non agricultural, non herders, rural (tous codes except 1 et 2)

Given the way the GSE were established, there was no crossing between GSE / natural region and residence area.

EDMC

In Bamako from April to July 1996. The sampling plan established within the survey is two degree stratification. For the first degree, there were two strates by city section (dwelling and constructed sections), the Enumerative section or SE (découpage censitaire correspondant approximativement au travail of an enumerator, between environ 1 000 and 1 500 persons) were picked with a probability proportional to the number of households enumerated in 1987. The sampling based used is the list of SE coming from the general census of the population and habitat realized in the country in 1987.

Within the SE pricked at the first degree, the households were counted. For the second degree on the basis of the dénombrement, a systematic random selection of 12 households were realized by SE. The inteviewed sample was made of 1008 households distributed between 84 Enumeration Sections located in the loties areas a dn well as the non loties areas of the capital city.

There were two types of interview:

- daily expenses were collected within special booklet. In each household, a member was picked able to write the expenses. The secretary writes all the expenses made for himself, for the household or gift to other households, except expenses to resell and expenses linked to a professional activity. The report had to be done during 15 days.

- a retrospective questionnaire was used for large expenses.

For each household, the enumerator made six successive visit every three days. Each visit had a different subject.

The data entry was made in the capital city. Data treatment was made for every UEMOA country, at the AFRISTAT center in Bamako. Data cleaning and coherence checking was also made in Bamako.