SPEL system

Methodological documentation (Rev. 1)
Vol. 1: Basics, BS, SFSS

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January 1995

The concept of the SPEL system was developed at the Institut für Agrarpolitik, Marktforschung und Wirtschaftssoziologie of the University of Bonn by W. Henrichsmeyer, W. Wolf and H.-J. Greuel.

Theme
Agriculture, forestry and fisheries **5**
Series
Methods **E**

Cataloguing data can be found at the end of this publication

Luxembourg: Office for Official Publications of the European Communities, 1995

ISBN 92-826-9773-8
ISBN 92-826-9772-X (Volumes 1 + 2)

Printed in Belgium

Gedruckt auf chlorfrei gebleichtem Papier
Printed on non-chlorine bleached paper
Imprimé sur papier blanchi sans chlore

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1. HISTORY

The SPEL/EU-Model[1] was developed in response to the demand for up-to-date information on trends over time in agricultural production and income in the European Union (EU) from those departments of the European Commission responsible for the Common Agricultural Policy (CAP).

Thought was first given to possible means of meeting this requirement in 1975. Two different approaches were envisaged:

- creation of a harmonized framework[2] within the Community for short-term forecasting of the Economic Accounts for Agriculture (EAA) by the national authorities in the various Member States;
- construction of a model for short-term forecasting of sectoral production and income in agriculture.

Both approaches seemed promising but the particular advantage of the first was that it could be put into practice quickly. It was therefore given priority.

As early as 1980, Professor Henrichsmeyer's institute at Bonn University was asked to work out a design concept for a sectoral model for short-term forecasting of agricultural income in the Communities and subsequently to implement this concept in Eurostat.

The SPEL System available today was developed in the following stages:

1980-1983:

- Development of the Base System (BS);
- Creation of SPEL/EU-Data for the ex-post period;
- Systematic application of BS.

1984-1985:

- Development of a Short-term Forecast and Simulation System (SFSS);
- Systematic application of SFSS;
- Integration of Greece into the SPEL/EU-Model;
- Development of a "provisional" Medium-term Forecast and Simulation System (MFSS-1);
- Application of MFSS-1 for the "Green Paper" (prospects for the CAP).

1986-1988:

- Short-term forecasts and short-term and medium-term simulations for the CAP;
- Implementation of the SPEL/EU-Model on the computer of the European Commission in Luxembourg;
- Integration of Spain and Portugal into the EU-Model;
- Completion of MFSS-1 with other CAP instruments;
- Beginning of the development of an expanded MFSS version (MFSS-2);

11 SPEL/EU-Model: Sektorales Produktions- und Einkommensmodell der Landwirtschaft der Europäischen Union (Sectoral Production and Income Model of Agriculture for the European Union)

2 These results are published by Eurostat yearly: Agricultural Income: sectoral income index analysis.

- Beginning of revision of EU-Model structure to adapt it to include the new Member States in the Communities (Greece, Spain and Portugal) with new farm production structures, and to cover the demand for agricultural products outside the agricultural sectors.

1989-1991:

- Short-term forecasts and short-term and medium-term simulations for the CAP;
- First application of MFSS-2 for the CAP;
- Beginning of the development of a foreign trade model (SPEL/Trade-Model[3]);
- Completion of the documentation of the SPEL System;
- Beginning of implementation of the revised SPEL/EU-Model.

1992-1994:

- Systematic application of MFSS-2 (Mc Sharry`s CAP changes);
- Systematic application of the revised BS and revised SFSS;
- Consolidation of the BS and SFSS with respect to data source changes and CAP changes;
- Further development of the MFSS (based on MFSS-1 combined with MFSS-2) with respect to supply and demand of agricultural products and CAP changes;
- First application of the SPEL/Trade-Model;
- First application of the revised MFSS;
- Completion of the documentation of the SPEL System (Rev. 1).

Maintenance, updating and application of the SPEL/EU-Model will be carried out in Eurostat. Further developments of the EU-Model will proceed in parallel on the basis of contracts with academic institutions.

3 SPEL/Trade-Model: European Union and Rest of the World, foreign trade model.

2. AIMS AND GENERAL GUIDELINES

The origin of the SPEL System is different from that of most econometric modelling work, which is mostly concerned with methodological explorations and academic exercises.

SPEL began with the demand from the European Commission (EC) for a systematically structured data system for the agricultural sector of the EU Member States and the EU as a whole. This data system was to be designed with the following requirements in mind:

- maximum possible use of Eurostat`s original data;
- implementation and maintenance within Eurostat;
- systematic application within Eurostat.

The first years of research work were therefore devoted to develope a design for a data system and an integrated data bank and its gradual construction. The data bank was to constitute the basis for

- checking the consistency of Eurostat's agricultural statistics;
- monitoring the present situation in the agricultural sector;
- ex-post analyses of sectoral developments;
- short-term and medium-term forecasts and policy simulations of the effects of alternative agricultural policies.

The research work was pursued under the project title Sectoral Production and Income Model for Agriculture (SPEL)[4]. The mandate was to establish a data system (modelling system) to be used by the EU administration (EC) and implemented by Eurostat in Luxembourg.

These requirements have largely influenced the basic design and structure of the SPEL System: it is designed as a tool for policy-oriented analyses, forecasts and simulations, which can be used in dialogue with policy-makers and administrators.

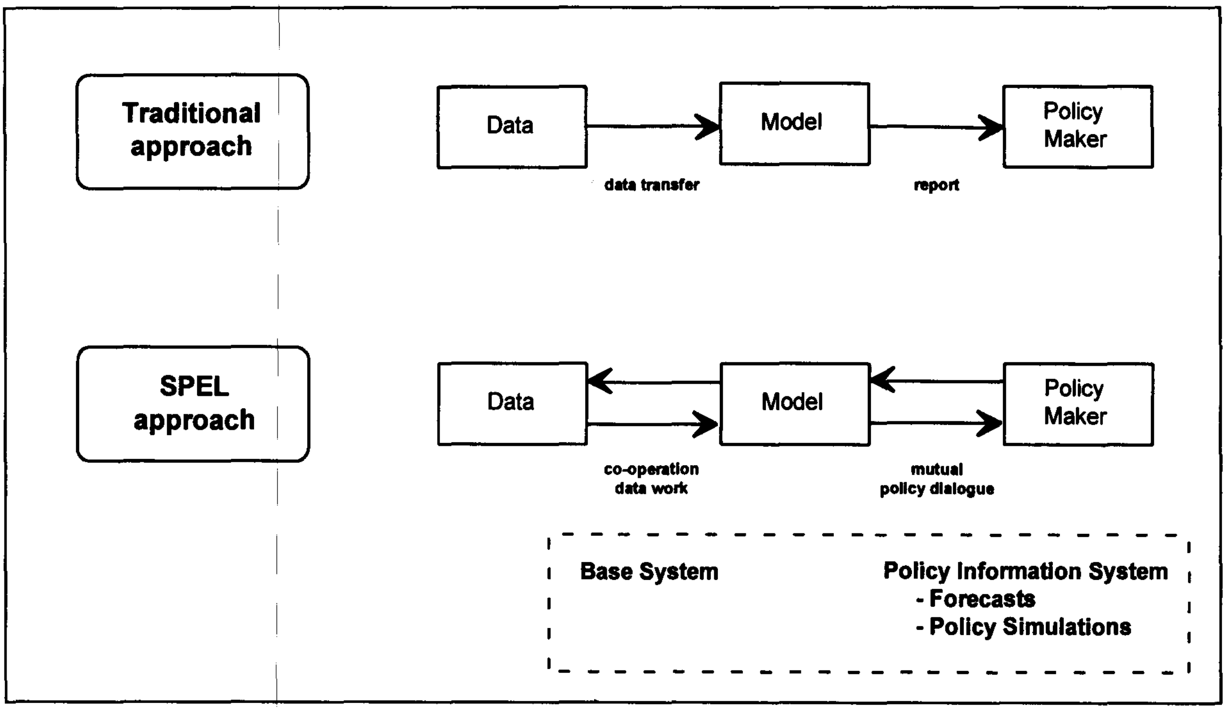
The long-standing collaboration with Eurostat and with policy-makers has led to a modelling approach which is different in principle from the traditional one (see figure 1): in the traditional approach the data are taken as a given set of numerical information. Econometric techniques are applied to estimate the parameters of the model and to produce forecasts and impact analyses of policy measures. Usually, a selected number of parameter estimates and of results of model runs are published and/or presented to policy-makers.

The SPEL approach, on the other hand, is characterized by mutual interaction between model-builders and statisticians or policy-makers. The set of statistical data is not taken as final but subjected to consistenc[5]y checks and critical investigations, which may lead to jointly agreed revisions of existing statistics, and proposals for amendments and conceptual changes for new statistics. Also, it is not assumed that the policy-makers are able to specify target variables before they take a closer look at the problems involved. Instead, the fundamental idea is that the target priorities emerge during the process of policy dialogue on trade-offs between target variables[6].

4 Sektorales Produktions- und Einkommensmodell der Landwirtschaft.

6 Bauer, S., Henrichsmeyer, W. (1989) (Hrsg.): Agricultural Sector Modelling. Proceedings of the 16th Symposium of the European Association of Agricultural Economists (EAAE), April 14th-15th, 1988 Bonn, FRG, Wissenschaftsverlag Vauk Kiel KG, Kiel 1989.

Figure 1: Alternative approaches for model-based policy-making



This principal approach gives the basic orientation for the design of the SPEL System in general and also for the SPEL/EU-Model. Some general features can be characterized by the terms:

- *block-building approach:*
  division of modules into separate work sectors which are freely combinable;
- *activity-based concept:*
  division of the agricultural sector into activities in order to trace production interactions within and between sectors;
- *consistency accounting framework:*
  to balance physical and monetary flows to guarantee consistency as well as comparability with the definitions used in the Economic Accounts for Agriculture (EAA);
- *transparency:*
  this means that each item data divided from the system components can be traced back to the basic data sources and the underlying assumption(s);
- *flexible user interface:*
  to facilitate dialogue between the model and statisticians or policy-makers.

In order to accommodate all these features, the SPEL System has rather simple, recursive structures within and between its different components.

3. ACCOUNTING SYSTEM DESIGN

Following the principles of national accounts and the Economic Accounts for Agriculture (EAA), the agricultural sectors of the Member States of the European Union are differentiated according to output and input groups.

Production activities in the SPEL/EU-Model are based on those of the EAA. As far as production structure is concerned, the agricultural sector is divided into poles (activities).

This activity-based approach is a most important characteristic of the SPEL/EU-Model, because it allows the characteristic features of agricultural production and interdependencies between the different production activities to be described. The sectoral accounting framework ensures consistency with respect to physical and monetary flows.

Country-specific production characteristics can be better represented by non-consolidated (gross) flows between the activities than by consolidated (net) flows. In particular, the "reflexive flows[7] " of an activity, insofar as they are of importance in production (as constraints on output), are also covered by such a gross flow concept.

Figure 2 shows a schematic circle of monetary flows of a two-pole agricultural sector. It indicates the intra-sectoral production interactions as well as the intersectoral flows with the other sectors of the national economy.

Gross payments[8] for the primary production factors (land, labour and capital) are included under inputs according to this concept, thus completing the circle. The circle-theory axiom:

"the sum of the incoming flows is equal to the sum of the outgoing flows"

is complied with.

The gross production value of each activity and, when added together, that of the agricultural sector as a whole, are the cornerstones of this concept. According to the circle-theory, the gross production value represents the sum of the incoming or outgoing flows.

Figure 3 illustrates this gross production concept by showing an agricultural production account drawn up in that form. The most important components for calculating the gross production value are shown in this figure.

The gross production value is represented and distinguished according to four logically connected principles. First, a distinction is made according to

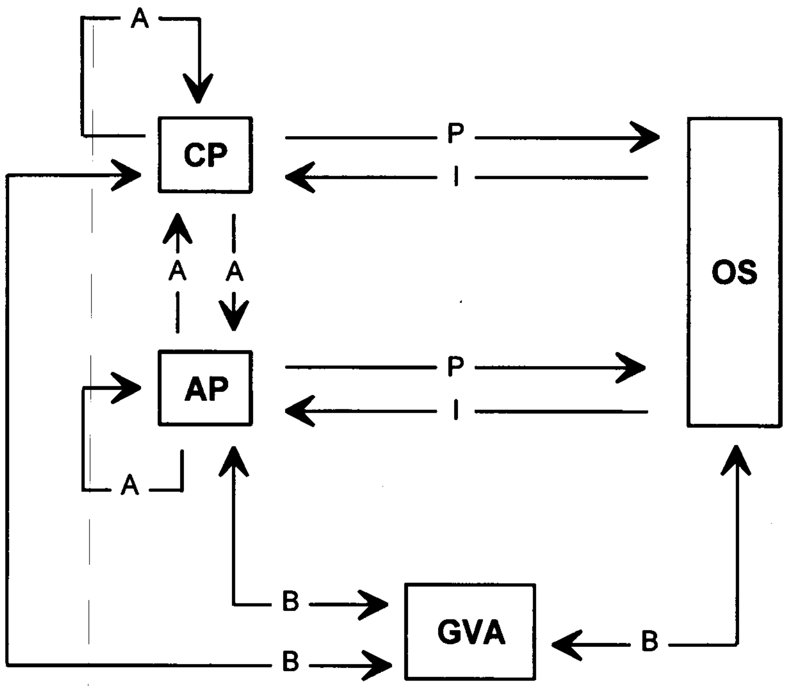
"Output" (O) and "Input" (I),

and secondly according to

"Generation" (G) and "Use" (U).

7 A reflexive flow of a production activity describes the input use of own-produced products (e.g. seed).
8 Gross payments for the primary production factors correspond to Gross Value Added (GVA) at market prices.

Figure 2: Schematic circular flow of production and income with two-activity production sector



Remarks :

CP : Crop Production area,
AP : Animal Production area,
OS : Other Sectors of national economy,
GVA : "Pole Balance" (Gross Value Added at market prices),
P : Production value of the corresponding area
I : Intermediate input produced or processed by other sectors,
A : Intermediate input produced by Agriculture,
B: Balance flows (Gross Value Added at market prices of the corresponding area).

Figure 3: The agricultural gross production account

AGRICULTURE	
DEBIT	**CREDIT**
Purchase of intermediate input from other sectors for: - crop production - animal production - crop and animal production	Sales to other sectors
Purchase of intermediate input from the agricultural sector for: - crop production - animal production	Sales to the agricultural sector - seed - fertilizer - feedingstuff - animals
	Stock changes
	Processing by producers
Gross value added at market prices	Own consumption
Gross production value	Gross production value

A combination of these four perspectives in the first instance gives a tautological relationship:

(1) $$OG = OU = IG = IU$$

where: OG : Output Generation, valued,
OU : Output Use, valued,
IU : Input Use, valued,
IG : Input Generation, valued.

This identity guarantees the completeness of the whole system, and by adding and combining these elements horizontally and vertically, a system of identities is obtained which forms the basic structure of the Activity-Based Table of Account.

4. DESIGN OF THE ACTIVITY-BASED TABLE OF ACCOUNT

4.1. Structure and equation system

The system of identities (figure 5) described below may be represented by an "Activity-Based Table of Account" (ABTA). This is schematically shown in figure 4. The ABTA is divided into a physical and a valued component, connected by a price component. Both the physical and the valued components are based on the structure of the identities (see figure 5).

The activity-based approach is the most important characteristic of the SPEL System, because it allows a detailed breakdown of production activities and a consideration of other activity links within and between sectors. A detailed breakdown of the agricultural production process (yields, production, area, etc.) and the interdependence between the different production activities (young animals, feedingstuff, etc.) can, for example, be shown.

The important intrasectoral product flows (including reflexive flows) between (within) production activities can be taken into account and an approximately realistic gross production value (gross flow) can be calculated. The EAA, for example contains only the intersectoral flows (so-called final production value or net production). However, after aggregation of all the production activity (gross) data of the agricultural sector, the sum of the consolidated flows is the same, i.e. the resulting gross value added at market prices is identical in the SPEL approach with that of the EAA.

The combination of the four gross production values (shown in figure 4) leads to the individual identities illustrated by figure 5.

Figure 4: Diagram of an Activity-Based Table of Account

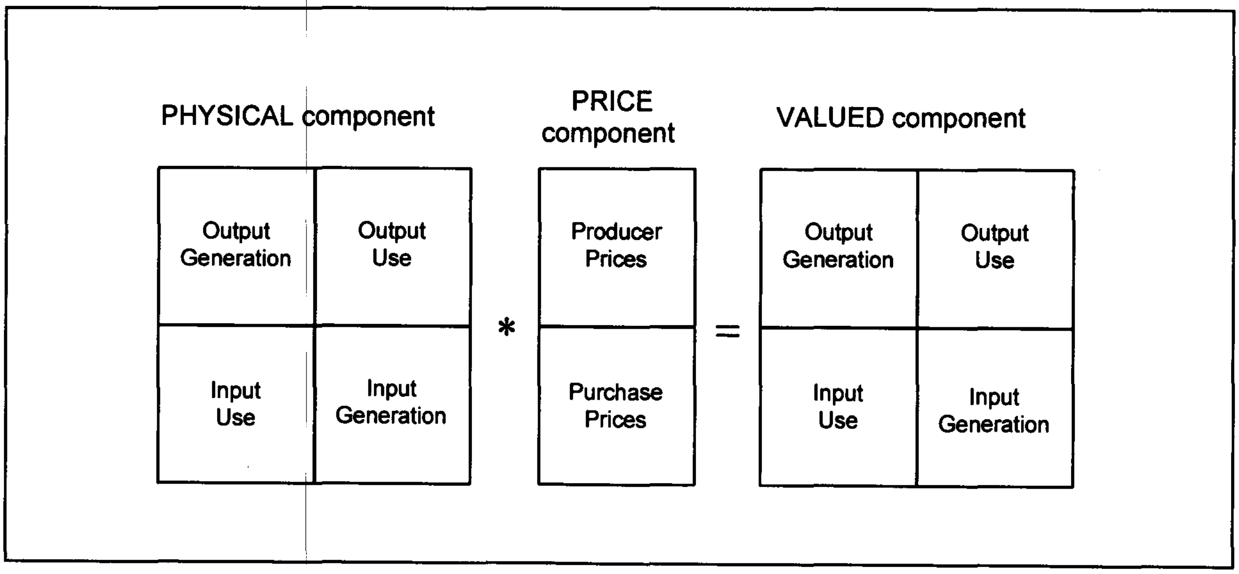


Figure 5: Identity system of Activity-Based Table of Account

	Output activities		Use activities	
Output balances	$\sum_i \sum_j XG_{i,j} PG_j$	+	$\left(-\sum_k \sum_j XU_{k,j} PU_{k,j}\right)$	$=0$
	+		+	
Input balances	$\left(-\sum_i \sum_h YU_{i,h} QU_h\right)$	+	$\sum_k \sum_h YG_{k,h} QG_{k,h}$	$=0$
	=		=	
	0		0	

with:

$$PG_j = \frac{\sum_k XU_{k,j} PU_{k,j}}{\sum_i XG_{i,j}}$$

$$QU_h = \frac{\sum_k YG_{k,h} QG_{k,h}}{\sum_i YU_{i,h}}$$

where :

XG : Output Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
YU : Input Use, ABTA, physical component,
PG : Unit value producer prices for Output Generation,
PU : Producer prices for Output Use,
QG : Purchase prices for Input Generation,
QU : Unit value purchase prices for Input Use,
i : Subscript, production activity, ABTA, $(i=(1,...,n))$,
j : Subscript, products, ABTA, $(j=(1,...,m))$,
k : Subscript, use activity, ABTA, $(k=(n+1,...,N))$,
h : Subscript ,input items, ABTA, $(h=(m+1,..., M))$.

In the columns of the ABTA a distinction is made between

- production activities (Output Generation, Input Use) and
- use activities (Output Use, Input Generation).

The lines contain the various

- product balances (Output Generation, Output Use) and
- input items balances (Input Generation, Input Use).

The links between the physical and valued ABTA components are made with prices consisting of producer and purchase prices (in the definition of unit values). Obviously, the identity system of the physical ABTA part is fulfilled only via the horizontal equations.

The equation system and also the individual equations are consistent through the horizontal and vertical definition. A disaggregation of these combined gross production values allows plausibility checks according to different criteria, in order to improve the accuracy of the elements in these identities.

The content of the different aspects of the ABTA can be interpreted as follows.

- In the upper section, *the Output balances of the ABTA* show the Output Generation (OG) of the different production activities and their uses (Output Use (OU)) for the different purposes: *intrasectoral uses* (seed, animal feed, calves etc., stock changes on farms, human consumption on farms), and *intersectoral uses* (sales). The intersectoral sales are further subdivided, according to an additional "Demand Component", into subgroups (processing, industrial use, human consumption, etc.). The sum of the generated values of outputs has to be equal to the sum of the values of uses for each individual product and all products as a whole.

  Correspondingly in the lower section, the *Input balances* of the ABTA present the Input Generation (within the agricultural sector and purchases from other sectors) and their uses in agricultural production activities (Input Use (IU)).

- The *columns of the ABTA* show the gross production value, the value of intermediate inputs and, as a residual, the gross value added at market prices for different activities and, after aggregation, for the agricultural sector as a whole (in the definition of EAA).

Such a breakdown of the gross production values allows aggregation or disaggregation, e.g. by regions or farm types. If one level of aggregation is consistent along the lines of the above identity system, the subsequent aggregations are consistent when the elements of identities are added up (e.g. the EU Member State values added up to obtain the EU as a whole).

The current structure of the ABTA (see Annex 1) covers the following groups:

<u>Production Activities :</u>

Crop Production Activities;
for Final Products,
for Intermediate Products,

Animal Production Activities;
for Final Products,
for Intermediate Products,

<u>Use activities</u> (sectoral interaction) :

for Intrasectoral Use
for Intersectoral Use

<u>Products :</u>

Crop Products;
Final Products,
Intermediate Products,

Animal Products;
Final Products,
Intermediate Products,

<u>Input Items :</u>

Variable Input Items;
Specific Crop Input Items,
Specific Animal Input Items, General Input Items,

Fixed Input Items;
Overheads,
Gross Payments for Primary Production Factor.

The gross payments for primary factors (land, labour and capital) are registered as Gross Value Added at Market prices. By considering production taxes and subsidies of the agricultural sector separately, the Gross Value Added at Factor cost is reflected by the identity system of the ABTA. The ABTA can therefore be understood as a further-differentiated system related to the EAA.

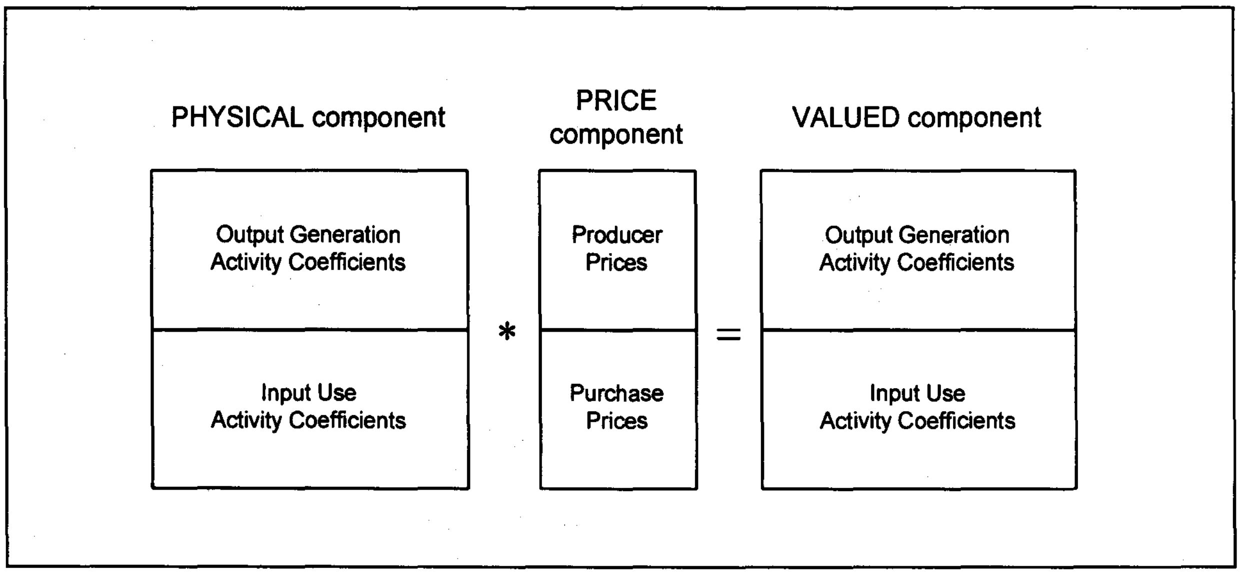
By taking account, outside of the ABTA, of a number of additional elements (e.g. depreciation, labour, etc.) at the whole sectoral level, the EAA aggregates up to Net Value Added at Factor cost (NVAF) or the NVAF per work unit are also available in the SPEL/EU-Model.

4.2. Derivation of the Matrix of Activity Coefficients

A Matrix of Activity Coefficients (MAC) is derived from the ABTA by computing Output Generation and Input Use per unit of production activity. Such a matrix may be based on either the physical or valued component of the ABTA. Figure 6 shows schematically how the system identities may be represented by a MAC similar to ABTA, described above.

Figure 7 shows the identity system derived from the ABTA using the production activity level vector (LEVEL). For this derivation a physical level vector is defined with the same sequence of elements as the production activities. The production activity level measures for crops the land use (number of hectares) and for animals the livestock (number of heads) used to generate the output.

Figure 6: Diagram of a Matrix of Activity Coefficients



The Output Generation sector of the MAC contains the output activity coefficients in the product differentiation for each production activity unit. The sector Input Use of the MAC contains the input activity coefficients per input item of each production activity unit.

Figure 7: Identity system of Matrix of Activity Coefficients

	Output activities
Output coefficients	$\sum_i \sum_j \frac{XG_{i,j}}{LEVEL_i} PG_j$
	+
Input coefficients	$\left(-\sum_i \sum_h \frac{YU_{i,h}}{LEVEL_i} QU_h\right)$
	=
	0

with:

$$PG_j = \frac{\sum_k XU_{k,j} \, PU_{k,j}}{\sum_i XG_{i,j}}$$

$$QU_h = \frac{\sum_k YG_{k,h} \, QG_{k,h}}{\sum_i YU_{i,h}}$$

where :
XG : Output Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
YU : Input Use, ABTA, physical component,
PG : Unit value producer prices for Output Generation,
PU : Producer prices for Output Use,
QG : Purchase prices for Input Generation,
QU : Unit value purchase prices for Input Use,
i : Subscript, production activity, ABTA, $\left(i = (1,\dots,n)\right)$,
j : Subscript, products, ABTA, $\left(j = (1,\dots,m)\right)$,
k : Subscript, use activity, ABTA, $\left(k = (n+1,\dots,N)\right)$,
h : Subscript ,input items, ABTA, $\left(h = (m+1,\dots,M)\right)$.

On the basis of these coefficients (figure 7), an income indicator for each production activity unit (measured as gross value added at market prices) can be calculated as a residual as follows:

$$(2) \qquad GVAM_i = \sum_j \frac{XG_{i,j}}{LEVEL_i} PG_j - \sum_{h-1} \frac{YU_{i,h}}{LEVEL_i} QU_h$$

where : $GVAM$: Gross value added at market prices per production activity unit,
$LEVEL$: Production activity level (number of hectares or number of heads),
XG : Output Generation, ABTA, physical component,
YU : Input Use, ABTA, physical component,
PG : Unit value producer prices for Output Generation,
QU : Unit value purchase prices for Input Use,
i : Subscript, production activity, ABTA, $(i = (1,...,n))$,
j : Subscript, products, ABTA, $(j = (1,...,m))$,
h : Subscript, input items, ABTA, $(h = (m+1,..., M))$.

These allow the characteristic features of agricultural production to be described in physical and/or value units per unit of the production activity level (yields, input and income per unit). This makes it possible, for example, to explain the development of plant production by both yield and acreage development, which is especially important for forecasts and policy simulations.

4.3. Consideration of Demand for agricultural products

The physical and monetary intra-agricultural supply and demand ratios are depicted in a differentiated manner by the Output Use and Input Generation section of the ABTA (physical and valued component).

The physical resource and use categories of agricultural products outside the agricultural sector are covered as gross flows by an additional "Demand component".

This "Demand component" is an extension of the supply-oriented ABTA in that it adds physical market balance sheets of agricultural products. The design of these physical market balance sheets ("Demand component") is very close to that of the supply balance sheets of agricultural products published by Eurostat.

Eurostat publishes supply balance sheets [9] for all the main agricultural products on the basis of

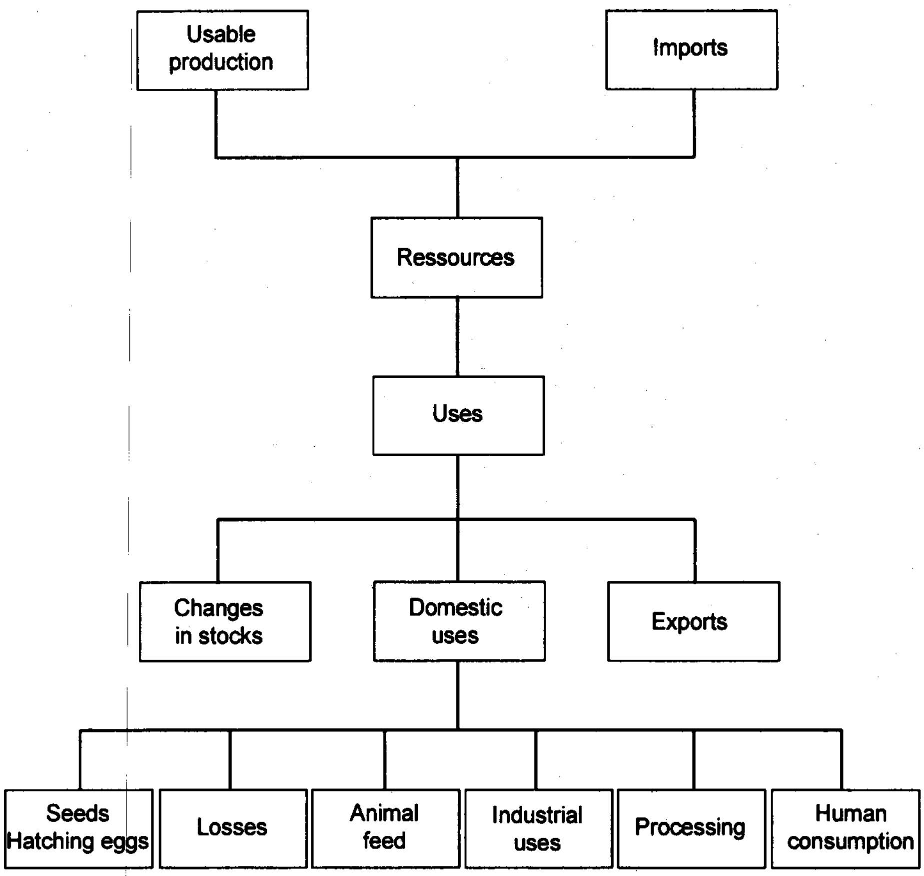
- a defined product sector,
- a given reference period and
- a geographically restricted area.

These supply balance sheets follow the general pattern shown in figure 8.

These physical supply balance sheets are "synthetic" balance sheets; that is, apart from the flows of basic agricultural products (e.g. cereals as grain weight), they also include the most important processing products (e.g. flour, semolina, etc.). They cover the entire domestic market of a product, including the import and export flows.

9 See Eurostat, Directorate E = Agricultural Statistics, Doc. E/V/001, 1985, page 5.

Figure 8: Schematic illustration of supply balance sheets



Source : Eurostat, Directorate E-Agricultural Statistics, Doc. E/V/001, 1985, page 2a.

The basis is the identity:

(3) $R = U$

where: R : Resources (total),
U : Uses (total).

The resources (R) are equal to the uses (U) for agricultural products in a specific period. This identity links the "Demand component" with the Output Use and Input Generation sections of ABTA (physical component).

The <u>resources</u> always include the usable domestic production and imports, which represent the total market availability of a product.

(4) $R = PR + IM$

where : R : Resources (total),
PR : Usable domestic production,
IM : Imports.

In the use of agricultural products of Eurostat's supply balance sheets, we have the following identity:

(5) $$U = EX + HC + FU + SU + PC + IU + LO + SC$$

where : U : Uses (total),
EX : Exports,
HC : Human consumption,
FU : Feed use,
SU : Seed use,
PC : Processing,
IU : Industrial use,
LO : Losses,
SC : Changes in stocks (final minus initial stocks).

The usable domestic production can then be written as :

(6) $$PR = EX + HC + FU + SU + PC + IU + LO + SC - IM$$

where : PR : Usable domestic production,
IM : Imports,
EX : Exports,
HC : Human consumption,
FU : Feed use,
SU : Seed use,
PC : Processing,
IU : Industrial use,
LO : Losses,
SC : Changes in stocks (final minus initial stocks).

The usable domestic production (equation 6) of the supply balance sheet has to be modified, if it is to match the ABTA and the extension "Demand Component". For each product, a "farm balance sheet" and a "market balance sheet" have to be established.

The use activities of agricultural products, differentiated according to equation 6, cover uses in agriculture and other sectors of the economy for "Human consumption", "Losses", and "Changes in stock".

Purchases, in agriculture, of seed and feed products [10] are divided into :

- intrasectoral purchases (recursive farm flow or farm to farm flow) and
- intersectoral purchases (non-agricultural sector flow to agricultural sector)

to match the above-mentioned "farm and market balance sheets". Once these constraints are taken into account, equation 6 can be written as :

(7) $$\begin{gathered} PR - HCF - LOF - SCF - FUF - SUF \\ = \\ EX + HCM + LOM + SCM + FUM + SUM + PC + IU - IM \end{gathered}$$

[10] Seed and feed use in other sectors of the economy are assumed to be negligible.

where :
PR : Usable domestic production,
HCF : Human consumption on farm,
LOF : Losses on farm,
SCF : Stock changes on farm,
FUF : Intrasectoral purchases of feed products,
SUF : Intrasectoral purchases of seed products,
EX : Exports,
HCM : Human consumption market $(HCM = HC - HCF)$,
LOM : Losses market $(LOM = LO - LOF)$,
SCM : Stock changes market $(SCM = SL - SLF)$,
FUM : Intersectoral feed purchases $(FUM = FU - FUF)$.
SUM : Intersectoral seed purchases $(SUM = SU - SUF)$,
PC : Processing,
IU : Industrial use,
IM : Imports.

Identity 7 and the illustration given in figure 9 represent the "intersectoral sales" of the Output Use sector of the ABTA (physical component) and are equal to the resource activity "marketable domestic production" of the "Demand component". The intersectoral purchases of feed and seed products contain the link between Input Generation of ABTA (physical component) and the "Demand component", with agriculture acting as a customer for agricultural products.

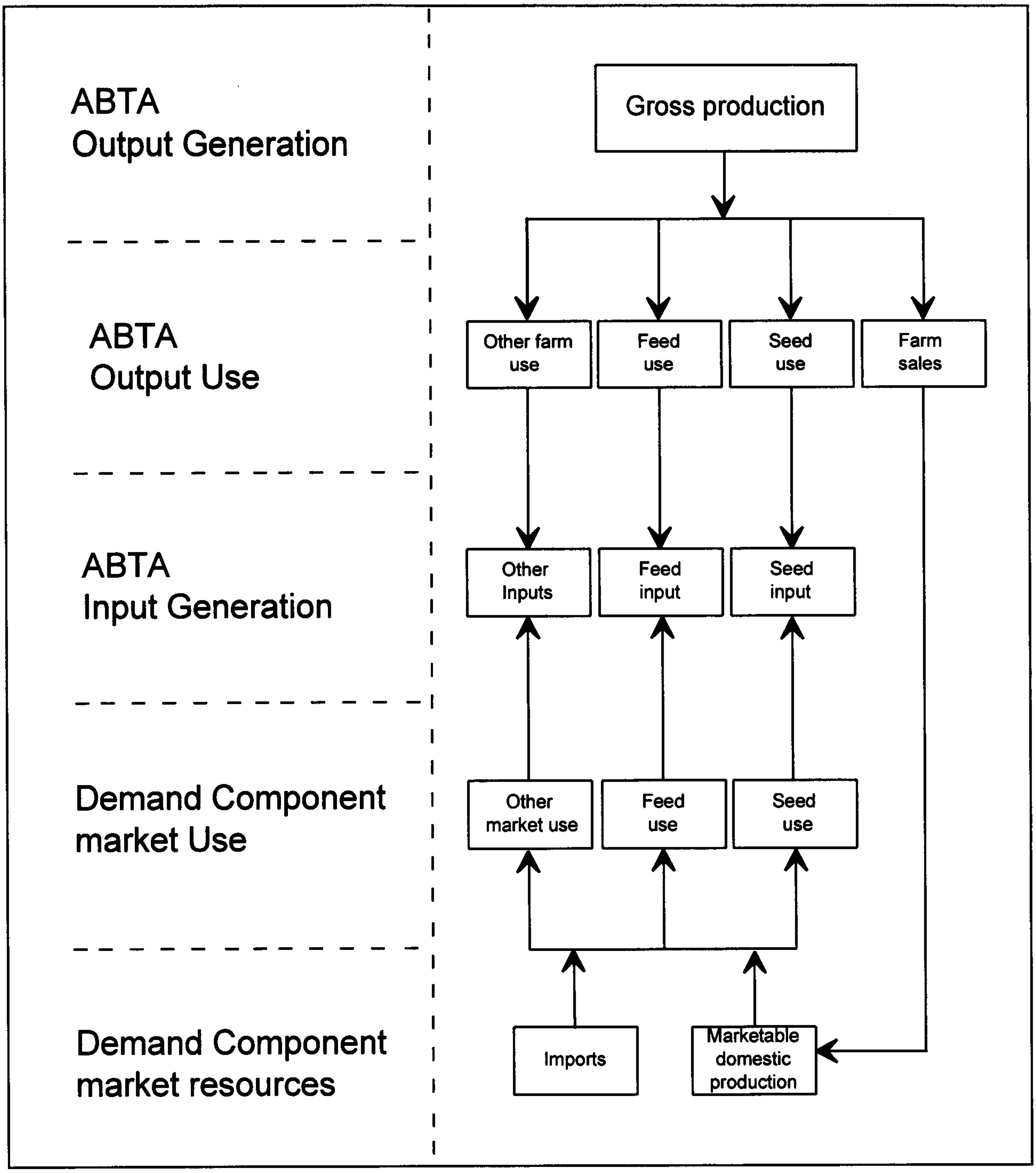
Exports and imports are further subdivided into intra- and extra-EU, so that a total of nine use activities and three resource activities are identified in the demand component.

The agricultural products covered by the demand component can be roughly classified into

- raw products:
  these include products produced on domestic and foreign agricultural holdings. Some serve as basic products for product processing. The differentiation of these products matches that of the ABTA final product grouping.
- processed products:
  these are obtained by processing raw agricultural products, which does not normally take place on agricultural holdings.

Following the ABTA structure, the use and resource activities are listed in columns, and the products in lines of a demand table. Several aggregates and national economic figures have been added. This demand table is described in detail in the following Annex 1 of this document.

Figure 9: Schematic illustration of the interaction between ABTA and Demand component



5. CONSEQUENCES OF DATA DEFICIENCIES

The SPEL approach is the result of a compromise between the requirements (general objectives) and the quality of the statistical material used for the numerical specification of the elements of the basic equation system. The well known shortcomings of statistical material make systematic data preparation work and data completion work necessary if such a concept is to become reality.

5.1. Data work principles and data classification

A number of general principles should be observed when carrying out such data work, and when updating, revising and using a system or model like the SPEL System:

Consistency:	data must satisfy all definitional identities.
Completeness:	the sum of inflows must equal the sum of outflows.
Entirety:	recording of all important interdependencies in flow and activity definitions.
Realism:	general consensus on plausibility and quality.
Transparency:	transparency with regard to assumptions, data origin and treatment.
Conformity:	conformity of intended uses with the system's possibilities.

The poorer the quality of the statistical material, the more important it becomes to adhere to these general principles when establishing and using such a system.

To maintain data *transparency* within the SPEL System, a special data classification was developed so that with the aid of electronic data processing, the origin and treatment can be revealed for each individual item of data and groups as well when needed by the operator or user.

Each result of the data work is stored. The computer instructions for producing results are also stored so that the criteria (computation algorithms, statistical monitoring, etc.) which led to the results can be checked subsequently by model users.

The system arrangement for data classification[11] e.g. the SPEL/EU-Model is illustrated by the following six concepts:

- area (e.g. "S" for supply-oriented data),
- origin (e.g. "ZPAC" for CRONOS domain ZPA1),
- treatment (e.g. "COMC" for ex-post extrapolation using trend estimations),
- region (e.g. "D" for BR Deutschland),
- time period (e.g. "90" for year 1990),
- definition (line and column code of corresponding table).

The individual data characterisations used in the SPEL/EU-Model are contained in the corresponding parts of documentation, for depicting the agricultural sectors of the Member States of the European Union and the EU as a whole.

[11] For technical notation, see: SPEL System, Technical Documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS.

5.2. Data categories

When establishing the model results (e.g. SPEL/EU-Data[12]) numerically and during the interpretation phase, it is useful to assign the various data to the following four categories:

- original statistical data (OD),
- semi-original statistical data (SD),
- calculation data (CD),
- residual data (RD).

The criteria for assigning the various data are their origin and treatment in the numerical specification of SPEL/EU-Data, the background being the availability and quality of some of the requisite statistical data.

Original statistical data (OD)

These data are regarded as "core data" for the purposes of data processing and consistency computations. They are taken from official agricultural statistics (mainly from Eurostat). When the SPEL/EU-Data figures are being established, these data form the "pillars" with which the remaining data must be brought into line. With from a few exceptions, they are incorporated into the equations unchanged (e.g. EAA data for the SPEL/EU-Model).

Semi-original statistical data (SD)

These data are based on original statistics, but are adjusted to ensure consistency and completeness within SPEL/EU-Data (e.g. intermediate consumption in SPEL/EU-Model).

Calculation data (CD)

This category comprises technical and management data. These data consist of a collection of coefficients and parameters which are used primarily to subdivide aggregated statistical values (mostly OD) into components. This category is mainly used for production or product ratios.

For example, the fertilizer input within the SPEL/EU-Data is allocated to the different crops according to their nutritional requirements. In addition, the parameters of requirement functions for the input of feeding stuffs are calculated on the basis of output-dependent feed requirements per animal unit.

Residual data (RD)

These data can be calculated as residual elements by resolving a system of defining equations with all the other elements fixed. It is useful to compare them with comparable independent statistical data, where available, because they are very sensitive to assumptions and to the numerical values of the coefficients in the system specification. Such comparisons allow certain plausibility checks to be made with respect to the generated data (e.g. gross value added at market prices per activity unit with gross margins within SPEL/EU-Data).

12 The SPEL/EU-Data are the results of the Base System of the SPEL/EU-Model (see Part 2 of this document).

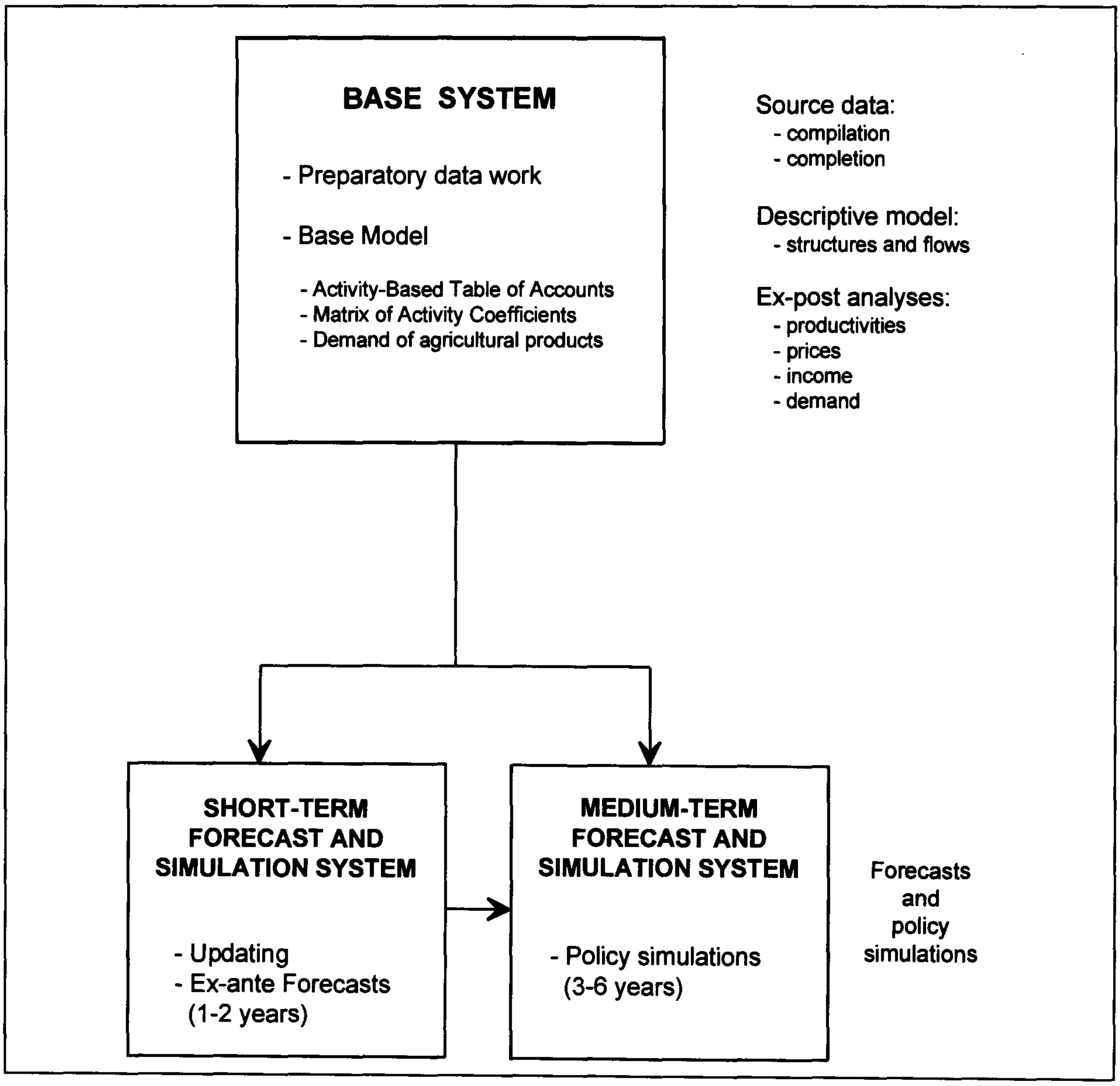
6. SPEL/EU-MODEL OVERVIEW

6.1. Model structure

In this chapter, a short overview of the structural design of the different modules of the SPEL/EU-Model and their interrelations (figure 10) is given. The following are the model modules:

- Base System (BS)
- Short-term Forecast and Simulation System (SFSS)
- Medium-term Forecast and Simulation System (MFSS)

Figure 10: Modules of the SPEL/EU-Model



6.2. Base System

Common data deficiencies (definitional anomalies, discontinuity of time series, etc.), caused by a variety of factors, make data preparation necessary in order to meet the needs of the different models of the system. Clearly, preparatory data work cannot ensure absolute removal of all data deficiencies. By including other, related information, an attempt is made to eliminate as far as possible major definitional deficiencies and to fill in missing data in order to meet requirements accurately.

The Base Model (BM) constitutes the basis for the other systems of the SPEL/EU-Model, since it integrates the different types of information (official statistics, farm sample data, calculation data, etc.). However, it is more than a "data bank", it is itself a "model", designed to depict the production structure and flows within the agricultural sector.

The model is based on the concept of sectoral accounting within the framework of the described above ABTA and MAC. It specifies the annual ABTA, MAC and ABTA extension "Demand component" for the ex-post period (beginning with 1973). The Base Model can be understood as the core of a Social Accounting Matrix (SAM) focusing on the agricultural sectors of the EU Member States and the EU as a whole.

The Base Model cannot be specified directly on the basis of official statistical data. The shortcomings of statistical material make preparatory data work necessary before such statistical data can be used in the model. The sets of input and output coefficients, activity levels and input and output prices have to be derived gradually in interactive treatment, making use of various categories of data[13] and consistency checking and data processing procedures. This operation requires a lot of imagination and care and is very time-consuming; it is described in more detail in the Base System documentation[14].

6.3. Short-term Forecast and Simulation System

The aims of SPEL/EU-SFSS are

- to "update" the system on the basis of current information (to bridge the statistical time-lag) and
- to produce ex-ante forecasts and policy simulations of production and income one to two (three) years ahead.

The central hypothesis of the short-term forecast model is that the major decisions on the initiation of the production process and the allocation of production factors have been made already. The production process can then be viewed as being "in the pipeline", so that most output and input variables can be forecast exogenously. Only those (limited) substitutions between products and factors which are feasible over the short term (e.g. substitutions between different feed categories) are explained endogenously by model mechanisms.

The short-term forecasts and simulations are based on:

- trend analyses of all the input, output and price variables of SPEL/EU-Data for the ex-post period,
- forecasts of exogenous trends by specialists (e.g. Eurostat, officials from different domains of statistics and officials from market divisions of DG VI),

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13 See chapter 5.2..

14 See SPEL System, Methodological Documentation (Rev. 1), Vol.1: Basics, BS, SFSS, Part 2: Base System, chapter 3. Base Model.

- consistency calculations using the accounting framework described above (for endogenous variables).

Advantages of the SPEL activity-based approach are:

- that the specific knowledge of experts from different fields of experience (changes in yields, input use, prices, labour input, etc.) can be integrated,
- that it contains the main political instrument variables (acreages, number of livestock, etc.).

Principal limitations over the short term result from the fact that only the immediate effects on agricultural production and income are considered, but not the allocational responses and the feedback on investment and labour mobility which determine medium and long-term developments.

The Short-term Forecast and Simulation System (SFSS) is described in more detail in the SFSS documentation (Part 3 of this document).

6.4. Medium-term Forecast and Simulation System

The Medium-term Forecast and Simulation System (SPEL/EU-MFSS) is designed for forecasts of sectoral production and income developments for an ex-ante period of about 6 years, simulations and *policy-oriented modelling*. It is created as a model for agricultural administration purposes and can be used in dialogues and mutual interaction between model-builders, statisticians, policy-makers and officials. Over the past years it has been used mainly for the comparative analysis of various options relating to the reform of the EU agricultural policy and for assessing the likely impact of the agricultural reform decided on in 1992 by the Council of Ministers.

MFSS is based on the ex-post data created by the Base Model. Forecasts and simulations start on the latest available statistical information and revisions of the SPEL/EU-Data provided by SFSS. The MFSS forecasts and policy simulations are projections of the ABTA, MAC and Demand component.

The realization of MFSS within the *activity-based accounting system* has several advantages:

- The detailed breakdown of agricultural production with respect to production activities, product and input items provides the possibility to explore the effects of a wide range of agricultural policies.
- The differentiated representation through ABTA and MAC are helpful for reviews of results by experts. At a disaggregated level (e.g. yields, land use), expert knowledge may be more adequately incorporated than at a more aggregated level (e.g. total production data).
- The realization within an activity-based accounting system ensures consistency in respect of both physical and monetary interactions, as well as the comparability of model results with the definitions used in the EAA.

The MFSS is divided into components:

- The *supply component* forecasts agricultural production and input use. The effects of changes in the political, economic and technological environment on agricultural supply and factor demand are calculated.
- The *demand component* forecasts the domestic intersectoral use of the agricultural products and models the influence of price and income changes on demand.
- The *external trade component* represents net trade at aggregate EU level with Rest of World (ROW). The response of world market prices in net trade changes by ROW is modelled.

These components are parts of a comprehensive sector model, in which *market clearing and price formation* are explained.

The basic assumptions can be summarized as follows:

On the *supply* side, production and inputs respond to expectations about the producer and purchase prices and to the expectations about the income (value added) per unit of the production activities. These expectations being formed by past experience. The medium-term response is modelled in a two-stage calculation:

- In the first stage, the quantities of the variable inputs per unit of the production activities (e.g. nitrogenous fertilizer input per hectare of barley) are calculated. These calculations are influencing the output coefficients. The solutions are determined by anticipations of future output and input prices.
- In the second stage the levels of the production activities (e.g. the acreage of barley) are calculated by the anticipated value addeds per unit of the production activities.

Total domestic *demand* for agricultural products depends on prices, consumer level and consumer income, the transformation costs of raw products into processed products, the demand for chemical, technical and energetic use (industrial use), and on agricultural production (seed and feed use).

Market clearing and price formation are very like the principle of communicating tubes:

- Markets are cleared at Member State level, aggregate EU level and globally through the operation of price adjustments. EU and ROW net foreign trade is equal.
- Price formation is a result of the interplay between the price-dependent supply, demand and external trade constrained by the market-clearing condition and the type of (price) policy.

The transmission of world market price changes into the "EU-pool" and from there into the Member State market depends mainly on the policy scenario.

The linkage of the supply, demand and external trade component follows the *dynamic coupling* principle. Beginning with the first year of the projection period (t+1), the model solves the supply component, with expected prices assumed as being the relevant incentives for the supply response of the agricultural sector in t+1. The solution of the supply component gives information about the sales and purchases of the agricultural sector in t+1. The sales and purchases are model input to the next step, i. e. the simultaneous solution of the demand and external trade component for t+1. The solution of the demand and external trade components comprise the consumer prices for t+1. The farmgate prices for t+1 are derived from the consumer prices for t+1 and influence the price expectations for t+2. For the second and further projection years, this coupling procedure is repeated.

MFSS offers flexible possibilities to incorporate *external information* from experts and other studies in order to make use of specialised knowledge. External information can be applied to the exogenous variables as well as to the parameters of the model.

- External information which enters the model as *exogenous variables* comprises information about the macroeconomic environment (exchange rates, etc.) and policy instruments (administrated prices, quotas etc.).
- External information which enters the model via *parameters* can comprise e.g. agronomic engineering information etc..

The Medium-term Forecast and Simulation System (MFSS) is described in more detail in the MFSS documentation [15].

[15] See SPEL System, Methodological Documentation (Rev. 1), Vol.2: MFSS.

7. CONCLUSIONS

The SPEL/EU-Model provides an overall picture of the agricultural sector of the Member States of the European Union (EU) and of the flow of agricultural products within the EU. By covering the agricultural production sector according to the gross production concept and dividing agriculture into production activities, the system includes and reveals the intricacies of the production network within the agricultural sector.

An identity system covers an accounting network to balance the depicted physical and valued flows inside the agricultural sectors of the EU for both ex-post representation and ex-ante simulations. The demand for agricultural products outside the agriculture is covered by the system of identities for physical flows.

Consistent data (SPEL/EU-Data) for the agricultural sector of the Member States and the EU as a whole are provided for a past reference period using Base System (BS).

These ex-post data form the basis for ex-post analytical work which can be used for

- checking the Base System itself,
- checking the in-flowing data material, and
- revealing past trends and the elements linking them, which again are taken into account in forecasts and simulations.

This method incorporates both ex-post representation by the BS and ex-ante simulation by the SFSS and MFSS.

Each module of the SPEL/EU-Model is based on the same identity system (accounting network) and therefore allows a combination of data for both ex-post representation and ex-ante simulations.

The technical design of the SPEL/EU-Model allows for updating of the incoming data several times a year. This updating, and also the use of the SPEL/EU-Model, are supported by detailed technical documentation [16].

[16] See SPEL System, Technical Documentation (Rev. 1), Vol. 1: Basics and see SPEL System, Technical Documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS.

ANNEXES

ANNEX 1

SUPPLY AND DEMAND TABLE STRUCTURE OF THE SPEL/EU-MODEL

8. ANNEX 1: SUPPLY AND DEMAND TABLE STRUCTURE OF THE SPEL/EU-MODEL

8.1. Introduction

This annex to the methodological documentation on the SPEL/EU-Model describes in detail the

supply-oriented composition of the

- Activity-Based Table of Account (ABTA),
- Matrix of Activity Coefficients (MAC),
- additional aggregates for agriculture and

demand-oriented composition of the

- ABTA extension "Demand component",
- other additional aggregates of the national economy.

Notes on the methodological concepts underlying these SPEL/EU-Model components can be found in the previous chapters of this publication. Each of these components are using the same concepts of a supply-oriented table and a demand-oriented table.

In view of the close connection between the ABTA and the MAC[17], these accounting tables are combined into one table to make technical conversion easier. The presented tabular form has proved helpful for analyses, forecasts and simulations in the past.

The following pages thus describe the structures (columns and lines) of the supply- and demand-oriented tables. Figures A1 and A2 are diagrams of the supply-oriented and demand-oriented tables respectively.

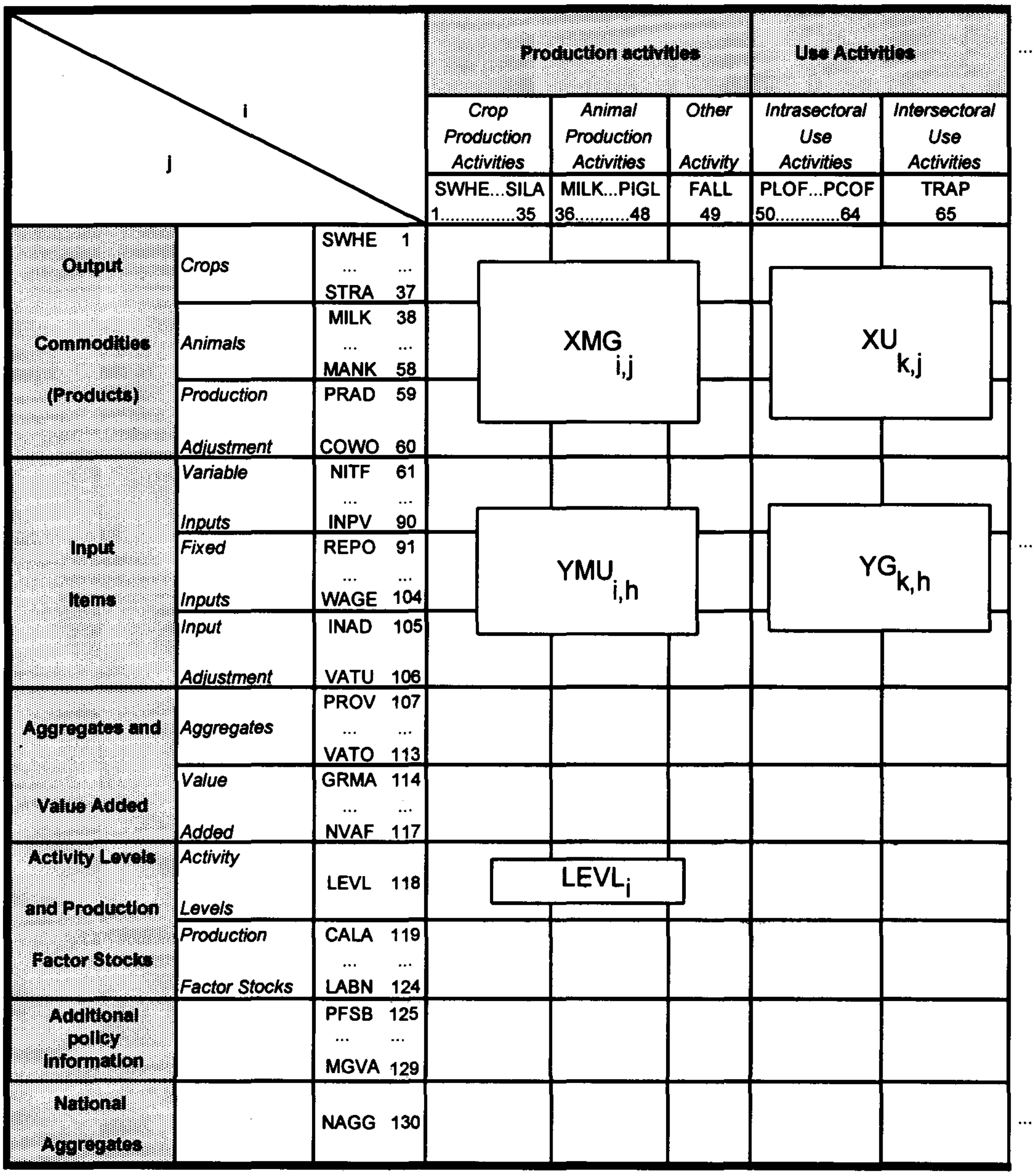
These table structures are the same for both compiling the ex-post SPEL/EU-Data using the Base System (BS) and computing the ex-ante projection results using the Forecast and Simulation Systems (SFSS and MFSS).

The given order of table columns and lines takes account of both the technical structures of algorithms for producing e.g. the SPEL/EU-Data, and of interrelated subject matter.

The overviews show the columns and lines of the EU-Model tables and table codes, as well as the consecutive numbering of the individual components. The code is important for SPEL/EU-Data users only if they wish to extract individual items of data. Each element in a table is specified by an 8-character code, the first 4 characters specifying the table column and the last 4 characters the table line. Details of this are given in the SPEL System, Technical Documentation (Rev. 1), Vol. 1, Basics.

17 See chapter 4. of this document.

Figure A1: Supply table structure



<u>Remarks :</u>

- column and line abbreviations are explained in the following pages of this annex.
- refering to chapter 3, 4 and 5 of this documentation part, the necessary sectors for establishing the whole ABTA and MAC are shown :
  - XMG = Output Generation activity coefficients of MAC (physical component)
  - YMU = Input Use activity coefficients of MAC (physical component)
  - XU = Output Use of ABTA (physical component)
  - YG = Input Generation of ABTA (physical component)
  - LEVL = Production activity level vector
  - FP = Producer prices
  - PP = Purchase prices

In the content of ABTA and MAC, the table line "GVAM" has to be considered in YMU and YG.

Physical Aggregates	**Prices and Price Elements**				**Monetary Aggregates**		**National Aggregates**	**Nutrient Content of Feed Aggregates**
Gross Interactions	*Prices*	*Additional Prices*	*Price Elements*	*Parities*	*Aggregates in Current Prices*	*Aggregates in Constant Prices*		
PROP 66	UVAL...PRIN 67...........69	PRII PRAD 70 71	LEVI SUBP 72 73	GRPA DOPA 74.............76	PROV PEAV 77 78	PROC PEAC 79 80	NAGG 81	ENNE...........DRMA 82......................88
	FP_j							
	PP_h							

Figure A2: Demand table structure

j \ i			**Resource and Use Activities**		**Demand Aggregates**		**National Economic Data**
			Use Activities	*Resource Activities*	*Resource Aggregates*	*Use Aggregates*	
			PEXE............PADJ	MAPR..........PIMW	PIMT PFSM	PDOM.....PEXT	CPRI..........................INHA
			1.........................10	11......................13	14 15	16..................17	18..................................20
Raw Products	*Crop*	SWHE 1 ... ... OCRO 32					
	Animal	MILK 33 ... ... WOOL 42					
Processed Products	*Crop*	RICE 43 ... ... OTHC 56					
	Animal	MIPO 57 ... ... OMPR 59					
Aggregated Feed Products		FCER 60 ... ... FOTH 66					
Additional Aggregate		NAGG 67					

Remarks :

- column and line abbreviations are explained in the following pages of this annex.

8.2. Supply table structure

Supply table Lines (SL)

	Line Code	Line No	Main/Joint product
Products (SL)[18]			
Crop products (SL)			
Final crop products (SL)			
Soft Wheat	SWHE	01	Main
Durum Wheat	DWHE	02	Main
Rye and Meslin	RYE	03	Main
Barley	BARL	04	Main
Oats	OATS	05	Main
Maize	MAIZ	06	Main
Other Cereals (excl. Rice)	OCER	07	Main
Paddy Rice	PARI	08	Main
Pulses	PULS	09	Main
Potatoes	POTA	10	Main
Sugar Beets	SUGB	11	Main
Rape and Turnip Rape Seed	RAPE	12	Main
Sunflower Seed	SUNF	13	Main
Soya Beans	SOYA	14	Main
Olives for Oil	OLIV	15	Main
Other Oilseeds and Oleaginous Fruit	OOIL	16	Main
Flax and Hemp	FLAX	17	Main
Tobacco Unmanufactured	TOBA	18	Main
Other Industrial Crops	OIND	19	Main
Cauliflower	CAUL	20	Main
Tomatoes	TOMA	21	Main
Other Vegetables	OVEG	22	Main
Apples, Pears and Peaches	APPL	23	Main
Other Fruits	OFRU	24	Main
Citrus Fruits	CITR	25	Main
Table Grapes	TAGR	26	Main
Table Olives	TABO	27	Main

18 Agricultural products are grouped into crop and animal products. In the SPEL/EU-Model, 58 products (37 crop and 21 animal products) are distinguished, each of them shown as a final or intermediate product. Final products are produced mainly for consumption outside the agricultural sector. Intermediate products are used only inside the sector. Both, final and intermediate products are further divided into main and joint products. Joint products (by-products) are technically related to the production of a main product. Depending on the production activity definition, a product is a main product for one activity and a joint product for another activity. The beef product for example is the main product for the "male adult cattle for fattening" activity and related to the "Dairy cow" activity a joint product. This product differentiation applies to the lines of the ABTA and of the MAC.

	Line Code	Line No	Main/Joint product
Grapes for Table Wine	TWIN	28	Main
Grapes for Other Wine	OWIN	29	Main
Nursery Plants	NURS	30	Main
Flowers, Ornamental Plants etc.	FLOW	31	Main
Other Final Crop Products	OCRO	32	Main
Intermediate crop products (SL)			
Other Root Crops	OROO	33	Main
Green Fodder	GRAS	34	Main, Joint
Silage	SILA	35	Main, Joint
Hay (dry weight)	DHAY	36	Joint
Straw Fed	STRA	37	Joint
Animal products (SL)			
Final animal products (SL)			
Milk of cows	MILK	38	Main, Joint
Beef	BEEF	39	Main, Joint
Veal	VEAL	40	Main
Pork	PORK	41	Main, Joint
Milk of Ewes and Goats	MUTM	42	Main
Sheep- and Goatmeat	MUTT	43	Main, Joint
Eggs	EGGS	44	Main
Poultry Meat	POUL	45	Main, Joint
Other Animal Products	OANI	46	Main
Raw Wool	WOOL	55	Joint
Intermediate animal products(SL)			
Calves	CALV	47	Main, Joint
Heifers	HEIF	48	Main
Dairy cows	DCOW	49	Joint
Piglets	PIGL	50	Main
Lambs	LAMB	51	Joint
Chicks	CHIC	52	Joint
Male adult cattle	BULL	53	Joint
Other cows	SCOW	54	Joint
Nitrogen from Manure	MANN	56	Joint
Phosphate from Manure	MANP	57	Joint
Potassium from Manure	MANK	58	Joint
Production adjustment (SL)			
Production Adjustment (related to EAA adjustments)	PRAD	59	
Contract work and new plantation	COWO	60	

	Line Code	Line No
Input items (SL)[19]		
Variable input items (SL)		
Specific crop input items (SL)		
Nitrogenous mineral Fertilizer	NITF	61
Phosphatic mineral Fertilizer	PHOF	62
Potassic mineral Fertilizer	POTF	63
Lime fertilizer	CAOF	64
Nitrogen from Manure	NITM	65
Phosphate from Manure	PHOM	66
Potassium from Manure	POTM	67
Seed Inputs	SEEP	68
Plant Protection	PLAP	69
Specific animal input items (SL)		
Fodder : cereals (incl. rice)	FCER	70
Fodder : rich protein	FPRO	71
Fodder : rich energy	FENE	72
Fodder : milk and milk products	FMIL	73
Fodder : dried (not marketable)	FDRY	74
Fodder : fresh and ensilaged (not marketable)	FFSI	75
Fodder : other	FOTH	76
Input Calves	ICAL	77
Input Heifers	IHEI	78
Input Cows	ICOW	79
Input Piglets	IPIG	80
Input Bulls	IBUL	81
Input Lambs	ILAM	82
Input Chicks	ICHI	83
Input Animal Imports (EAA)	IAIM	84
Pharmaceutical Input	IPHA	85

19 Variable and fixed inputs (costs) are both shown. The variable inputs are grouped into specific crop and animal input items. The fixed input items include farm overheads. The primary factor costs are additional sectoral aggregates, which are not allocated to individual production activities. This input differentiation applies to both the lines of the ABTA and those of the MAC, excluding the primary factor cost items.

	Line Code	Line No
General input items (SL)		
Losses on farm	**PLOF**	86
Variable Costs Repairs	**REPV**	87
Variable Costs Energy	**ENEV**	88
Variable Costs Water	**WATV**	89
Variable Costs Other Inputs	**INPV**	90
Fixed input items (SL)		
Overheads (SL)		
Overheads Repairs	**REPO**	91
Overheads Energy	**ENEO**	92
Overheads Other Inputs	**INPO**	93
Primary factor cost items (SL)		
Subsidies, crop production (EAA)	**SUBC**	94
Subsidies, animal production (EAA)	**SUBA**	95
Subsidies, other production (EAA)	**SUBO**	96
Taxes linked to crop production (EAA)	**TAXC**	97
Taxes linked to animal production (EAA)	**TAXA**	98
Taxes linked to production (EAA)	**TAXO**	99
Depreciation Buildings	**DEPB**	100
Depreciation Machinery	**DEPM**	101
Interest Paid	**INTE**	102
Rent Paid	**RENT**	103
Wages Paid	**WAGE**	104
Input adjustment (SL)		
Input Adjustment (related to EAA adjustments)	**INAD**	105
Value added tax, undercompensation	**VATU**	106

	Line Code	Line No
Aggregates and value added (SL)[20]		
Aggregates (SL)		
Gross Production, valued	PROV	107
Total intermediate input	TOIN	108
Total Variable Inputs	TOVA	109
Total Overheads	TOOV	110
Subsidies	SUBS	111
Taxes linked to production	TAXE	112
Value added tax, overcompensation	VATO	113
Value added (SL)		
Gross Margin	GRMA	114
Gross Value Added Mark. Pric.	GVAM	115
Gross Value Added Fact. Cost	GVAF	116
Net Value Added Factor Cost	NVAF	117
Activity levels and production factor stocks (SL)[21]		
Levels of Production Activities	LEVL	118
Capital Stocks Land	CALA	119
Capital Stocks Buildings	CABU	120
Capital Stocks Machinery	CAMA	121
Capital Crop / Livestock	CACL	122
Total Labour (annual work unit)	LABO	123
Non-Family Labour (annual work unit)	LABN	124

[20] These aggregates are additional to the ABTA and MAC data. Only the table line Gross Value Added at Market prices (GVAM) is linked to the ABTA and MAC definition, which contains the gross payments for primary factors (land, labour and capital). Depending on the related column, the listed aggregates are available by activity or as sectoral aggregates.

[21] The table line "Levels of production activities" (LEVL) is used to calculate the MAC. The group "production factor stocks" is additional information as a sectoral aggregate.

	Line Code	Line No
Additional policy oriented information, CAP (SL)[22]		
Basic factor related subsidies (CAP)	PFSB	125
Additional factor related subsidies (CAP)	PFSA	126
Basic factor related taxes (CAP)	PFTB	127
Additional factor related taxes (CAP)	PFTA	128
"Modified" gross value a. m. pr. (CAP)	MGVA	129
National aggregates (SL)[23]		
National aggregates	NAGG	130

[22] Additional, non harmonized data for subsidies and taxes linked to production factor determined by CAP changes of 1992 are added to calculated a modified gross value added at market price figure per production activity unit.

[23] The "exchange rate" data (ECU/NC, Dollar/NC and Purchasing Power Standards) are placed in the line "NAGG".

Supply table Columns (SC)

	Column Code	Column No
Production activities (SC)[24]		
Crop production activities (SC)		
For final crop products (SC)		
Soft Wheat	SWHE	01
Durum Wheat	DWHE	02
Rye and Meslin	RYE	03
Barley	BARL	04
Oats	OATS	05
Maize	MAIZ	06
Other Cereals (excl. Rice)	OCER	07
Paddy Rice	PARI	08
Pulses	PULS	09
Potatoes	POTA	10
Sugar Beets	SUGB	11
Rape and Turnip Rape Seed	RAPE	12
Sunflower Seed	SUNF	13
Soya Beans	SOYA	14
Olives for Oil	OLIV	15
Other Oilseeds	OOIL	16
Flax and Hemp	FLAX	17
Tobacco Unmanufactured	TOBA	18
Other Industrial Crops	OIND	19
Cauliflowers	CAUL	20
Tomatoes	TOMA	21
Other Vegetables	OVEG	22
Apples, Pears and Peaches	APPL	23
Other Fruits	OFRU	24
Citrus Fruits	CITR	25
Table Grapes	TAGR	26
Table Olives	TABO	27
Table Wine	TWIN	28
Other Wine	OWIN	29
Nursery Plants	NURS	30
Flowers, Ornamental Plants etc.	FLOW	31
Other Final Crop Products	OCRO	32

24 The agricultural production activities are grouped into crop and animal activities. In the SPEL/EU-Model, 49 production activities (35 crop, 13 animal production activities and a fallow land activity) are distinguished. Each of them is shown as producing final and/or intermediate products. A single activity produces one to four products, depending on the kind of product. This production activity differentiation applies to the column of the ABTA as well as to that of the MAC.

	Column Code	Column No
For intermediate crop products (SC)		
Other Root Crops	OROO	33
Grass/Grazings	GRAS	34
Fodder Plants on Arable Land	SILA	35
Animal production activities (SC)		
For final animal products (SC)		
Dairy Cows	MILK	36
Male Adult Cattle for Fattening	BEEF	37
Calves for Fattening	CALF	38
Pigs for Fattening	PORK	39
Ewes and Goats	MUTM	40
Sheep and Goats for Fattening	MUTT	41
Laying Hens	EGGS	42
Poultry for Fattening	POUL	43
Other Animals	OANI	44
For intermediate animal products (SC)		
Other cows	CALV	45
Calves, rearing	RCAL	46
Heifers	HEIF	47
Pig Breeding	PIGL	48
Other activities (SC)		
Fallow Land	FALL	49

	Column Code	Column No
Sectoral interactions (SC)[25]		
Intrasectoral (SC)		
Losses: on farm	PLOF	50
Animal Feed: on farm	FEEP	51
Seed: on farm	SEEP	52
Nitrogen from Manure	MANN	53
Phosphate from Manure	MANP	54
Potassium from Manure	MANK	55
Calves	CALP	56
Heifers	HEIP	57
Cows	COWP	58
Piglets	PIGP	59
Bulls	BULP	60
Lambs	LAMP	61
Chicks	CHIP	62
Stock Changes: on farm	PCSF	63
Human Consumption: on farm	PCOF	64
Intersectoral (SC)		
Sales/Purchases	TRAP	65
Physical aggregates (SC)		
Gross Interactions (production, input)	PROP	66

25 The sectoral interactions (flows) are grouped into intrasectoral and intersectoral flows. The intrasectoral flows reflect intra-agricultural movements and intersectoral flows extra-agricultural movements.In total, 16 interactions (use activities or flows) are shown, 15 of which are intra-agricultural interactions and one extra-agricultural (sales or purchases).The ABTA sectors "Output Use" and "Input Generation" are subdivided in the columns with these interactions.

	Column Code	Column No
Prices and price elements (SC)[26]		
Prices (SC)		
Unit Value	UVAL	67
Farm Gate Price	PRIC	68
Internal Use Price	PRIN	69
Additional prices (SC)		
Price Index	PRII	70
Administered Price	PRAD	71
Price elements (SC)		
Levies	LEVI	72
Subsidies (Price-side)	SUBP	73
Parities, product related[27]		
Green parity	GRPA	74
Budget parity	BUPA	75
Double parity	DOPA	76
Monetary aggregates (SC)		
Aggregates in current prices (SC)		
Gross Interactions	PROV	77
Final Production, EAA	PEAV	78
Aggregates in constant prices (1990) (SC)		
Gross Interactions	PROC	79
Final Production, EAA	PEAC	80

26 The prices are broken down into ABTA and MAC related prices and additional prices. The price elements are included to take possible administrative aspects into account. In the supply oriented table the prices and price elements are shown separately in the columns. In the context of ABTA and MAC the "Unit value" column represents the price vector for valuing the "Output Generation" and "Input Use" of ABTA and MAC. The "Farm Gate Price" column is used to value the intersectoral interactions and the "Internal Use Price" column to value the intrasectoral interactions of "Output Use" and "Input Generation" of ABTA.

27 Additional, non harmonized data for parities related to CAP changes of 1992.

	Column Code	Column No
National economy-complementary aggregates (SC)[28]		
National aggregates	NAGG	81
Nutrient content of feed aggregates (SC)[29]		
Net energy (lactation)	ENNE	82
Metabolizable energy (ruminants)	ENMR	83
Metabolizable energy (pigs)	ENMP	84
Metabolizable energy (chicken)	ENMC	85
Metabolizable energy (horses)	ENMH	86
Crude protein	CRPR	87
Dry matter	DRMA	88

28 The gross domestic product (GDP) data (valued at current prices, Price index and Quantity index) are placed in the column "NAGG".

29 The weighted nutrient content per unit of feed aggregate is used to calculate the feed input per animal production activity.

8.3. Demand table structure

Demand table Lines (DL)

	Line Code	Line No
Products (DL)[30]		
Raw products (DL)		
Crop products (DL)		
Soft Wheat	SWHE	01
Durum Wheat	DWHE	02
Rye and Meslin	RYE	03
Barley	BARL	04
Oats	OATS	05
Maize	MAIZ	06
Other Cereals (excl. Rice)	OCER	07
Paddy Rice	PARI	08
Pulses	PULS	09
Potatoes	POTA	10
Sugar Beets	SUGB	11
Rape and Turnip Rape Seed	RAPE	12
Sunflower Seed	SUNF	13
Soya Beans	SOYA	14
Olives for Oil	OLIV	15
Other Oilseeds and Oleaginous Fruit	OOIL	16
Flax and Hemp	FLAX	17
Tobacco Unmanufactured	TOBA	18
Other Industrial Crops	OIND	19
Cauliflowers	CAUL	20
Tomatoes	TOMA	21
Other Vegetables	OVEG	22
Apples, Pears and Peaches	APPL	23
Other fresh Fruits	OFRU	24
Citrus Fruits	CITR	25
Table Grapes	TAGR	26
Table Olives	TABO	27

30 The lines of the demand table are divided into raw and processed products. Both are grouped into crop and animal products. The demand components are divided into 43 raw products (32 crop and 10 animal products) and 17 processed products (14 crop and 3 animal products). In addition, 7 aggregated feed products are shown (corresponding to the supply table), to calculate the intersectoral purchases of agriculture. For additional national aggregates a line (NAGG) is added.

	Line Code	Line No
Table Wine	TWIN	28
Other Wine	OWIN	29
Nursery Plants	NURS	30
Flowers, Ornam. Plants etc.	FLOW	31
Other final Crop Products	OCRO	32
Animal products (DL)		
Milk of dairy cows	MILK	33
Beef	BEEF	34
Veal	VEAL	35
Pork	PORK	36
Milk of Ewes and Goats	MUTM	37
Sheep- and Goatmeat	MUTT	38
Eggs	EGGS	39
Poultry Meat	POUL	40
Other Animal Products	OANI	41
Raw Wool	WOOL	42
Processed products (DL)		
Processed crop products (DL)		
Rice (milled rice equivalent)	RICE	43
Molasses	MOLA	44
Potato Starch	STAR	45
Sugar	SUGA	46
Vegetable Fats and Oil		
Rape and Turnip Rape	RAPO	47
Sunflower	SUNO	48
Soya	SOYO	49
Olives	OLIO	50
Others	OTHO	51
Oilcake - Rape and Turnip Rape	RAPC	52
Oilcake - Sunflower	SUNC	53
Oilcake - Soya	SOYC	54
Oilcake - Olives	OLIC	55
Other Oilcakes	OTHC	56
Processed animal products (DL)		
Milk powder	MIPO	57
Butter	BUTT	58
Other products of milk	OMPR	59

	Line Code	Line No
Aggregated feed products (DL)		
Fodder : cereals (incl. rice)	FCER	60
Fodder : rich protein	FPRO	61
Fodder : rich energy	FENE	62
Fodder : milk and milk products	FMIL	63
Fodder : dried (not marketable)	FDRY	64
Fodder : fresh and ensilaged (not marketable)	FFSI	65
Fodder : other	FOTH	66
Additional economic aggregate (DL)		
National Aggregates	NAGG	67

Demand table Columns (DC)

	Column Code	Column No
Resource and use activities (DC)[31]		
Use activities (DC)		
Exports, intra EUR12	PEXE	01
Exports, extra EUR12	PEXW	02
Change in Stocks: Market	PCSM	03
Human Consumption: Market	PCOM	04
Animal Feed: Market	PFEE	05
Seed: Market	PSEE	06
Losses: Market	PLOS	07
Industrial Use	PIND	08
Processing	PPRO	09
Statistical adjustments	PADJ	10

31 The rows of the demand table show separately resource/use activities, which make up the market balance.

	Column Code	Column No
Resource activities (DC)		
Marketable Production	MAPR	11
Imports: intra EUR 12	PIME	12
Imports: extra EUR 12	PIMW	13
Demand aggregates (DC) [32]		
Resource aggregates (DC)		
Imports: Total	PIMT	14
Final/Initial Stocks: Market	PFSM	15
Use aggregates (DC)		
Total domestic use	PDOM	16
Exports, Total	PEXT	17
National aggregates (DC)		
Consumer prices	CPRI	18
Expenditure	EXPE	19
Population	INHA	20

[32] The additional aggregates combining resource and use activities are defined as table columns.

ANNEX 2

PRODUCT GROUP DEFINITION OF THE SPEL/EU-MODEL

9. ANNEX 2: PRODUCT GROUP DEFINITION OF THE SPEL/EU-MODEL

9.1. Introduction

This Annex to the methodological documentation on the SPEL/EU-Model describes in detail the product groups distinguished in the model. According to the breakdown given in Annex 1, the products are divided into crop and animal products and then further into final and intermediate products.

As well as consecutive numbering, the SPEL/EU-Model code and, where available, the NACE/CLIO[33] coding are shown. The products and sub-products of the EU-Model product groups listed were taken from the Eurostat manuals on the statistics in question (land use statistics, crop and animal supply balances, animal production statistics, mainly Economic Accounts for Agriculture (see Annex 1 of EAA manual)).

33 This list is consistent with the NACE Rev. 1 nomenclature of activities only at the 2 digit level.

9.2. Crop products

Final crop products

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
01	SWHE		SOFT WHEAT
		011.111	soft wheat and spelt
		111.1	-Winter wheat and spelt
		111.11	-Winter wheat
		111.12	-Spelt
		111.2	-Spring wheat
02	DWHE		DURUM WHEAT
		011.112	Durum wheat
		112.1	-Winter wheat
		112.2	-Spring wheat
03	RYE		RYE AND MESLIN
		011.12	Rye and Meslin
		121	-Rye
		121.1	-Winter Rye
		121.2	-Spring Rye
		122	-Meslin
04	BARL		BARLEY
		011.13	Barley
		130.1	-Spring Barley
		130.2	-Winter Barley
05	OATS		OATS
		011.14	Oats and summer cereal mixtures
		141	-Oats
		142	-Summer cereals mixtures
06	MAIZ		MAIZE
		011.15	Maize
07	OCER		OTHER CEREALS (excl. rice)
		011.19	Other cereals (excluding rice)
		191	-Buckwheat
		192	-Millet
		193	-Grain sorghum
		194	-Canary seed
		199	-Cereals, not elsewhere specified (excluding rice)
08	PARI		PADDY RICE
		011.2	Rice (in the husk or paddy)

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
09	PULS		PULSES
		011.311	Dried peas (Other than fodder)
		311.1	-Dried peas (excluding chick peas)
		311.2	-Chick peas
		011.32	Haricot beans, kidney and horse beans
		321	-Fodder peas
		322	-Kidney and horse beans
		321	-Haricot beans
		011.39	Other pulses
		391	-Lentils
		392	-Vetches
		393	-Lupins
		399	-Pulses, not elsewhere specified as pulse mixtures and cereal and pulse mixtures
10	POTA		POTATOES
		011.41	Potatoes
		411	-Potatoes (excluding seed potatoes)
		411.1	-New potatoes
		411.2	-Main crop potatoes
		011.412	-Seed potatoes
11	SUGB		SUGAR BEETS
		011.42	Sugar beets
12	RAPE		RAPE AND TURNIP RAPE SEED
		011.511	Rape and turnip rape seed
		511.1	-Winter rape seed
		511.2	-Summer rape seed
		511.3	-Turnip rape seed
13	SUNF		SUNFLOWER SEED
		011.512	Sunflower seed
14	SOYA		SOYA BEANS
		011.513	Soya beans
15	OLIV		OLIVES FOR OIL
		011.822	Other olives (for olive oil production)
16	OOIL		OTHER OILSEEDS AND OLEAGINOUS FRUIT
		011.514	Castor seed
		011.515	Linseed
		011.516	Sesame, hemp, mustard and poppy seed
		516.1	-Sesame seed
		516.2	-Hemp seed
		516.3	-Mustard seed
		516.4	-Oil poppy and poppy seed
		011.517	Groundnuts
		011.518	Oleaginous products, not elsewhere specified
		011.523	Cotton
17	FLAX		FLAX AND HEMP
		011.52	Fibre plants
		521	-Flax
		522	-Hemp
18	TOBA		TOBACCO UNMANUFACTURED
		011.53	Unmanufactured tobacco (including dried tobacco)

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
19	OIND		OTHER INDUSTRIAL CROPS
		011.54	Hop cones
		011.59	Other industrial crops
		591	-Chicory roots
		592	-Medicinal plants, aromatics, spices and plants for perfume extraction
		592.1	-Saffron
		592.2	-Caraway
		592.9	-Medicinal plants, aromatics, spices and plants for perfume extraction, not elsewhere specified
		593	-Sugar cane
20	CAUL		CAULIFLOWER
		011.611	Cauliflower's
21	TOMA		TOMATOES
		011.631	Tomatoes
		631.1	-Tomatoes intended for direct consumption
		631.2	-Tomatoes intended for processing
22	OVEG		OTHER VEGETABLES
		011.619	-Other brassicas
		619.1	-Brussels sprouts
		619.2	-White cabbages
		619.3	-Red cabbages
		619.4	-Savoy cabbages
		619.5	-Green cabbages (Brassica oleraca)
		619.9	-Cabbages, not elsewhere specified
		011.62	Leaf and stalk vegetables other than brassicas
		621	-Celery and celeriac
		622	-Leeks
		623	-Cabbage lettuces
		624	-Endives
		625	-Spinach
		626	-Asparagus
		627	-Witloof chicory
		628	-Artichokes
		629	-Other Leaf and stalk vegetables
		629.1	-Corn salad
		629.2	-Cardoons and edible thistle
		629.3	-Fennel
		629.4	-Rhubarb
		629.5	-Cress
		629.6	-Parsley
		629.9	-Leaf and stalk vegetables not elsewhere specified
		011.64	Root and tuber crops
		641	-Kohlrabi
		642	-Turnips
		643	-Carrots
		644	-Garlic
		645	-Onions and shallots
		646	-Salad beetroot (red beet)
		647	-Salsify and scorzonera
		649	-Other root and tuber crops (chives, radishes, French turnips, horse radishes)
		011.65	Pod vegetables
		651	-Green peas
		652	-Beans
		659	-Other pod vegetables
		011.66	Cultivated mushrooms

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
23	APPL		APPLES, PEARS AND PEACHES
		011.71	Dessert apples and pears
		711	-Dessert apples
		712	-Dessert pears
		011.72	Cider apples and perry pears
		721	-Cider apples
		722	-Perry pears
		011.731	Peaches (including nectarines)
24	OFRU		OTHER FRUITS
		011.632	Cucumbers and gherkins
		011.633	Melons
		011.634	Egg plants (aubergines), marrows, courgettes and pumpkins
		011.635	Sweet capsicum
		011.639	Other vegetables grown for fruit
		011.732	Apricots
		011.733	Cherries
		011.734	Plums (incl. greengages, mirabelles and quetsches)
		011.739	Other stone fruit
		011.74	Nuts
		741	-Walnuts
		742	-Hazelnuts
		743	-Almonds
		744	-Chestnuts
		745	-Other nuts (excl. tropical nuts)
		745.1	-Pistachios
		745.9	-Nuts, not elsewhere specified
		011.75	Other tree fruits
		751	-Figs
		752	-Quinces
		759	-Other tree fruits, not elsewhere specified (excl. tropical fruits)
		011.76	Strawberries
		011.77	Berries
		771	-Currants
		771.1	-Blackcurrants
		771.2	-Other currants
		772	-Raspberries
		773	-Gooseberries
		774	-Kiwis
		775	-Other berries (e.g. cultivated blackberries)
25	CITR		CITRUS FRUITS
		011.78	Citrus fruits
		781	-Oranges
		781.1	-Sweet Oranges
		781.2	-Other Oranges
		782	-Mandarins
		783	-Clementines
		784	-Lemons
		785	-Grapefruit
		786	-Other citrus fruits
		786.1	-Citrons
		786.2	-Limes
		786.3	-Bergamots
		786.9	-Citrus fruit, not elsewhere specified

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
26	TAGR		TABLE GRAPES
		011.81	Grapes
		811	-Dessert grapes
		812	-Raisins
		813	-Other grapes (for wine making and fruit juice production)
27	TABO		TABLE OLIVES
		011.821	Table olives
28	TWIN		GRAPES FOR TABLE WINE
		012.022	Table wine and wine for distilling or processing
29	OWIN		GRAPES FOR OTHER WINE
		012.01	Grape must
		012.021	-Quality wine (including Port and Madeira)
30	NURS		NURSERY PLANTS
		011.92	Nursery plants
		921	-Fruits trees and bushes
		922	-Vine slips
		923	-Ornamental trees and shrubs
31	FLOW		FLOWERS, ORNAM. PLANTS, ETC.
		011.93	Vegetable materials used primarily for plaiting
		931	-Osier, rushes, rattans
		932	-Reeds, bamboos
		939	-Other vegetable materials used primarily for plaiting
		011.94	Flowers, ornamental plants and Christmas trees
		941	-Flower bulbs, corms and tubers
		942	-Ornamental plants
		943	-Cut flowers, branches and foliage
		944	-Christmas trees
		945	-Perennial plants
		011.95	Seeds
		951	-Agricultural seeds
		952	-Flower seeds
32	OCRO		OTHER FINAL CROP PRODUCTS
		011.96	Products gathered in the wild (e.g. wild mushrooms, cranberries, bilberries, blackberries, raspberries, etc.)
		011.97	Byproducts from plant cultivation of
		971 p.p.	-Cereals (excl. rice) (not straw)
		972	-Rice
		973	-Pulses
		974 p.p.	-Root crops
		975	-Industrial crops
		976	-Fresh vegetables
		977	-Fruit and citrus fruit
		978	-Grapes and olives
		979	-Other plants
		011.99	Vegetable products, not elsewhere specified

Intermediate crop products

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
33	OROO		OTHER ROOT CROPS
		011.49	Mangolds, swedes, fodder carrots and fodder turnips, other root crops
		491	-Mangolds
		492	-Swedes, fodder carrots, fodder turnips
		492.1	-Swedes
		492.2	-Fodder carrots, fodder turnips
		499	-Other root crops
		499.1	-Jerusalem artichokes
		499.2	-Sweet potatoes
		499.9	-Root crops, not elsewhere specified
34	GRAS		GREEN FODDER
			Green fodder from grassland and from fodder plants (not silage)
35	SILA		SILAGE
		011.91 p.p.	-Fodder plants (e.g. hay, clover, kale, cabbage etc. but excl. fodder roots)
		011.974 p.p.	-By products from Root crops
36	DHAY		HAY (dry weight)
		011.91 p.p.	as a part of fodder plants
37	STRA		STRAW FED
		011.971 p.p.	By-products from plant cultivation of cereals (excluding rice)

9.3. Animal products

Final animal products

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
38	MILK		MILK OF COWS
		014.71	Cows' milk
		014.74	Buffalo milk
39	BEEF		BEEF from:
		014.104 p.p.	-Cows
		014.105	Male breeding animals
		105.1	-1-2 years old
		105.2	-More than 2 years old
		014.106	Cattle for slaughtering and fattening
		106.1	-1-2 years old
		106.2	-More than 2 years old
40	VEAL		VEAL from:
		014.101 p.p.	Calves
		014.102	Other cattle less than 1 year old
41	PORK		PIG MEAT from:
		014.201 p.p.	Piglets
		014.202	Young pigs
		014.203	Pigs for fattening
		014.204	Breeding sows
		014.205	Breeding boars
42	MUTM		MILK OF EWES AND GOATS
		014.72	Ewes' milk
		014.73	Goats' milk
43	MUTT		SHEEP- AND GOATMEAT from:
		014.41	Domestic sheep
		014.42	Domestic goats
44	EGGS		EGGS
		014.8	Eggs
		81	-Hens' eggs
		811	-Hatching eggs
		812	-Other
		82	-Other eggs
		821	-Hatching eggs
		822	-Other eggs

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
45	POUL		POULTRY MEAT from:
		014.51	Hens, cocks, chicks, chickens
		014.52	Ducks
		014.53	Geese
		014.54	Turkeys
		014.55	Guinea-fowl
46	OANI		OTHER ANIMAL PRODUCTS
		014.3	Equines
		31	Horses
		32	-Donkeys
		33	-Mules and hinnies
		014.56	Domestic rabbits
		014.57	Domestic pigeons
		014.59	Other animals
		591	-Bees
		592	-Silkworms
		593	-Animals reared for fur
		594	-Snails (excluding sea-snails)
		599	-Animals, not elsewhere specified
		014.6	Game and game meat
		61	-Game
		62	-Killed game
		014.92	-Honey
		014.93	-Silkworm cocoons
		014.94	-By products of animal rearing
		014.95	-Animal products, not elsewhere specified
55	WOOL		RAW WOOL
		014.91	Raw wool (including animal hair, if it is a principal product)

Intermediate animal products

Line No.	SPEL/EU code	NACE/CLIO code	Product groups and sub-groups
47	CALV		CALVES (not slaughtered)
		014.101	Calves
48	HEIF		HEIFERS (not slaughtered)
		014.103	Heifers
49	DCOW		DAIRY COWS
		014.104 p.p.	
50	PIGL		PIGLETS (not slaughtered)
		014.201	Piglets
51	LAMB		LAMBS
52	CHIC		CHICKS
54	SCOW		OTHER COWS
		014.104 p.p.	
56	MANN		NITROGEN FROM MANURE
		014.94 p.p.	
57	MANP		PHOSPHATE FROM MANURE
		014.94 p.p.	
58	MANK		POTASSIUM FROM MANURE
		014.94 p.p.	

ANNEX 3

INTERMEDIATE INPUT DEFINITIONS OF THE SPEL/EU-MODEL

10. ANNEX 3: INTERMEDIATE INPUT DEFINITIONS OF THE SPEL/EU-MODEL

Introduction

This Annex to the methodological documentation on the SPEL/EU-Model describes in detail the intermediate input groups distinguished in the model.

Apart from consecutive numbering, the EU-Model code and, where available, the codes of Appendix III of the Handbook on Economic Accounts for Agriculture are shown. The input groups and sub-groups of the EU-Model input groups listed were taken from the Handbook on Economic Accounts for Agriculture.

Where two EU-Model codes are given, the input definitions include both variable and shares of fixed inputs (overheads).

Specific crop variable inputs

Line No.	SPEL/EU code		Product groups and sub-groups
61	NITF		NITROGENOUS MINERAL FERTILIZER
		4.11	Nitrogenous fertilizer
62	PHOF		PHOSPHATIC MINERAL FERTILIZER
		4.12	Phosphate fertilizers
63	POTF		POTASSIC MINERAL FERTILIZER
		4.13	Potash fertilizers
64	CAOF		LIME FERTILIZER
65	NITM		NITROGEN FROM MANURE
66	PHOM		PHOSPHATE FROM MANURE
67	POTM		POTASSIUM FROM MANURE
68	SEEP		SEED INPUTS (MARKETED AND FARM USE)
		1.	Seeds and plants for:
		1.1	Cereals (excluding rice)
		1.2	Rice
		1.3	Pulses
		1.4	Root crops
		1.5	Industrial plants
		1.6	Vegetables
		1.7	Tree nursery products (excluding forestry seeds, seedlings and cuttings) (including seeds and plants for Christmas trees)
		1.8	Other crop products (e.g. flower bulbs, flower corms and tubers, flower seeds, grass and clover seeds)
69	PLAP		PLANT PROTECTION
		5.	Plant protection products, herbicides, insecticides and pesticides
		5.1	-Fungicides
		5.2	-Insecticides
		5.3	-Herbicides
		5.4	-Others

Specific animal variable inputs

Line No.	SPEL/EU code		Product groups and sub-groups
70	FCER		Fodder : CEREALS (incl. rice)
71	FPRO		Fodder : RICH PROTEIN
72	FENE		Fodder : RICH ENERGY
73	FMIL		Fodder : MILK AND MILK PRODUCTS
		7.13	Milk and dairy products
74	FDRY		Fodder : DRIED (not marketable)
75	FFSI		Fodder : FRESH AND ENSILAGED (not marketable)
76	FOTH		Fodder : OTHER
77	ICAL		INPUT CALVES
78	IHEI		INPUT HEIFERS
79	ICOW		INPUT COWS
80	IPIG		INPUT PIGLETS
81	IBUL		INPUT BULLS
82	ILAM		INPUT LAMBS
83	ICHI		INPUT CHICKS
84	IAIM		INPUT ANIMAL IMPORTS
85	IPHA		PHARMACEUTICAL INPUT
		6.	Pharmaceutical Products (Medicines where not purchased together with veterinary services)

General variable input items and overheads

Line No.	SPEL/EU code		Product groups and sub-groups
87/91	REPV/REPO		VARIABLE COSTS REPAIRS / OVERHEADS REPAIRS
		8.1	Materials and small tools
		8.11	Light implements (e.g. knapsack sprayers, water pumps, small electric motors, small internal combustion engines, electrified fences)
		8.12	Small tools (e.g. shovels, spades, hoes)
		8.13	Other material (e.g. batteries, lamps, switches, wire, nails, wire netting, sacks, leather straps, planks, barrels, cases, packing material, refills for fire extinguishers, binding materials, plastic materials, plastic sheeting, work clothes, boots, anti-frost smoke, anti-hail cover, detonators for the protection of crops
		8.2	Maintenance and repair of vehicles, machinery and other items of equipment
		8.21	Spare parts (e.g. sparking-plugs, batteries, reaper components, saw blades, ploughshares, tyres)
		8.22	Labour charges (e.g. for blacksmiths, mechanics, electricians)
		8.23	Total costs borne by farmers in respect of overall payments to non-agricultural units (e.g. materials, labour charges, management earnings and profits)
		8.3	Maintenance and repair of agricultural buildings and other buildings
		8.31	Materials used (e.g. cement, sand, bricks, tiles, glass)
		8.32	Labour charges (e.g. for painters, builders, labourers, carpenters, joiners, plumbers, electricians)
		8.33	Total costs borne by farmers in respect of overall payments to non-agricultural units (e.g. materials, labour charges, management earnings and profits)
88/92	ENEV/ENEO		VARIABLE COSTS ENERGY / OVERHEADS ENERGY
		3.	Energy, Lubricants
		3.1	Heating fuels
		3.2	Motor fuels
		3.3	Electricity
		3.4	Lubricants
89	WATV		VARIABLE COSTS WATER

Line No.	SPEL/EU code		Product groups and sub-groups
90/93	INPV/INPO		VARIABLE COSTS OTHER INPUTS/OVERHEADS OTHER INPUTS
		9.	Services
		9.1	Veterinary services
		9.11	Fees
		9.12	Total services (i.e. overall payments for pharmaceutical products and fees)
		9.2	Rental costs
		9.21	Business use of non-residential buildings
		9.22	Machinery and other items of equipment without operating staff
		9.3	Others
		.310	Services provided by transport, commercial and storage enterprises, costs of intra agricultural exchange of seeds, feed and capital account and non-capital account livestock
		.311	Postage and telephone charges incurred in the performance ofwork
		.312	Insurance premiums (service component only) relating to current and capital goods to cover losses incurred in the course of business
		.313	Cover charges
		.314	Expenditure on artificial insemination
		.315	Bank fees
		.316	Levies and subscriptions to economic and professional organizations (e.g. farmers associations, chambers of commerce, etc.)
		.317	Expenditure on milk inspection, shows, entries in pedigree registers
		.318	Fees for seed certification
		.319	Fees for medical examinations of workers necessitated by their employment
		.320	Costs of engaging labour (advertising, recruitment)
		.321	Fees for agricultural consultants, surveyors, accountants, tax consultants, lawyers, etc.
		.322	Costs of soil analyses
		.323	Purchase of services of scientific research, market research and advertising
		.324	Travel expenses and payments to independent transport firms engaged by the employer for the transport of employees
		.325	Other services, not elsewhere specified
		10.	Other items of intermediate consumption
		10.1	Water rates (business use) related directly or indirectly to the quantity of water consumed (water rates paid purely as a tax and unrelated to the quantity of water consumed are recorded under "Taxes linked to production other than VAT"
		10.2	Expenditure on agricultural newspapers and magazines
		10.3	Substances added in transforming wine must to wine (fining agents, sulphur, sugar, other additives)
		10.4	Intermediate consumption, n.e.s.

Primary Factor Cost items

Line No.	SPEL/EU code	Product groups and sub-groups
94	DEPB	DEPRECIATION : BUILDINGS
95	DEPM	DEPRECIATION : MACHINERY
96	INTE	INTEREST PAID
97	RENT	RENT PAID
98	WAGE	WAGES PAID

PART 2
Base System

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1. INTRODUCTION

This part of the methodological documentation for the SPEL/EU-Model (EU-Model) component Base System (BS) describes the basic approach to establish the SPEL/EU-Data[34] resultant from the work sector Base Model (BM).

In view of the common deficiencies of different statistical material, data have to be treated to allow model components or work sectors to be supplied with as homogeneous a data set as possible. The preparatory data work, preliminary treatment of original statistical material (Data Preparation) and the algorithms to insure completeness of time series (Data Completion on time series) are therefore also described below.

If original statistical data series are needed for other models of the system[35], the stages of treatment described below are applied more or less intensively, depending on the problem. Any instances where these procedures are not followed are listed in the documents on the parts of the system involved.

The chapters below provide users of SPEL/EU-Data (consistent data set resultant from Base Model) with information on assumptions and algorithms which will be useful for work with those data. None of the described Base System work listed is to be carried out by users; it is performed by the Eurostat SPEL team as and when required.

1.1. Structure of the EU-Model

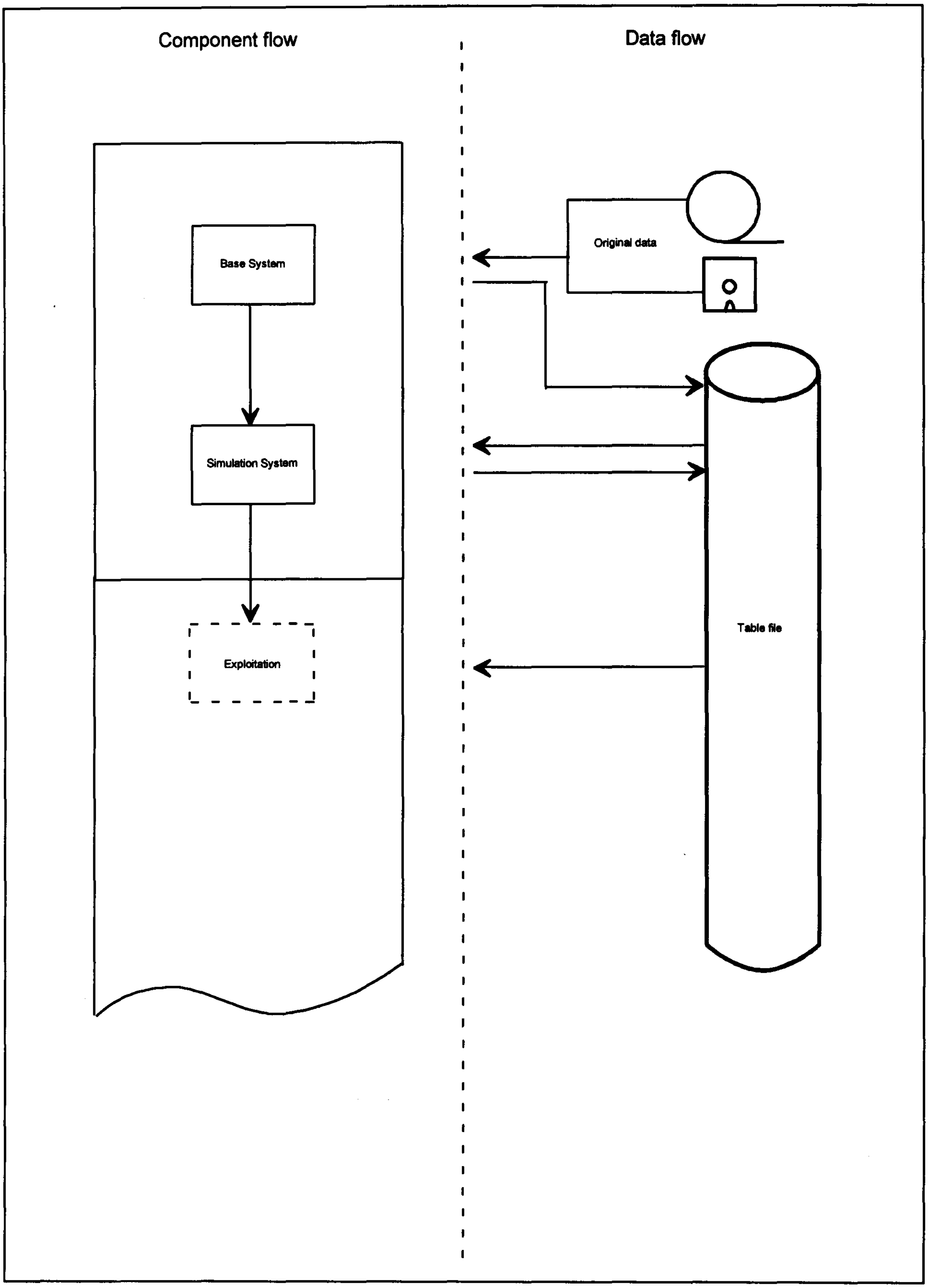
A structural concept of the EU-Model is illustrated within Figure 10 (see Part 1: Basics). The Figure 1 below provides a more technical brief description of the entire EU-Model in general.

The Base System and the simulations are executed only by operator. The results of the Base System are stored and usable by executing forecasts and simulations (SFSS[36] and MFSS[37]). These forecast and simulation results are also stored, so that EU-Model users are able to carry out exploitations using the stored model results.

A basic feature of the SPEL System's structure is the repeated application or execution of the separate model components or work sectors. Chapter 2.3. of this document contains information on routine updating for the ex-post period.

[34] The SPEL/EU-Data are disseminated by Eurostat.
[35] European Union Agricultural Sector Model or SPEL/Trade, Foreign Trade Model.
[36] SFSS, Short-term Forecast and Simulation System, see Part 3 of this document.
[37] MFSS, Medium-term Forecast and Simulation System, see SPEL System, Methodological Documentation (Rev. 1), Vol. 2: MFSS.

Figure 1: SPEL/EU-Model structure



1.2. Structure of Base System

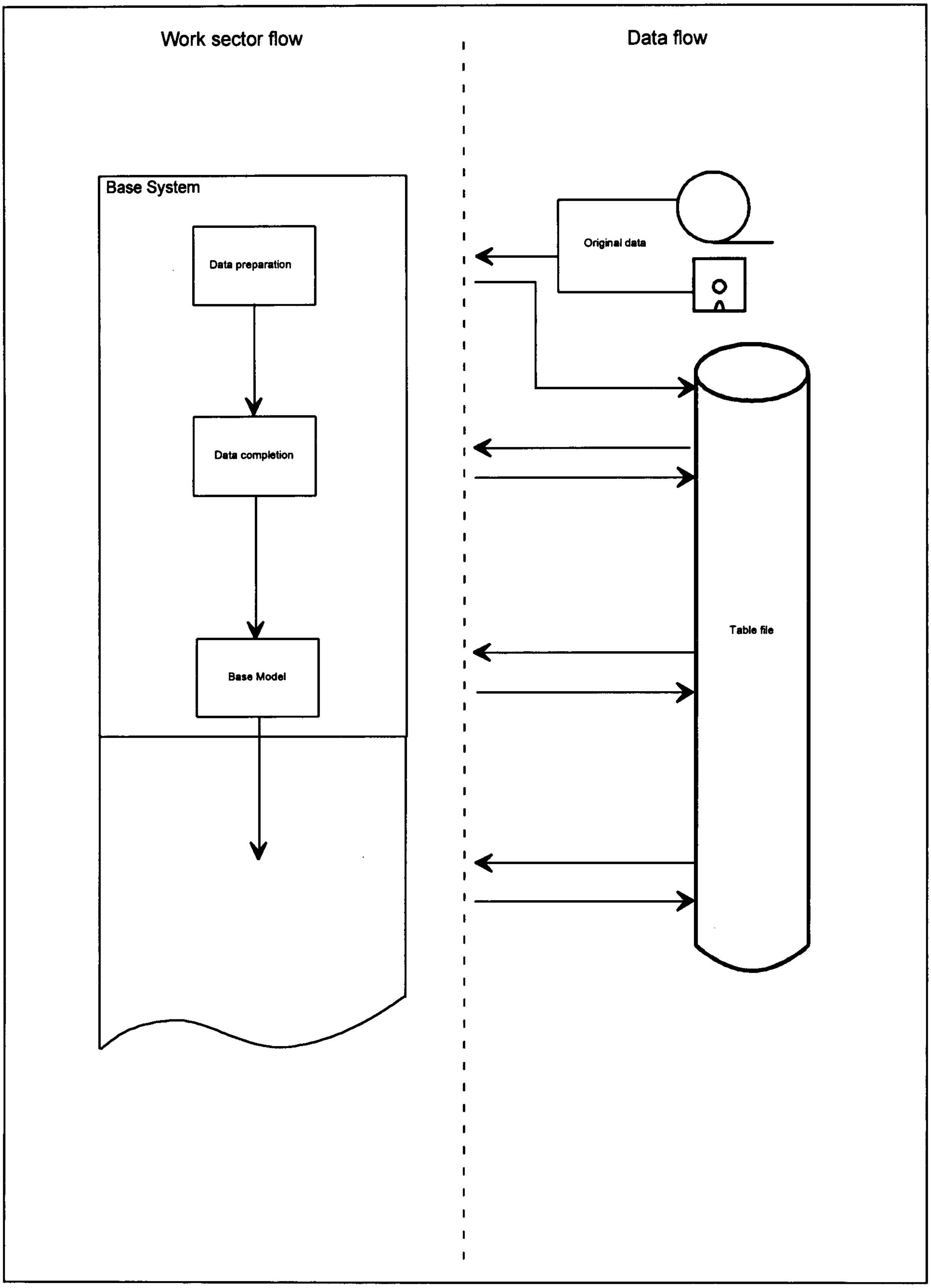
The text and Figure 2 below provide an overview of the Base System general work sectors, showing where data preparation, etc. comes into play and its importance for subsequent stages. The sequence of Base System work sectors is also indicated, but in exceptional cases, as a result of data deficiencies or the needs of the subsequent work sectors, this sequence may be changed or repeated several times over.

Whilst the various stages are being completed, feedbacks may occur which are not mentioned in the figures, because otherwise these would become too complex and no longer provide an overview. The other documentation goes into more detail on this point.

During data preparation and completion of time series, statistical data undergo preliminary processing, the influence of which on subsequent work sectors depends on the type of treatment.

Furthermore, Figure 2 shows that the SPEL/EU-Data available to users represent a synthesis of previously computed and stored results.

Figure 2: Structure of Base System



2. PREPARATORY DATA WORK

The principal aim of preparatory data work is to provide complete, harmonized data for the following work sector and model components as far as possible. Since the EU-Model contains different data sectors and sources (see chapter 2.1.2), the establishment of SPEL/EU-Data always requires preparatory work of a more or less intensive nature.

Obviously, where the basic statistical material is already homogeneous and without breaks in the time series, the preparatory data work procedures are restricted to data extraction.

Common data deficiencies (definitional anomalies, discontinuity of time series, etc.) caused by a variety of factors, make preparatory data work necessary in order to meet the needs of the different models of the system. Clearly, this data work cannot ensure absolute removal of all data deficiencies. By including other, related information, an attempt is made to eliminate as far as possible major definitional deficiencies and to fill in missing data in order to meet requirements more accurately.

Chapter 2.3. concludes the comments with a few remarks on the subsequent combination of preparatory data work results with original statistical data.

2.1. Data preparation

The following chapters contain some comments on data extraction: the origin of data, frequency of extraction and the amount of data extracted. A detailed list of extracted data for the EU-Model is shown in Annex 2. The compilation of the extracted data is also briefly described.

Figure 3 provides an overview of the structure of the data preparation work steps and its sequence. The labels given to the work steps reflect the main activities involved.

2.1.1. Data extraction

All data extracted from various sources are strictly allocated to the data classification[38]. Preliminary statistical data are regularly updated in the course of each year. The SPEL/EU-Data are updated at least in spring and autumn to allow the latest crop and animal production data to be included immediately after they become available in Eurostat's data bank (e.g. CRONOS). As mentioned at the beginning of this document, this work is performed by the Eurostat SPEL team.

As a rule, the figures are extracted from Eurostat's CRONOS[39] data bank. These CRONOS data are supplemented by national[40] and international[41] statistics which are updated in the system depending on availability and use. The technical and management data are checked for their significance every two to four years and updated where necessary.

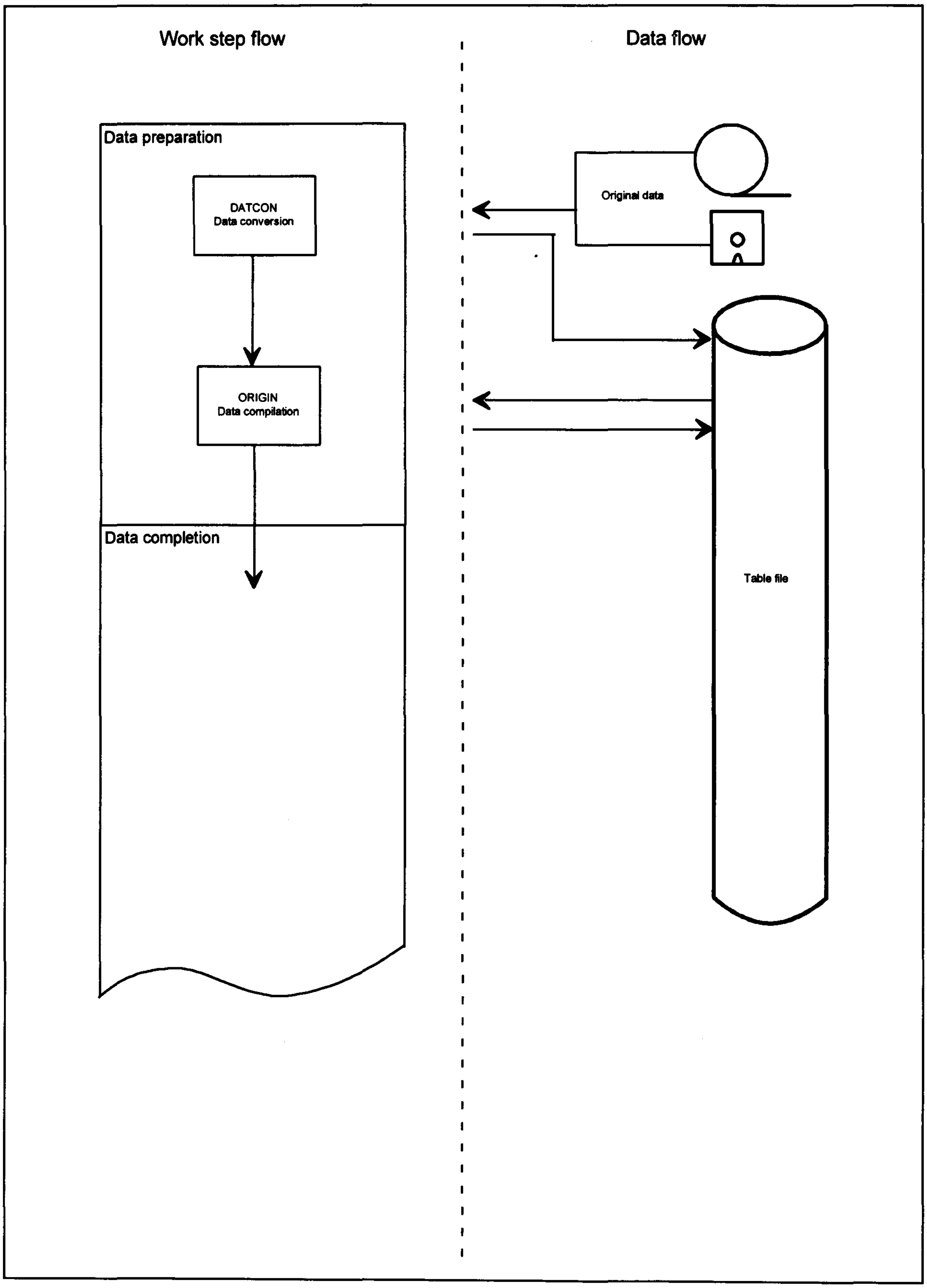
[38] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, chapter 5.

[39] The CRONOS data bank is divided into several independent domains. The SPEL/EU-Model extracts data from the following domains: ZPA1, COSA, FEED, PRAG, SEC1. The CRONOS manuals give information on the designations and meaning of these domains or see chapter 3.2..

[40] National statistics are mainly used for the SPEL/EU-Data for the some southern Member States of the EU.

[41] International statistics are needed mainly for the SPEL/Trade-Model, such as FAO data.

Figure 3: Structure of data preparation



All data for the EU-Model are extracted in the course of an updating procedure. These data are also extracted for the whole time series so that definitional or other changes can be revealed by comparison with data obtained at the previous extraction. About 1 200 items of data, for example, are needed for a Member State's agricultural sector for one year for the SPEL/EU-Model. An updating operation thus involves the extraction of about 300.000 items of data (1200*12*21) so that these problems have to be constantly taken into account in the subsequent work sector. During data extraction, the original unit of measurement is converted to the dimension specified for the other work sectors of the SPEL/EU-Model. For example, prices per 100 kg are converted into prices per ton, to allow work in a uniform dimension in subsequent stages.

A particular problem in data extraction lies in distinguishing between genuine zero values and missing data. If this is clearly distinguished in the statistical data sources, it is taken into account during extraction and converted into the SPEL coding. However, very few data sources have a continuous uniform characterisation.

The list for data extraction (see Annex 2) contains direct usable and indirect usable data for the SPEL/EU-Model. The data which can be used directly are not subjected to preliminary treatment, since they are already in line with the requirements of other work sectors. Indirect data, on the other hand, undergo preliminary treatment or serve as subject-related data for producing missing directly usable data.

2.2. Data completion of time series

This chapter deals with general methods for reducing data deficiencies, and in particular the problem of filling in missing data. Both the inclusion of specific information and the use of trend estimates are discussed.

Figure 4 provides an overview of the structure of data completion worksteps and its sequence. The tables given to the work steps reflect the main activities involved

2.2.1. Introductory remarks

During a complete revision of the data completion work sector, when the empirical specification of the model is revised, all algorithms are checked in an attempt to eliminate data deficiencies if known at the time.

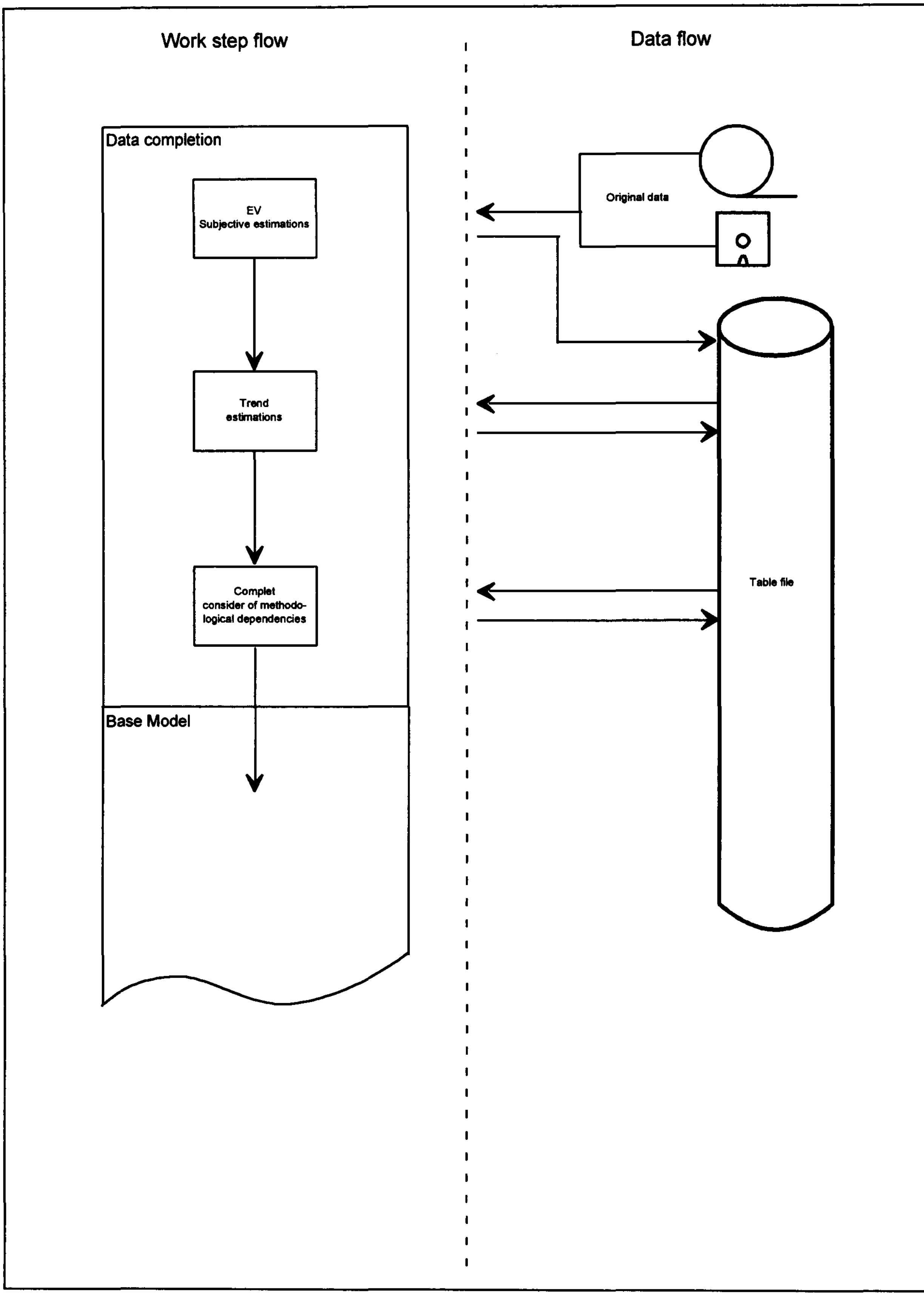
During updating, the complete revision results are checked on the basis of lists of data changes. According to experience, it can be assumed that where data show no or very small changes, the corresponding algorithms do not need to be rechecked. The same applies to time series data, provided the only change is that the complete series has been extended by an additional observation.

The data deficiency problems are the same both at the revision stage and during updating of a model. However, for each updating, use is made of the treatment algorithms designed and checked during the last complete revision. As already mentioned, this updating work is performed by the Eurostat SPEL team.

Statistical data treated as imprecise by virtue of their provisional character, which also include estimates from statistical departments and administrations, which are taken over into SPEL/EU-Data without modification[42].

[42] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, chapter 5.2..

Figure 4: Structure of data completion



During the updating of SPEL/EU-Data, the following problems occur in the use of statistical data: input errors, missing data, definitional divergencies.

2.2.2. Treatment of input errors

Easily recognizable errors occurring during data input (e.g. incompatible orders of magnitude) are corrected directly and recorded to allow a separate check during subsequent updating. This type of error is corrected as far as possible in direct cooperation with the suppliers of the data

Less easily recognizable errors are in some cases detected only when the final plausibility checks of consistent SPEL/EU-Data are carried out; these errors are also eliminated immediately, as described above.

2.2.3. Treatment of missing data

For empirically based models, missing data are a problem to which constant attention has to be given at all work stages from development to routine updating and use.

The requirements of the EU-Model cannot be fully met if the necessary data are missing.

The output of the Base Model (see next chapter 3) for ex-post description of agricultural sectors are restricted to time-linked regionally differentiated items.

The corresponding data can be classed into categories[43]. These categories must be complete in the required spatial and time dimensions.

The next chapter deals briefly with the complete lack of data on specific categories. Subsequent chapters deal with the problem of incomplete data in the spatial or time dimension.

2.2.3.1. Complete lack of data on categories

The availability or lack of data of entire categories is taken into account when a model is designed and implemented. However, certain data still have to be obtained by a transformation of available information or by *ad hoc* (subjective) estimations.

The transformation of available data generally takes the form of identities or identity systems and such data should be classed in the "residual data" category[44].

Technical or management data which belong to the "calculation data" category[45] are used for *ad hoc* estimations.

In the EU-Model these two procedures are not classed as data completion work but are carried out in the next work sector Base Model. These solutions are therefore described in the following Chapter 3 (Base Model).

---

43 Examples of categories are data on crop or animal production.
44 See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, chapter 5.2..
45 See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, chapter 2.2..

2.2.3.2. Incompleteness of regionally differentiated data

Where data are incomplete in the regional dimension, a distinction is made between missing data within a single category and absence of data for the whole category.

Experience shows that the latter is a temporary situation which is rectified after one to two years satisfactorily enough for the category only to need completion in the time dimension. During this transitional period, use is made of improvised constructions in close cooperation with national experts. These solutions are taken into account pragmatically in the Base Model following this work step.

Where individual data of a category are missing, they are calculated where possible using related data from the same field in order to take account of regional aspects as far as possible.

The following examples illustrate some of the methods used.

Example 1:

For example, the production (X) of a crop product (j) is missing for a region. The missing value is calculated with the aid of the harvested area (Y) and an assumed yield coefficient weighted with a climatic index (W).

(1) $$X_{i,t} = y_i^* W_{i,t} Y_{i,t}$$

with: $$W_{i,t} = \frac{y_{j,t}}{\sum_t y_{j,t} / T}$$

where:
X : Dependent variable,
Y : Regionally related independent variable,
W : Climatic index,
y^* : Yield coefficient constant,
y : Related coefficient,
i :..Subscript, product,
j : Subscript, related product.
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

Example 2 :

In some cases, the required data are available in aggregate form, but the components of the aggregate are not individually available.

That is where

(2) $$A_t = Z_{1,t} + ... + Z_{i,t} + ... + Z_{n,t}$$

where:
A : Aggregate,
Z : Component of aggregate,
i : Subscript of component($i = (1, ..., n)$)
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

The aggregate A_t is available but the $Z_{i,t} (i = i, ..., n)$ are not available. Suppose there is a related aggregate (A'_t) such that

(3) $A'_t = Z'_{1,t} + \ldots + Z'_{i,t} + \ldots + Z'_{n,t}$

where:
A' : Aggregate, regionally related to A,
Z' : Component of A',
i : Subscript of component(i = (1, ..., n)),
t : Subscript, year (t ∈ (73, ..., T),
T : Subscript, last available year of reference period.

and that the components $Z'_{i,t}(i = i,\ldots,n)$ are available. The component of aggregate A_t may be estimated as

(4) $Z_{i,t} = Z'_{i,t}\,c_t$

with: $c_t = \dfrac{A_t}{A'_t}$

where:
A : Aggregate,
A' : Aggregate, regionally related to A,
Z : Component of aggregate,
Z' : Component of A',
c : Correction factor,
i : Subscript of component(i = (1, ..., n)),
t : Subscript, year (t ∈ (73, ..., T),
T : Subscript, last available year of reference period.

This procedure imposes on the components of A_t the same proportions as those of A'_t ,whilst preserving the identity (2), since

(5) $\sum_{i=1}^{n} Z_{i,t} = c_t\left(\sum_{i=1}^{n} Z'_{i,t}\right)$

where:
Z : Component of aggregate,
Z' : Component of A',
c : Correction factor,
i : Subscript of component(i = (1, ..., n)),
t : Subscript, year (t ∈ (73, ..., T),
T : Subscript, last available year of reference period.

<u>Example 3:</u>

Where all components of the aggregate A_t are available except one $Z_{n,t}$, the missing component can be derived as residual data as follows:

(6) $Z_{n,t} = A_t - \sum_{i=1}^{n-1} Z_{i,t}$

where:
A : Aggregate,
Z : Component of aggregate,
i : Subscript of component(i = (1, ..., n)),
t : Subscript, year (t ∈ (73, ..., T),
T : Subscript, last available year of reference period.

This estimate of $Z_{n,t}$ preserves the identity (2).

If this type of breakdown into components or disaggregation is not possible in specific cases, use has to be made of data whose definition does not match that of required data. Adjustments are then made in accordance with chapter 2.2.3.1..

For the breakdown into components and application of data with definitional divergencies, national experts are consulted as far as possible in order to decide on the assumptions to be applied and to check results.

2.2.3.3. Incompleteness of time series data

Most estimates for completing data are undertaken to fill in time-linked data (time series). For some regional categories, the time series data are not available for the required ex-post period due to problems of harmonization. This also sometimes occurs in individual time series within a category.

The SPEL System provides for three approaches to this completion work:

- time series which are subject-related or have a different definitional basis are used for completion;
- missing data are replaced by ex-post extrapolation and interpolation using trend estimates;
- missing data are replaced by completion of methodological dependencies.

2.2.3.3.1. Completion by means of subject-related data

In this work step, subject-related time series or those differing only in their definitional basis are used for completing data. These additional time series are either taken from regional statistical publications or obtained by experts from regional data banks or surveys.

When the available time series and the subject-related time series have a time overlap, the missing data are computed according to the degree of definitional concurrence either by:

- applying a scaling factor to the subject-related time series, or
- a regression equation (OLS[46]).

If there are only slight definitional inconsistencies, the pattern over time is transferred to the dependent data using a scaling factor. With this approach it is assumed that the missing data have the same relative divergencies between dependent (Y) and independent data (X) as in the basic period (b).

The link is established as follows:

(7) $$Y_t = X_t S$$

with: $$S = \frac{Y_b}{X_b}$$

where:
Y : dependent series,
S : scaling factor,
X : independent series,
t : Subscript, year (t $\in$ (1, ..., T),

[46] Ordinary Least Squares method (OLS).

T : Subscript, last available year of reference period,
b : Base year (b $\in$ (t)).

This solution is also selected in exceptional cases, in spite of the presence of greater definitional divergencies, if the time overlap of the two series does not allow a single equation regression.

Where definitional divergencies are greater and independent data have an adequate time overlap, the missing data are established by means of a regression equation (OLS).

(8) $$Y_t = f(X_{1,t},\ldots,X_{i,t},\ldots,X_{n,t}) = a_0 + a_1 X_{1,t} + \ldots + a_i X_{i,t} + \ldots + a_n X_{n,t}$$

where : Y : estimation for data missing dependent series,
X : data of the complete independent series,
i : Subscript, number independent series,
t : Subscript, year (t $\in$ (1, ..., T),
T : Subscript, last available year of reference period.

The regression equation is checked for its plausibility and according to the standard diagnostic statistics (e.g. coefficient of determination, t ratios).

2.2.3.3.2. Completion by means of trend regression

If no subject-related information is available to fill in missing data or if a simple function of a time trend proves better, the completion work steps preparation sector has a procedure designed specifically for this approach.

The most important point about this procedure[47] is the fact that, when all extracted and prepared data are finally checked for their completeness in time, if data are still missing, estimates are calculated by this method and recorded for checking.

All missing data in a time series (Y) are estimated by means of an OLS regression. Missing values are replaced by:

(9) $$Y_t = f(t) = a_0 + a_1 t$$

where: Y : Dependent data,
t : Years, independent data (t = (1,..., T)),
T : Subscript, last available year of reference period.

The dependent data Y and independent data t can be transformed as follows to obtain a better fit (the transformations indicated may also apply to the time trend):

Linear (no transformation) $x' = x$

Logarithm $x' = LOG_e(x)$

Square root $x' = \sqrt{x}$

Inverse $x' = \frac{1}{x}$

[47] See SPEL System, Technical Documentation (REV. 1), VOL. 2: BS, SFSS, MFSS, program TREND. Guide: SPEL/EU Model, program TREND.

Exponential $x' = e^x$

Power $x' = 10^x$

Square $x' = x^2$

A large number of regression functions are possible as a result of combining these transformations.

The combination that fits best according to the coefficient of determination is then automatically selected unless the operator wants to force a particular combination, determined on the basis of plausibility.

Any transformation that provides a negative value or a value greater than a given maximum is disregarded, and replaced by an estimate based on the regression with the next highest coefficient of determination.

When there is only one observed item of data in the time series, the whole time series is set equal to that observed value. When there are two observations, the whole series (except these two observations) is set to their arithmetic mean. When there are only three or four observations, only linear regression is performed without transformations, unless this gives an unacceptable estimated value.

A change in the number of observations would lead to a change in the estimated results. Therefore, to stabilise the estimates for the ex-post period, trend estimates are generally made for a specific length of time, generally for several updating periods. The number of observations thus remains the same for this period and the same results are obtained when estimates are repeated.

This procedure of period-based estimates is in line with the conventional statistical practice of publishing provisional data.

2.2.3.3.3. Completion of components by consideration of methodological dependencies

A large amount of the extracted time series are e.g. components of an aggregate. Experience shows that the extracted aggregates are mostly more complete in time than the related components.

Based on this experience, if necessary

-the aggregates are completed by the two approaches described in the above chapters and

-the components are completed in time in a separate work step.

The missing data of an individual component are calculated with the completed time series of the related aggregate. As with the completion by trend estimation, the ex-post period is divided into two parts, in order to stabilise the completion results and to calculate a better time period related result.

In this work step two kinds of algorithms are generally used for completion in time of the components:

- *Completion by ratio:*

  The completion by ratio is used if there are more then two individual components of an aggregate which has to be completed. By using this kind of algorithm, the relative changes in time of the components are equal to the relative changes in time of the aggregate. This kind of estimation ensures that the sum of the completed figures of the components is equal to the value of the aggregate.

The missing data in a component time series are calculated with the first available average share related to the aggregate. Missing values are replaced by:

(10) $$Y_{i,t} = r_{i,b} X_t$$

with: $$r_{i,b} = \frac{\sum_{b=1}^{l} Y_{i,b}}{\sum_{b=1}^{l} X_b}$$

where:
- X : Aggregate
- Y : Component of aggregate,
- t : Subscript, year (t ∈ (73, ..., T),
- T : Subscript, last available year of reference period,
- b : Subscript, available data of period (b ∈ (1, ..., T),
- l : Sequence of available data of period, (l ∈ (2, ..., 5) and l ∈ (tb)),
- i : Subscript of component (i = (1, ..., n)).

♦ *Completion by means of an OLS regression.*

The completion by means of OLS regression is used if there are only two individual components of an aggregate. One of these components is estimated by regression, the other is then calculated as an residual.

The missing data in a component time series are estimated by means of an OLS regression depending on the available aggregate data. Missing values are replaced by:

(11) $$Y_{i,t} = f(X_t) = a_0 + a_1 X_t$$

where:
- X : Aggregate,
- Y : Component of aggregate,
- t : Subscript, year (t ∈ (73, ..., T),
- T : Subscript, last available year of reference period,
- i : Subscript of component (i = (1, ..., n)).

The dependent data and independent aggregate data can be transformed to obtain a better fit (see above chapter 2.2.3.3).

The combination that fits best according to the coefficient of determination is then automatically selected unless the operator wants to force a particular combination, determined on the basis of plausibility.

All the solutions described in the above chapters are checked and modified when the EU-Model is revised. Nevertheless, during each updating operation, the operator should check to see whether the numerical values of the independent data have changed as a result of definitional changes. Estimates have to be recalculated only in such cases. So far, it has been possible in most cases to continue working with the set of algorithms.

The completion algorithms described above are also used for dealing with data whose definitions do not conform to EU-Model definitions (see chapter 2.2.3.1.) of the whole period.

2.2.4. Remarks on data of EU-Model

As already mentioned at the start of this document, all these preparatory data work operations are carried out by the Eurostat SPEL team, which for its part produces SPEL/EU-Data on the basis of ready made approaches worked out during creation of the SPEL/EU-Model.

The SPEL/EU-Data for past periods depiction provided to the user contains estimates which impair their accuracy. Considering the relatively small percentage of past data (on average under 10%) affected, however, the accuracy of the data is dominated by the quality of the original statistics. Any deficiencies contained in these statistics are also contained in SPEL/EU-Data if they are not clearly recognisable as errors.

Since SPEL/EU-Data contains data combined from different statistical sources, inevitably it is not error-free. Inaccuracies may be detected when ex-post analytical work is performed by the Eurostat SPEL team or by other users. This information is passed on to the competent statistical authorities by the Eurostat team.

On the basis of the principles set out in chapter 3 (Base Model), the EU-Model is so designed that whenever updating is carried out, priority is given to new original statistics over estimates. Hence, it can be assumed that the trend is towards a decrease in the proportion of estimates contained in SPEL/EU-Data.

Apart from the available documents, the user can obtain from the Eurostat SPEL team all necessary information on the origin and treatment of individual data series.

By means of the characterization described in chapter 2, the operator can provide the corresponding statistical decision-making criteria for single regression estimates as well, in response to users' enquiries on origin and treatment. In view of the large number of estimates already carried out, there are no plans for the moment to provide users with all estimated results.

3. BASE MODEL

3.1. Introduction

The position of the Base System (BS) within the SPEL/EU-Model is illustrated in figure 1 chapter 1.1 of this documentation. The sequence of the work sectors of the Base System, especially the position of the Base Model (BM), is shown in figure 2 (chapter 1.2.). The BM results, i.e. SPEL/EU-Data, form the basis for a broad range of ex-post analytical work and are used for forecast and simulation tasks [48].

A knowledge of the "Basics" (Part 1 of this document) on which the SPEL/EU-Model is based and of its structure [49] will make it easier to follow and to appraise the details given below on the Base Model. The text also contains references to the table structures, explanations and abbreviations given in Annex 1 of Part 1, Basics of this documentation.

The SPEL/EU-Data user will find detailed information on the assumptions which have been made and on calculation algorithms which are important for assessing the results obtained for analytical and simulation work.

Several times a year, SPEL/EU-Data are updated for the ex-post period. Experience from recent years has shown that most of this basic statistical material for the past one or two years is subsequently revised by the statistical offices. Individual time series, however, are also revised retroactively for the entire ex-post period.

Consequently, the SPEL/EU-Data for the entire ex-post period are always included in the update carried out at least twice a year (in spring and autumn). In the spring, the main changes lie in the new revised figures for the animal sector which are then available. In the autumn, the new revised Economic Accounts for Agriculture (EAA) data and crop production data represent the main changes.

The Base System, and hence the Base Model as well, are targeted to these requirements, with the result that the latest data are used at each update and all algorithms have to be recalculated. SPEL/EU-Data are thus calculated without reference to the previous update.

All work with the BM is carried out by the Eurostat team. Technical documentation [50] is available for the BM operator.

3.2. Aims and structure

In Part 1 (Basics, chapter 2) the following SPEL/EU-Model objectives are listed :

- to check the consistency of Eurostat's agricultural statistics,
- to monitor the current situation in the agricultural sector,
- to carry out ex-post analyses of sectoral developments,
- to draw up forecasts and policy simulations of the effects of alternative agricultural policies (CAP [51]) from the short-term and medium-term viewpoints.

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48 See following Part 3: Short-term Forecast and Simulation System (SFSS) of this document and SPEL System Methodological documentation (Rev. 1), Vol. 2: MFSS, the "Medium-term Forecast and Simulation System" (MFSS).

49 See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, chapter 6, figure 10.

50 See SPEL System, Technical documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS.

To achieve these objectives, consistent data are calculated with the BM for the representation period (from 1973 on) in order to depict the agricultural sectors of the European Union (EU) and of the Union as a whole.

The BM collates the results of the preparatory data work (chapter 2) by applying the identity system which determines the structure of the ABTA[52] and MAC[53]. The elements of the equation system which cannot be filled in with original statistical data are calculated and the required consistency for the equation system is obtained by applying the assumptions and algorithms described below. This process amounts to a numerical specification of the ABTA, MAC and demand component which allow consistent data to be obtained which are referred to as SPEL/EU-Data for representation period.

The elements of the ABTA, MAC and demand component identity systems[54] are to be filled in with observed statistical data as far as possible. It is evident that not all elements of these identity systems can be filled in with original statistical data, so that other means have to be used for specifying some groups of elements[55].

Eurostat's CRONOS databank is the main data source for numerical specification; CRONOS data are obtained from various statistical sources, but they are already harmonized to a large degree. The following CRONOS domains are involved:

COSA: Economic accounts for agriculture and forestry,

ZPA1: Production, balances and foreign trade of agricultural products,

PRAG: Agricultural prices and price indices,

SEC1: National accounts aggregates,

FEED: Feed resource data.

As could only be expected, when these CRONOS data are collated, discrepancies occur because the data are collected independently of each other.

As already mentioned, the statistical data for some groups of elements (e.g. Input Use) cannot be obtained in the right definition from statistical sources, so that supplementary sources have to be used (e.g. farm survey data, calculation data[56], etc.).

The BM approach calls for satisfactory processing results from the Data preparation and Data completion stages in order to produce consistent SPEL/EU-Data for the representation period. During a revision stage, and during routine use of the BM, provision is made for an iterative procedure between the BM and the data preparatory work steps because a conclusive assessment of the preparatory data work results cannot be made until the systematic collation of data in the BM is carried out.

However, assumptions and algorithms used for the BM, as well as the results of the Data preparation and Data completion, are checked and if necessary altered in the course of additional ex-post analytical work with SPEL/EU-Data.

The quality of ex-post representation by the BM thus depends on work in two areas in the future as well:

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51 Common Agricultural Policy (CAP).
52 Activity-Based Table of Account (ABTA), see Part 1: Basics, Figure 5 of this document.
53 Matrix of Activity Coefficients (MAC), see Part 1: Basics, Figure 7 of this document.
54 See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, figures 6 and 7.
55 The elements which are formed into groups are those which are subject-related (e.g. input coefficients, output coefficients).
56 Technical data and management data (CD data category). See SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, chapter 5.2. of this document.

- improvement of the amount and quality of original statistical material;
- obtaining findings from ex-post analytical work on inter-relationships and structures within agriculture in general and in particular on the accuracy of SPEL/EU-Data.

Leaving aside the demands and challenges for the SPEL/EU-Model, which will change with time, these two areas already highlight future adaptation requirements to be met by the BM. The Base Model solution structure and assumptions thus require constant revision to ensure that SPEL/EU-Data are always adapted to the latest knowledge and the most recent statistical material.

The elements of the ABTA, MAC and demand component identity systems are numerically specified by a recursive approach[57] as schematically indicated in figure 5. The order of numerical specification of the individual groups of elements shown in figure 5 is adapted to the availability of original statistical data material and the types of problems which have to be solved in the specification of the equation systems[58]. The elements of an individual group are specified numerically, element by element, except for those of Input Use of feed products, which are specified simultaneously using an optimization algorithm (see chapter 3.7.5.).

The guiding principles behind the structuring of the BM solution path are:

- maximisation of original statistical information content,
- utilisation of inter-relationships within the equation systems,
- minimisation of corrections to statistical data,
- minimisation of information requirement from other sources (farm sample data, calculation data, etc.).

The physical part of the ABTA (MAC) is the focal point of numerical specification, since after the specification or calculation of the product and input prices, the monetary part of the ABTA (MAC) can be calculated by multiplication.

The numerical specification algorithms are commented on in the following chapters in the sequence indicated in figure 5.

Neither Figure 5 nor the identity systems (Part 1, Basics, figure 5 and 7) contain time references, because this schematic structure has to be passed through in the given order of succession for any period under consideration (calendar year). Nor do the equations in the following comments contain a subscript for time references and regional subscript. Such a subscript is added only if the comments focus on this subscript. The ABTAs (MACs) for separate EU Member States are also numerically specified sequentially as shown in figure 6.

[57] The numerical specification of some individual groups of elements depends on the specification of another element group.
[58] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1, Basics, figures 6 and 7.

Figure 5: Scheme of the recursive solution of ABTA and MAC

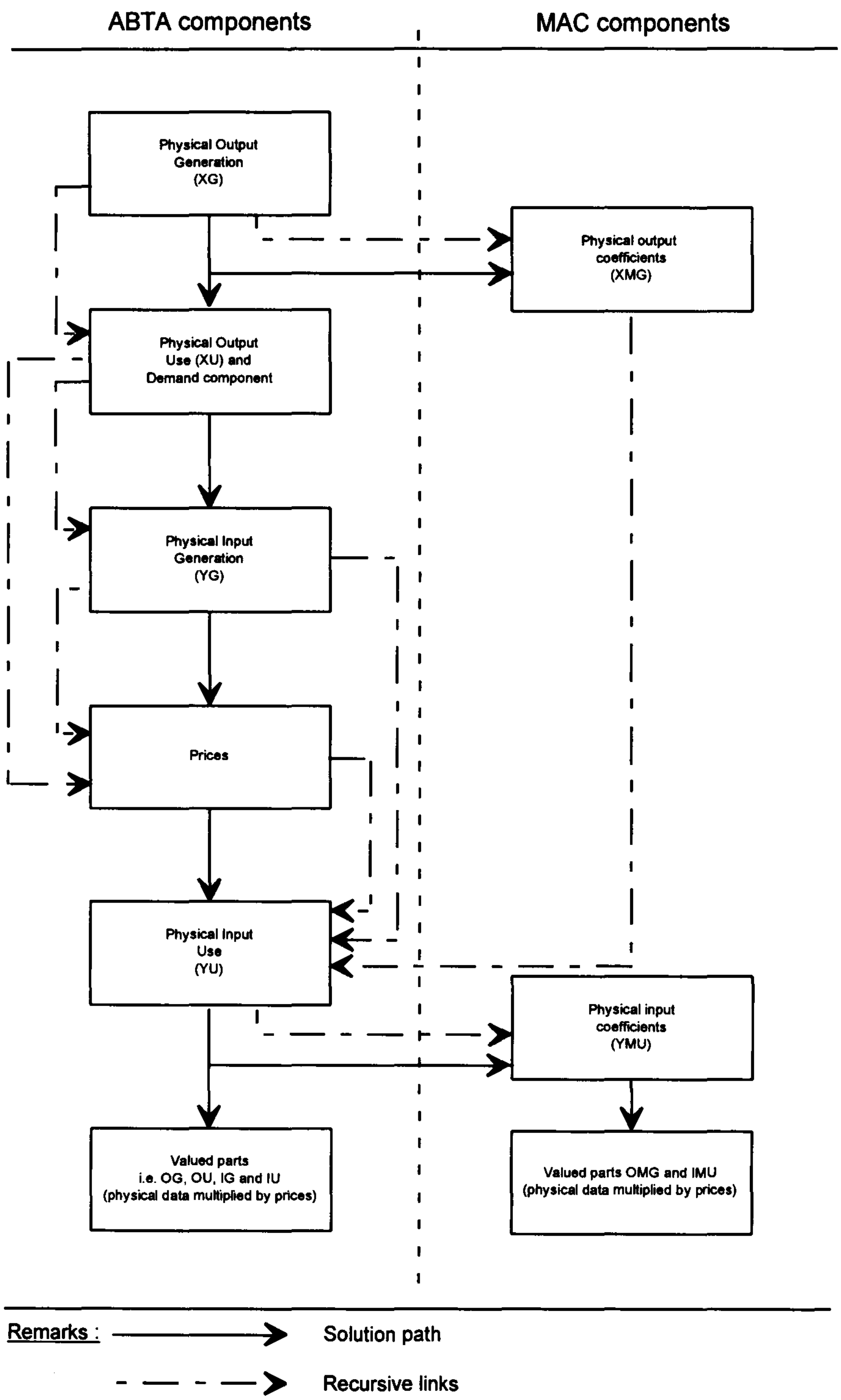
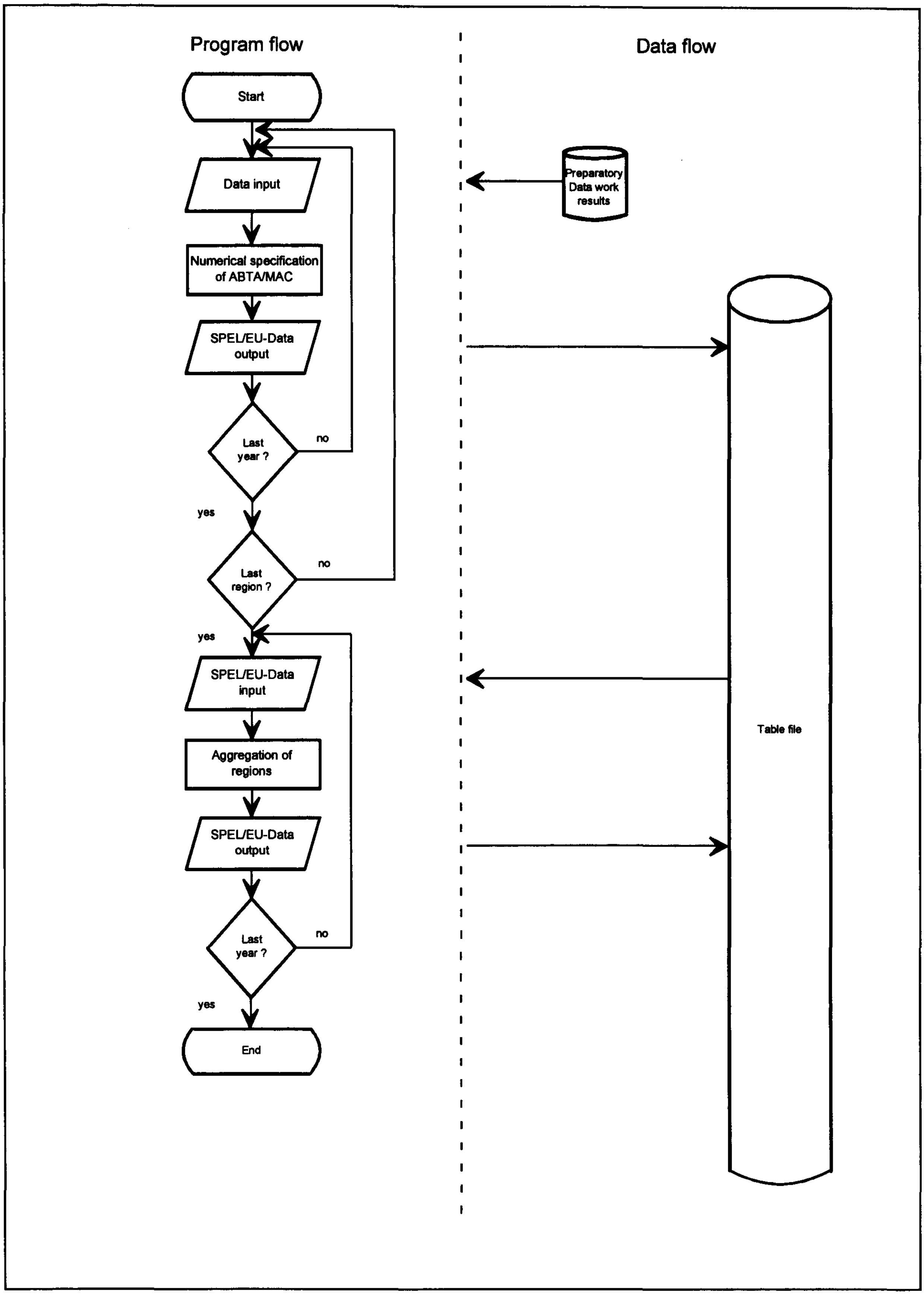


Figure 6: Solution scheme for the time and regional dimensions of the Base Model



Once all the SPEL/EU-Data for the Member States have been produced, they are put through a further work stage to obtain the aggregates for the EU as a whole. Details of the algorithms are given in Chapter 3.1.

The basic units used in the SPEL/EU Model are:

- Quantities:	kg	: kilogram	
	hd	: head	(poultry, laying hens: 10^3 hd)
	ha	: hectare	
	ltr	: litre	
	kJ	: kilojoule	
- Values:	nc	: national currency	(Italy: 10^3 lire).

When the calculations have been completed, the resulting SPEL/EU-Data are shown in the following units only (basic units or multiple of 10^3):

- Quantities:	kg	: kilogram	
	t	: metric tonne	
	1000 t	: 1000 metric tonnes	
	1000 hd	: 1000 head	(poultry, laying hens: 10^6 hd)
	1000 ha	: 1000 hectares	
	1000 ltr	: 1000 litres	
	Mio ltr	: million litres	
	MJ	: megajoule	
- Values:	nc	: national currency	(Italy: 10^3 lire)
	Mio. nc	: million national currency	(Italy: 10^9 lire).

3.3. Output Generation of agricultural products

The agricultural products are grouped into crop and animal products, each of them shown as final products or intermediate products. The final products are produced mainly for consumption outside the agricultural sector. The intermediate products are used only inside the sector.

Both the final and the intermediate products are broken down further into main and joint products. The joint products (by-products) are technically related to the production of a main product. Depending on the production activity definition, a product is either a main product, or a joint product.

The Output Generation of ABTA and MAC are numerically specified in an independent work step sequence for:

- crop Output Generation and
- animal Output Generation.

The following chapters (3.3.1. and 3.3.2.) provide some explanations of the numerical specification and calculations which are to be made for the crop Output Generation. Chapter 3.3.4. and 3.3.5. are related to the animal Output Generation.

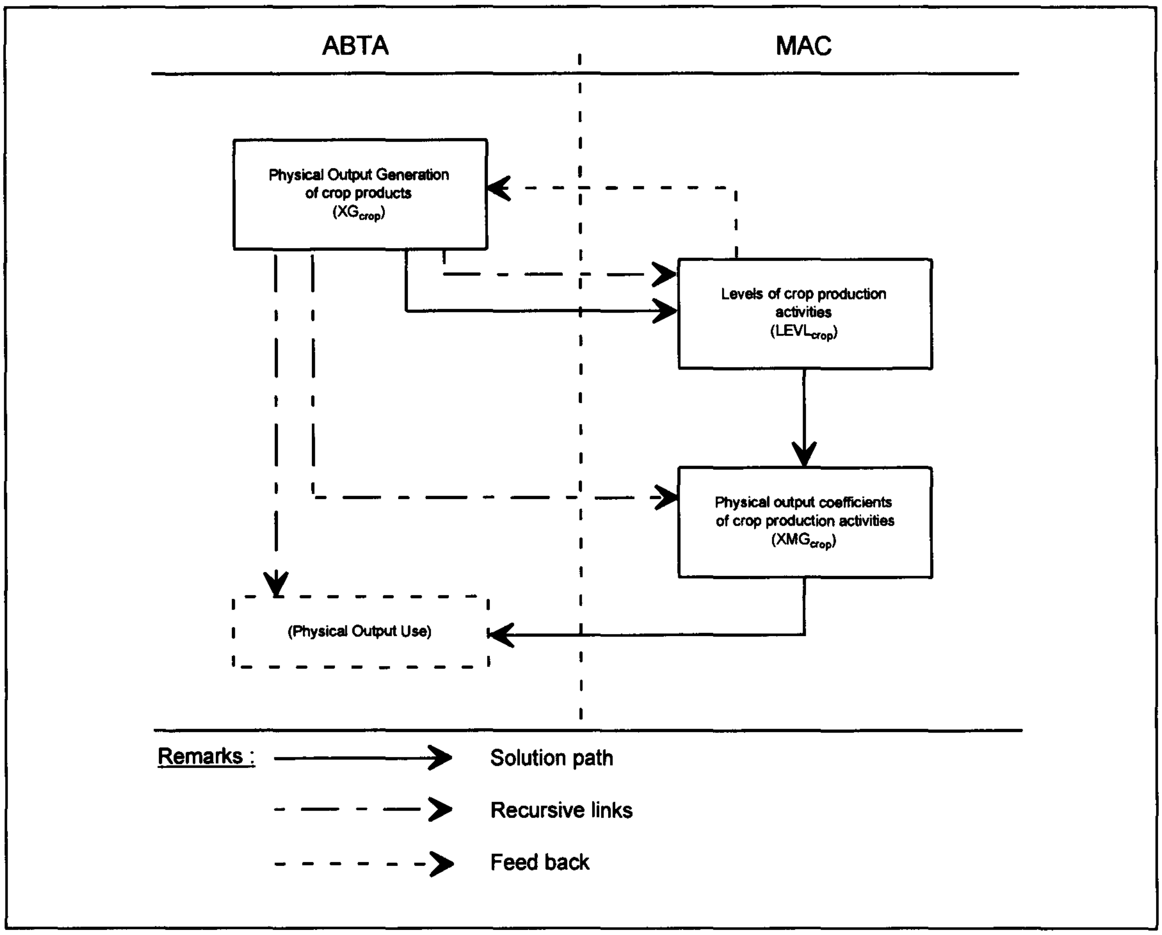
Both the crop and animal product definitions specified in the EU-Model are shown in detail in Annex 2 of Part 1 (Basics) of this document.

3.3.1. Crop Output Generation of the ABTA

Figure 7 offers the scheme of the recursive solution for the crop Output Generation of ABTA and MAC. The work step flow, dependencies of the work steps and also the feedback are shown.

When calculating the (gross) production generation according to the production activity differentiation, first the production data of the final products and then those of intermediate products of the ABTA are determined. Both are main products related to the production activity definition. Finally, the joint products of the ABTA are determined. The domestic production data for main products are based entirely on original data (OD), and those of joint products are mainly based on data of the CD category[59]. Data of the CD category are used for the distribution of some production data to more than one production activity.

Figure 7: Scheme of the recursive solution of crop Output Generation of ABTA and MAC



59 See Part 1: Basics, chapter 5.2 of this document.

3.3.1.1. Sources and reference periods

The data for depicting the ABTA physical Output Generation of a product by a crop production activity are taken from Eurostat statistics (CRONOS domain ZPA1).

In domain ZPA1, the production data are taken from :

- Crop Products: Supply Balance Sheets by Crop Years (collection 3) and
- Crop Products: Annual Statistics of Crop Products (collection 2)

in that order. Since the "usable production" of the supply balance sheet is not available for all the separate products, use is also made of the "harvested production"[60] of the land use statistics (collection 2).

Gross production = ZPA1 (collection 3)

or

Gross production = ZPA1 (collection 2).

As a rule these production data are compiled and published for a crop year. Table 1 shows the different annual periods for various products.

The harvested production of the great majority of products becomes available in the second half of the calendar year (July to December). The crop year production data are therefore allocated to calendar year data of physical Output Generation of ABTA as

(12) $$XG_t = CYP_{t/(t+1)}$$

where: XG : Output Generation, ABTA, physical component,
CYP : Production crop year,
t : Subscript, calendar year,
t/(t+1): Subscript, crop year.

without adjustment. By this procedure, the multiple harvests of individual product groups are allocated to <u>one</u> calendar year period.

Inaccuracies occur in the product groups where several harvests are normally achieved in one crop year but in two calendar years (e.g. potatoes, vegetables, etc.). For product groups whose harvests extend from one calendar year into the next, the total output for the crop year is allocated to the first of the two calendar years (e.g. citrus fruits and sugar beet harvests in southern Europe).

Since no harmonized monthly harvesting statistics are available and since this is only a problem for a few product groups the resultant error can be regarded as negligible[61].

For the gross value added calculations (income generation account), this restriction on the harvesting period is also insignificant because it hardly affects the allocation of costs and yields to specific periods.

60 For some "harvested products", the "harvested production" for some Member States is calculated by adding the "harvested production of principal crops" and "harvested production of secondary crops".

61 This assumption involving a restriction in the harvesting period was discussed with national experts, and in particular those of southern European Member States, who were all of the opinion that it would be unproblematic as far as the accuracy of SPEL/EU-Data was concerned.

Table 1: Crop years of products

Products	Crop year
Cereals	01.07. - 31.06.
Rice	01.09. - 31.08.
Dried pulses	01.07. - 30.06.
Potatoes, potato starch	01.07. - 30.06.
Vegetables	01.07. - 30.06.
Cauliflowers, tomatoes	01.04. - 31.03.
Fresh fruits, nuts	01.07. - 30 06.
Citrus fruits	01.07. - 30.06.
Fresh grapes	01.04. - 31.03.
Apples, pears, peaches	01.04. - 31.03.
Sugar, sugar beet, molasses	01.07. - 30.06.
Oilseeds and oleaginous fruits	01.07. - 30.06.
Vegetables fats and oils	01.07. - 30.06.
Oil cakes	01.07. - 30.06.
Source : Eurostat, Doc. E/V/000, 06/88.	

3.3.1.2. Final products

The product differentiation allows the farthest-reaching numerical specification of the ABTA Output Generation sector in the dimension of physical product weight. The data are extracted from the above-mentioned sources and allocated to the "OD category". The Output Generation of the final (main) product is allocated to the production activity as:

(13) $$XG_{i,j} = CYP_i$$

where : XG : Output Generation, ABTA, physical component,
CYP : Crop year production data,
i : Subscript, production activity, ABTA, (i = j),
j : Subscript, final products, ABTA, (j = (SWHE, ... , OCRO)).

Because of the obvious non-uniformity of the product groups "Nursery plants", "Flowers", "Other industrial crops" and "Other final crop products", there is no point in specifying the production with physically dimensioned data (product weight). Therefore the production value at constant prices is taken from the Economic Accounts for Agriculture (EAA).

For the "other" final (main) product groups[62], the general rule is that Output Generation of a production activity is calculated as a residuum from related higher aggregate production data. The following equation 4 gives an example for calculating the Output Generation of the "other vegetables" product group.

[62] "Other" final products are other cereals, other oilseeds, other industrial crops, other vegetables, other fruits, other wine and other crop products (see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, Annex 1).

(14) $$XG_{OVEG,OVEG} = CYP_{vegetables} - XG_{TOMA,TOMA} - XG_{CAUL,CAUL}$$

where: XG : Output Generation, ABTA, physical component,
CYP : Crop year production data,
$OVEG$: Subscript for "other vegetable" product and activity,
$TOMA$: Subscript for tomatoes product and activity,
$CAUL$: Subscript for cauliflowers product and activity.

3.3.1.3. Intermediate and joint products

The product group "Other Root Crops" is allocated to intermediate products in the product system arrangement, because of its composition (mainly consisting of fodder beet). The calculation follows the given example in equation 14.

As already mentioned three intermediate products are separately identified, other root crops (OROO), green fodder (GRAS) and silage (SILA). Each of these product groups is allocated to a production activity.

The production of GRAS and SILA is published in Eurostat's feeding stuffs statistics or land use statistics. If both statistical sources offer production data, the largest one is used, in order to force the feasibility of the feed distribution (see chapter 3.7.5).

The freshly-used product "Green Fodder" is produced as a main product by the production activity "Grass/Grazings" and as a joint product by the activity "Fodder Plants on Arable Land". The product "Silage" as a main product is produced by, the activity "Fodder Plants on Arable Land" and a joint product of the activity "Grass/Grazings".

To distribute the green fodder production and the silage production to production activities, a distribution factor (r) is used,

(15) $$XG_{i,j} = r_{i,j} CYP_j$$

where: XG : Output Generation, ABTA, physical component,
CYP : Crop year production data,
i,j : Subscript, product and activity, (i = j = (GRAS,SILA)),
r : Distribution factor, constant,

so that the sum of distribution factors over is equal to one. It is assumed that 70% (r = 0,7) of the production of green fodder and silage are produced as a main product by the related production activity.

These two activities also produce hay as a joint product. It is assumed that the green fodder production relationship between these two production activities (GRAS and SILA) is used for distributing the hay production. The Output Generation is calculated according to equation 15. Therefore 70% of the hay production is produced by the activity grass/grazing and the rest by silage.

The joint product "Silage" from sugar beet production is also taken into account by the production activity "Sugar Beets". It is published in Eurostat's feeding stuffs statistics and is calculated according to equation 13.

Straw is a joint product of cereal production. Straw production is calculated using a fixed coefficient[63] for each item of cereal production.

[63] Farm management data (CD-category): see Faustzahlen für Landwirtschaft und Gartenbau, 10. Ausgabe, Frankfurt 1983, page 308.

(16) $$XG_{i,STRA} = \frac{CYP_{STRA}}{\sum_i c_i XG_{i,j}} c_i XG_{i,j}$$

where:
- XG : Output Generation, ABTA, physical component,
- CYP : Crop year production data,
- $STRA$: Subscript, product straw,
- i : Subscript, production activities (i = (SWHE, DWHE, RYE, BARL, OATS, MAIZ, OCER))[64],
- j : Subscript, products, (j = i),
- c : Constant factor, c_i = (1.15, 1.15, 1.65, 1.10, 1.30, 1.60, 1.20).

The straw production of each cereal production activity is adjusted with equation (16) to the total sectoral straw production published in Eurostat's feeding stuffs statistics. For some Member States, the straw production is missing. In that case the straw production will be estimated by using the constant factor c (see equation 16) and the related cereal production.

After the feed distribution (chapter 3.7.5) the Output Generation XG of the intermediate products used for feed will be proportionally adjusted to the fed quantities. Losses and/or stocks of the previous year(s) are regarded as negligible. Therefore the intermediate crop production of green fodder, silage, other root crops and straw represents the quantity which is used as animal feed.

3.3.2. Crop Output Generation of the MAC

Before the MAC output coefficients can be calculated, the crop production activity levels have to be numerically specified in a level vector.

3.3.2.1. Crop production activity levels

The elements of the level vector are in the same sequence as the production activity sequence of the ABTA (columns). The levels of crop production activities are extracted from the CRONOS data bank.

(17) $$LEVL_i = CYL_i$$

where :
- $LEVL$: Levels of production activities,
- CYL : Main areas (ZPA1, collection 2),
- i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)).

As a rule, the main areas are available for the crop year. In order to bring the production area data into line with the Output Generation data, the crop year data are allocated to the calendar year data without adjustments as follows:

(18) $$LEVL_{i,t} = CYL_{i,(t-1)/t}$$

where :
- $LEVL$: Levels of production activities,
- CYL : Main areas (ZPA1, collection 2),
- i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)),
- t : Subscript, calendar year,
- $(t-1)/t$: Subscript, crop year.

64 Subscript cereal activities, see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, Annex 1).

Since by experience main crop areas of less than 250 hectares mainly result in implausible yield and input coefficients and their value added amounts become implausible positive or negative figures, these levels are normally allocated the value 0.

(19) $LEVL_i = 0$, if $LEVL_i < 250$

where : $LEVL$: Levels of production activities,
i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)).

Also, the value 0 is generally allocated to levels when there is no Output Generation of a production activity.

(20) $LEVL_i = 0$, if $\sum_j XG_{i,j} = 0$

where : $LEVL$: Levels of production activities,
XG : Output Generation, ABTA, physical component,
i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)),
j : Subscript, crop products, ABTA, (j = (SWHE, ..., SILA)).

"Other" production activity levels are calculated as described above for Output Generation (see equation 14, chapter 3.1.2.).

The level data not taken into account in the case of equation 19 and 20 increase the residual calculated level of the production activity "Other crops".

(21) $LEVL_{OCRO} = LEVL_{total} - \sum_i LEVL_i$

where : $LEVL$: Levels of production activities,
i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)), excluding OCRO.

The main area definition[65] was used to determine the crop level because the intercropping of the production activities concerned cannot be taken from the statistical data. Furthermore, by using the main crop area definition, it is ensured that in simulations, a land use balance can be carried out because the total utilized agricultural area only changes relatively slightly over time.

3.3.2.2. Crop output coefficients

Before calculating the output coefficients, a revision of the crop Output Generation data is necessary to ensure that the production is only possible with input. This is done by imposing the rule (see "feedback" figure 7):

(22a) $XG_{i,j} = 0$, if $LEVL_i = 0$

where : XG : Output Generation, ABTA, physical component,
$LEVL$: Levels of production activities,
i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)),
j : Subscript, crop products, ABTA, (j = (SWHE, ..., SILA).

65 "Main area" in CRONOS denotes the cultivated area, as opposed to "harvested" (i.e. cropped) area.

The crop output coefficients (yield coefficients) of the MAC are calculated by using the Output Generation data of the ABTA of a product group and the crop production activity levels of the production activity, as follows:

(22b) $$XMG_{i,j} = \frac{XG_{i,j}}{LEVL_i}$$

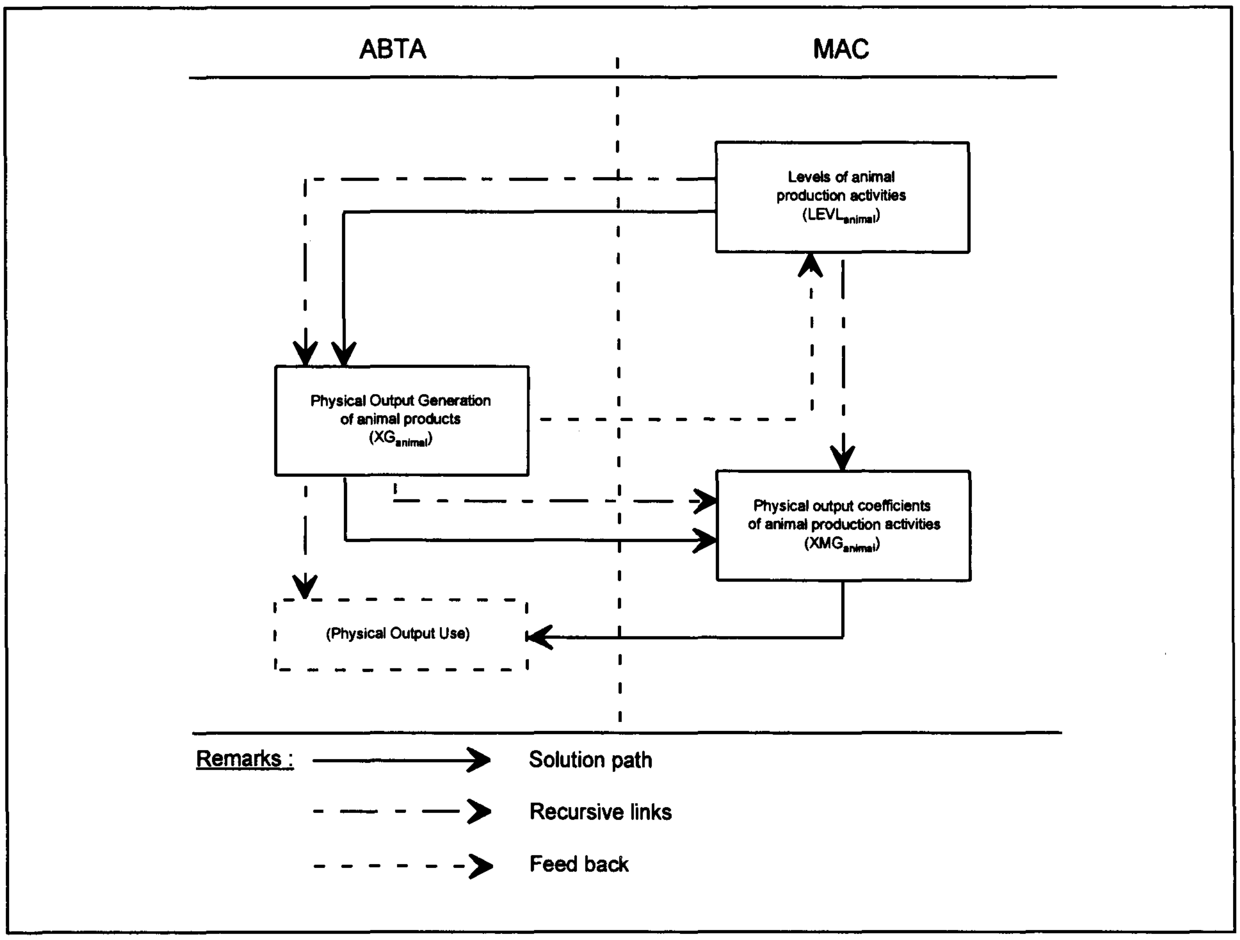
where : XMG : Output Generation, MAC, physical component,
XG : Output Generation, ABTA, physical component,
$LEVL$: Levels of production activities,
i : Subscript, crop production activity, ABTA, (i = (SWHE, ..., SILA)),
j : Subscript, crop products, ABTA, (j = (SWHE, ..., SILA)).

Depending on the level definition (main area) and the harvested (usable) production definition, yield coefficients reflect the main and interim production of a product group.

3.3.3. Animal production activity levels

Figure 8 shows a scheme of the recursive solution of Output Generation of the physical component of the ABTA and also the MAC. The work step flows, dependencies and feedback are shown.

Figure 8: Scheme of the recursive solution of animal Output Generation of ABTA and MAC



Before the calculations are made for animal Output Generation, the levels of animal production activities have to be numerically specified. The Output Generation of the ABTA is calculated later on. After this, the MAC Output Generation can be determined.

In the animal production area, some of the period-related data (flows) have to be calculated, since they are not available as original statistics in the required definition. In order to calculate plausible animal production flows for specific regions, use is made of animal population statistics. As a rule, the levels of production activities are measured in heads per animal category.

Where available, as for crop production, the data are mostly taken from the CRONOS Data bank (Domain ZPA1). Depending on the category of animal, the livestock data are taken from:

Collections 15, 16, 17, 18, 19 and 20.

The meat production data are taken from :

Collection 14

and the milk production from :

Collection 11.

Animal production flow data are collected for the calendar year period.

3.3.3.1. Cattle production activity levels

Since the production of cattle products in European agriculture is particularly important and certain items are produced over a period of more than one year, the activity level calculation is treated separately from the other production activity groups.

3.3.3.1.1. Production activity interaction

The EU-Model differentiates between the following cattle production activities:

- cattle younger than 12 months for fattening (CALF),
- cattle younger than 12 months, rearing (RCAL),
- female cattle, 12 to 24 months, designated heifers (HEIF),
- male cattle, 12 to 24 months, designated bulls (BEEF),
- dairy cows, older than 24 months (MILK) and
- other cows, older than 24 months (CALV).

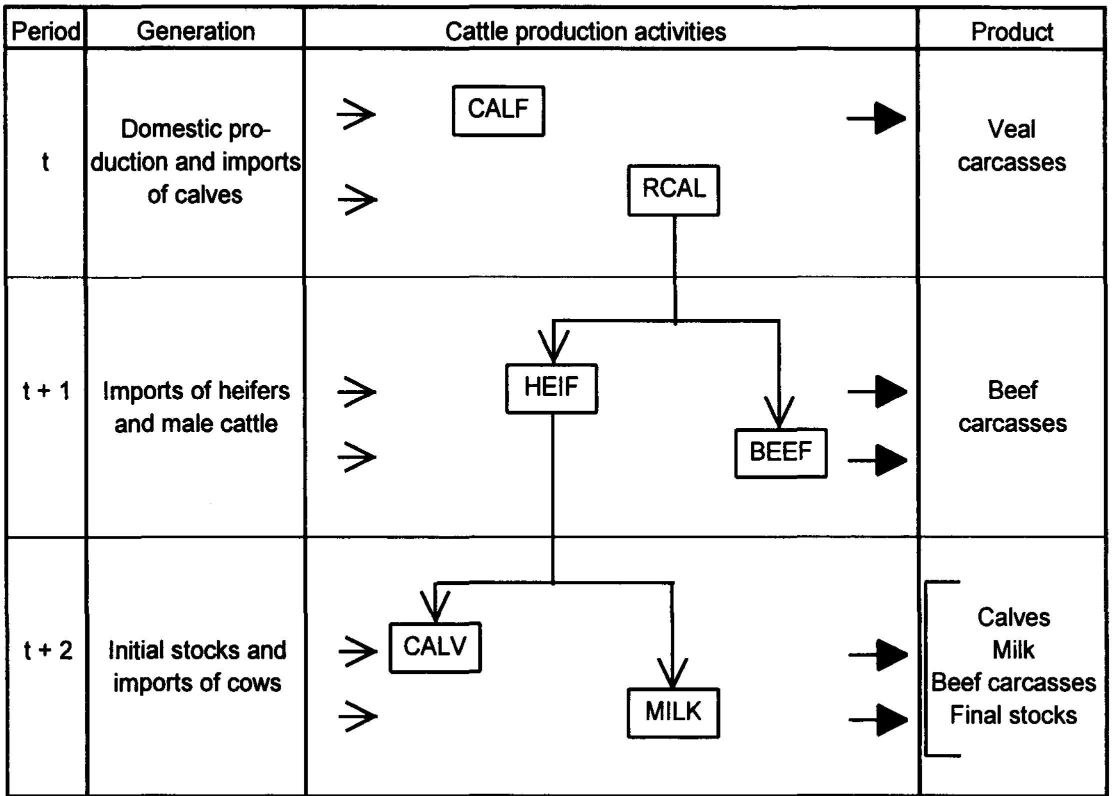
These production activities are adapted to the EU-Model's annual representation period.

Figure 9 provides an indication of the annual interaction between these production activities. By way of example, it takes a calf 24 months to replace a cow in the herd.

The final and intermediate products generated by the cattle production activities (figure 9) in the course of an annual production period are listed in the following chapter 3.4., under the heading "Animal Output Generation".

Figure 9 shows the recruiting of the production activity levels by the preceding activity and the time sequence of these activities. This schematic description of cattle production is, in practice, undeniably a vast simplification of the much more complex interaction within production.

Figure 9: Cattle production activities interaction



Remark:

The meat products include live animal exports for slaughter.

The calves produced at the end of period t + 2 are inputs into the cattle younger than 12 months production activities at the beginning of the period t + 3.

The annual unit time period selected for the EU-Model calls for highly simplified assumptions for both the cattle and the animal branches of agriculture. Much more differentiated and realistic production links could be depicted by six-monthly or quarterly studies. The data available with the periodicity, however, are not sufficient for the moment to meet the EU-Model targets with regard to original statistical data.

At the start of period (t), the calves are available for the production of production activities (CALF and RCAL) which were born at the end of period (t-1) from cows (MILK and CALV). It is assumed that imports are always carried out at the start of the production period and therefore imported calves are also considered in the computation of the production result.

In the course of period (t) the meat product veal (including exports) is produced with the activity CALF. At the end of period (t) the production of products "heifers" and "bulls" are produced by activity RCAL.

These animals (heifers and bulls) are available to production activities HEIF and BEEF for production at the beginning of period (t + 1). As in the case of CALF, imports and meat production (including exports) are taken into account in these production activities as well.

In the production activity, before the end of the annual production period (t+1), all adult male cattle (bulls) in stalls are slaughtered, therefore no bulls are carried over into the following production period.

The activity HEIF produces for the product "beef" and also "cows" which are available at the end of the production period. These cows are taken over into the activities MILK and CALV in the following period, together with cow imports.

Initial and final stocks of cows are explicitly taken into account only in those activities based on the production factor "cows", since these animals are generally used in production for several years. In other cattle production activities, it is thus assumed that no animal remains in the same production activity for longer than one period (year).

Exports of live cattle are taken into account in meat production. It is thus assumed that in most cases animals are exported for meat production. For the agricultural export sector, the slaughter of animals is a realistic alternative.

By the inclusion of foreign trade in live cattle in the agricultural production process, it is assumed that imported animals influence the agricultural production of period (t). This assumption was introduced because available data do not provide any indication, for example, of the period between the importing and slaughtering of animals.

In Eurostat's slaughter statistics, the number of animals slaughtered is published together with the quantity of meat. Domestic production is given in the following equation:

(23a) $$GIP = NIP + EXP - IMP$$

In order to depict agricultural production of beef and veal, apart from indigenous production, foreign trade is taken into account so that for production we have the following equation:

(23b) $$GIP_t + IMP_t = NIP_t + EXP_t$$

where:
GIP : Gross indigenous production,
NIP : Net indigenous production,
IMP : Imports,
EXP : Exports,
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

which is also included in the calculation of production activity levels. The production activity levels, measured in head numbers, are characterised by the equations given in the following chapter.

3.3.3.1.2. Production activity level definitions

In this chapter, the definitions of cattle production activity levels are given.

- **Cattle, younger than 12 months, for fattening designated "Calves for Fattening" (CALF),**

(24) $$LEVL_{CALF,t} = CALV_{fattening,t-1} + IMP_{CALF,t}$$

where :
$LEVL$: Level of production activity,
$CALV$: Calves born for fattening,
IMP : Imports,
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

- **Cattle, younger than 12 months, rearing designated "Calves, rearing" (RCAL),**

(25) $$LEVL_{RCAL,t} = CALV_{rearing,t-1}$$

where : $LEVL$: Level of production activity,
$CALV$: Calves born for rearing,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

- **Female cattle, 12 to 24 months, designated "Heifers" (HEIF),**

(26) $$LEVL_{HEIF,t} = HEIF_{t-1} + IMP_{HEIF,t}$$

where : $LEVL$: Level of production activity,
$HEIF$: Heifers produced,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

- **Male cattle, 12 to 24 months, designated "Male Adult Cattle for Fattening" (BEEF),**

(27) $$LEVL_{BEEF,t} = BULL_{t-1} + IMP_{BEEF,t}$$

where : $LEVL$: Level of production activity,
$BULL$: Adult male cattle produced,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

- **Other cows, older than 24 months, (CALV),**

(28) $$LEVL_{CALV,t} = SCOW_{t-1} + FS_{CALV,t-1} + IMP_{CALV,t}$$

where : $LEVL$: Level of production activity,
$SCOW$: Other cows produced,
FS : Final livestocks,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

- **Dairy cows, older than 24 months, (MILK),**

(29) $$LEVL_{MILK,t} = DCOW_{t-1} + FS_{MILK,t-1}$$

where : $LEVL$: Level of production activity,
$DCOW$: Dairy cows produced,
FS : Final stocks,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

These definition equations for cattle activity levels are numerically specified with original statistical data in the next chapter.

3.3.3.1.3. *Numerical specification of production activity levels*

The definitions given in the preceding chapter cannot be immediately numerically specified with original statistical data. Therefore, a well-defined combination of available data has to be made. The following headings contain in brackets the corresponding definition equation of the previous chapter.

- **Production activity level CALF (equation 24),**

(24a) $CALV_{fattening,t-1} = GIP_{calves,t}$

and equation 24a combined with 24,

(24b) $LEVL_{CALF,t} = GIP_{calves,t} + IMP_{CALF,t}$

where : $LEVL$: Level of production activity,
$CALV$: Calves born for fattening,
GIP : Gross indigenous production of slaughtered animals,
IMP : Imports.
t : Subscript, year (t = (73, ..., T)),
T : Subscript, last available year of reference period.

which specifies the level of CALF.

- **Production activity level RCAL (equation 25),**

(25a) $CALV_{rearing,t-1} = \Delta FS_{cows,t+2} + GIP_{cows,t+2} + GIP_{heifers,t+1} GIP_{bulls,t+1}$

and equation 25a combined with 25,

(25b) $LEVL_{RCAL,t} = \Delta FS_{cows,t+2} + GIP_{cows,t+2} + GIP_{heifers,t+1} + GIP_{bulls,t+1}$

where : $LEVL$: Level of production activity,
$CALV$: Calves born for rearing,
GIP : Gross indigenous production of slaughtered animals,
ΔFS : Final stock changes (equation 26b),
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

which specifies the level of RCAL.

- **Production activity level HEIF (equation 26),**

(26a) $HEIF_{t-1} = GIP_{heifers,t} + \Delta FS_{cows,t+1} + GIP_{cows,t+1}$

and

(26b) $\Delta FS_{cows,t+1} = \Delta FS_{SCOW,t+1} + \Delta FS_{DCOW,t+1}$

and

(26c) $\Delta FS_{SCOW,t+1} = FS_{SCOW,t+1} - FS_{SCOW,t}$

and

(26d) $$\Delta FS_{DCOW,t+1} = FS_{DCOW,t+1} - FS_{DCOW,t}$$

and equations 26a, 26b combined with 26 :

(26e) $$LEVL_{HEIF,t} = \Delta FS_{cows,t+1} + GIP_{heifers,t} + GIP_{cows,t+1} + IMP_{HEIF,t}$$

where : $LEVL$: Level of production activity,
$HEIF$: Subscript, product, female cattle, 12 to 24 months, or female cattle produced,
GIP : Gross indigenous production of slaughtered animals,
ΔFS : Final stock changes, cows older than 24 months,
$SCOW$: Subscript, product, other cows,
$DCOW$: Subscript, product, dairy cows,
FS : Final stock,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

by which the level of HEIF is specified.

- **Production activity BEEF (equation 27),**

(27a) $$BULL_{t-1} = GIP_{bulls,t}$$

and equation 27a combined with 27 :

(27b) $$LEVL_{BEEF,t} = GIP_{bulls,t} + IMP_{BEEF,t}$$

where : $LEVL$: Level of production activity,
$BEEF$: Subscript, product, male cattle, 12 to 24 months,
$BULL$: Adult male cattle produced,
GIP : Gross indigenous production of slaughtered animals,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

which specifies the level of BEEF.

- **Production activity level CALV (equation 28)**

For other cows produced by the heifers activity (equations 26a, 26c), the level is specified as follows:

(28a) $$SCOW_{t-1} = \Delta FS_{SCOW,t} + R_{SCOW,t} GIP_{cows,t}$$

and

(28b) $$R_{SCOW,t=} \frac{FS_{SCOW,t-1}}{FS_{SCOW,t-1} FS_{DCOW,t-1}}$$

and

(28c) $$LEVL_{CALV,t} = FS_{SCOW,t-1} + \Delta FS_{SCOW,t} + R_{SCOW,t}GIP_{cows,t} + IMP_{SCOW,t}$$

where : $LEVL$: Level of production activity,
FS : Final stock, cows older than 24 months,
ΔFS : Final stock changes (equation 26c), cows older than 24 months,
R : Distribution factor,
GIP : Gross indigenous production of slaughtered animals,
$SCOW$: Subscript, product, other cows or produced other cows,
$DCOW$: Subscript, product, dairy cows,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The published figures for imported cows for slaughtering are not broken down into other cows and dairy cows. It is therefore assumed that imported cows are other cows, so that

(28d) $$IMP_{SCOW,t} = IMP_{cows,t}$$

- **Production activity level MILK (equation 29)**

For dairy cows produced by the heifers activity (equations 26a, 26d), the level is specified as follows:

(29a) $$DCOW_{t-1} = \Delta FS_{DCOW,t} + R_{DCOW,t}GIP_{cows,t}$$

and

(29b) $$R_{DCOW,t} = \frac{FS_{DCOW,t}}{FS_{SCOW,t-1} + FS_{DCOW,t-1}}$$

and

(29c) $$LEVL_{MILK,t} = FS_{DCOW,t-1} + \Delta FS_{DCOW,t} + R_{DCOW,t}GIP_{cows,t}$$

where : $LEVL$: Level of production activity,
FS : Final stock, cows older than 24 months,
ΔFS : Final stock changes (equation 26d), cows older than 24 months,
R : Distribution factor,
GIP : Gross indigenous production of slaughtered animals,
$DCOW$: Subscript, product, dairy cows or produced dairy cows,
$SCOW$: Subscript, product, suckler cows,
IMP : Imports,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

Because it is assumed that the imported cows are other cows only (equation 28d), it follows that

(29d) $$IMP_{DCOW,t} = 0$$

By applying this method of numerical specification of the cattle production activity levels, the production of the individual cattle categories in their production cycles is depicted consistently. The natural losses of the individual cattle categories are not taken into account because only incomplete figures are available for the EU on this subject[66].

3.3.3.2. Production activity levels for livestock other than cattle

The production period for the production activities of pigs, poultry and sheep/goats is less than one year. As in the case of cattle production activity levels (chapter 3.3.3.1.), the use of a unit time period for these activities of less than one year would allow a more realistic presentation.

These three production activity groups are divided into a breeding activity and a fattening activity, resulting in the following breakdown :

- pig production activities:
  - Pigs for fattening
  - Pig breeding
- poultry production activities:
  - Poultry for fattening
  - Laying hens (also breeding)
- sheep/goat production activities:
  - Sheep and Goats for fattening
  - Ewes and Goats (for breeding)

Unlike the cattle production activities, the normal fattening period for these other livestock production activities is shorter than the annual time period used in the EU-Model. Therefore, these activities require no annual link-up of production processes. Only in the case of breeding activities is there provision for carry-over stocks of animals.

Any residual animal production activity not covered by the above activities comes under "Other animal" production activity, so that the entire animal production of agriculture is covered.

In general, fattening production activities produce only meat; breeding activities produce young animals for fattening, replacement, meat from killed breeding animals and other related products. Imports and exports of live animals for slaughter are taken into account in fattening activity figures, as in the case of the cattle level calculations mentioned previously.

3.3.3.2.1. Pig production activity levels

The "Pig Breeding" production activity level (PIGL) covers sows over an annual production period. It is calculated as follows:

(30a) $$LEVL_{PIGL,t} = FS_{sows,t-1} + YSO_t$$

and

66 Physical losses can be taken into account by extending the equations (24-29) to include a loss element.

(30b) $$YSO_t = YSO_{a,t} + YSO_{b,t} + YSO_{c,t}$$

where : $LEVL$: Level of production activity,
FS : Final stock,
YSO : Maiden gilts,
a,b,c : Subscript, observation month April, August, December,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The "Pigs for Fattening" production activity level (PORK) covers the number of pigs slaughtered (excluding slaughtered sows) during the year. It is calculated as follows:

(31a) $$LEVL_{PORK,t} = GIP_{pigs,t} + IMP_{pigs,t} - SSO_t$$

and

(31b) $$SSO_t = YSO_t - FS_{sows,t} + FS_{sows,t-1}$$

where : $LEVL$: Level of production activity,
SSO : Sows slaughtered,
FS : Final stock,
YSO : Maiden gilts (equation 30b),
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

3.3.3.2.2. Poultry production activity levels

The "Laying hens" production activity level (EGGS) covers only the laying hens used in a yearly production process. It is calculated as follows :

(32a) $$LEVL_{EGGS,t} = FS_{hens,t-1}$$

If the chicks for replacement of laying hens are not available in some regions, these data are calculated as follows:

(32b) $$CHI = c\ FS_{hens,t-1}$$

where : $LEVL$: Level of production activity,
CHI : Chicks for laying,
FS : Final stock,
c : Constant (assumption 0.8),
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The "Poultry for Fattening" production activity level (POUL) covers the number of poultry slaughtered per year (excluding slaughtered laying hens). It is calculated as follows :

(33a) $$LEVL_{POUL,t} = GIP_{poultry,t} + IMP_{poultry,t} - SLH_t$$

and

(33b) $SLH_t = CHI_t - FS_{hens,t} + FS_{hens,t-1}$

where : *LEVL* : Level of production activity,
GIP : Gross indigenous production of slaughtered animals,
IMP : Imports,
SLH : Hens slaughtered,
FS : Final stock,
CHI : Chicks for laying,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The data for imported animals for slaughter are not available. It is assumed that these data are zero, so that:

(33c) $IMP_{poultry,t} = 0$

If data on the gross indigenous production of slaughtered poultry used in equation 33a are not available, the following calculation is used instead:

(33d) $GIP_{poulty,t} = (TU_t + GO_t + DS_t + BR_t)(1-c)$

where : *GIP* : Gross indigenous production of slaughtered animals,
TU : Use of chicks, turkey,
GO : Use of eggs, geese,
DS : Use of eggs, ducks,
BR : Use of eggs, broilers,
c : Constant (loss rate assumption 0.06),
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

3.3.3.2.3. Sheep and goat production activity levels

The "Ewes and Goats" production activity level (MUTM) covers ewes and she-goats final stocks of the previous year. It is calculated as follows:

(34a) $LEVL_{MUTM,t} = FS_{ewes,t-1} + FS_{she-goats,t-1}$

The slaughterd ewes and she-goats in the yearly production process are calculated as follows:

(34b) $SLEG_t = (GIP_{sheep,t} - GIP_{lambs,t}) + GIP_{goats,t}\dfrac{1-GIP_{lambs,t}}{GIP_{sheep,t}}$

where : *LEVL* : Level of production activity,
FS : Final stock,
SLEG : Slaughtered ewes and she-goats,
IMP : Imports,
GIP : Gross indigenous production of slaughtered animals,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The imports of ewes and she-goats for slaughter are missing for most regions.It is therefore assumed that these import data are zero.

The "Sheep and Goats for Fattening" production activity level (MUTT) covers the number of lambs and kids slaughtered during the year. It is calculated in terms of the series equation 34 as follows :

$$LEVL_{MUTT,t} = GIP_{total,t} + IMP_{total,t} - SLEG_t \tag{35}$$

where : $LEVL$: Level of production activity,
$SLEG$: Slaughtered ewes and she-goats,
IMP : Imports,
GIP : Gross indigenous production of slaughtered animals,
$total$: Total sheep and goats for slaughter
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

3.3.3.2.4. Other animal production activity levels

The "Other Animals" production activity level (OANI) covers horse and donkey numbers. It is calculated as follows:

$$LEVL_{OANI,t} = FS_{horse,t-1} + FS_{donkey,t-1} \tag{36}$$

where : $LEVL$: Level of production activity,
FS : Final stock,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

3.3.4. Animal Output Generation of the ABTA

As already mentioned (chapter 3.3.3.), the animal products are grouped into final and intermediate products and also into main and joint products.

The data for numerical specification of animal production are mainly taken from the CRONOS databank (domain ZPA1).

3.3.4.1. Final products

3.3.4.1.1. Meat products

The production of beef, veal, pigmeat, poultry, sheepmeat and goatmeat of the agricultural sector is taken from the CRONOS databank, expressed in carcass weight (not including offal). As a rule, agriculture produces and sells animals for slaughter. Slaughterings are carried out outside the sector.

By including in the model figures for the number of head and quantity of meat produced, additional information is gained about production processes which can be used to make a better calculation of income generation and producer prices. The average carcass weight, for example, sheds light on the length of the fattening process which is taken into account for the allocation of feedingstuffs.

Based on the production activity level definition for cattle calculations (chapter 3.3.3.1.), the meat production for each calendar year is defined for all meat Output Generation elements as follows:

$$XG_{i,j} = NIP_{i,j} + EXP_{i,j} \tag{37}$$

where : XG : Output Generation, ABTA, physical component,
NIP : Net indigenous production of meat,

EXP : Exports,
i : Subscript, production activity, ABTA, (i = (MILK,...,PIGL)),
j : Subscript, final products, ABTA, (j = (BEEF, VEAL, PORK, MUTT, POUL)).

Some of the available data for net indigenous production and exports of meat have to be distributed over the related production activities (fattening and breeding activities). For this distribution the calculated head numbers of the production activities levels are used.

The Output Generation of **cattle meat** is allocated to the cattle production activities as follows:

- **Cattle, younger than 12 months, for fattening (CALF):**

(38a) $$XG_{CALF,VEAL} = NIP_{veal} + EXP_{veal}$$

- **Female cattle, 12 to 24 months, (HEIF):**

(38b) $$XG_{HEIF,BEEF} = NIP_{heifers} + EXP_{heifers}$$

- **Other cows, older than 24 months, (CALV):**

(38c) $$XG_{CALV,BEEF} = NIP_{cows}R_{SCOW} + EXP_{cows}$$

- **Dairy cows, older than 24 months, (MILK):**

(38d) $$XG_{Milk,BEEF} = NIP_{cows}R_{DCOW}$$

- **Male cattle, older than 12 months, (BEEF):**

(38e) $$XG_{BEEF,BEEF} = NIP_{cattle} + EXP_{cattle} - \sum_i XG_{i,BEEF}$$

where : XG : Output Generation, ABTA, physical component,
NIP : Net indigenous production of meat,
EXP : Exports,
R : Distribution factor (equations 28b and 29b),
$SCOW$: Subscript, product, suckler cows,
$DCOW$: Subscript, product, dairy cows,
$cattle$: Total adult cattle meat,
i : Subscript, production activities (i = (HEIF, CALV, MILK)).

It is assumed that the production activity "Cattle, rearing" (RCAL) does not produce a meat product.

On the basis of production activity level calculations other than cattle activities (chapter 3.3.3.2.), the meat production for each calendar year is calculated as follows :

- **Pigmeat production of activities (PORK, PIGL):**

The "Pig Breeding" production activity (PIGL) covers the meat of the sows slaughtered in one year (see equation 31a) in Output Generation. It is calculated as follows :

(39a) $$XG_{PIGL,PORK} = c\ SSO$$

The "Pigs for Fattening" production activity (PORK) produces the pigmeat in production generation (XG) as follows:

(39b) $$XG_{PORK,PORK} = NIP_{pork} + EXP_{pork} - XG_{PIGL,PORK}$$

where : XG : Output Generation, ABTA, physical component,
NIP : Net indigenous production of meat,
EXP : Exports,
SSO : Sows slaughtered (equation 31b),
c : Constant (average carcass weight, assumed 150 kg).

- **poultry meat production of activities (POUL, EGGS):**

The "Laying hens" production activity (EGGS) covers the meat of slaughtered hens (equation 33a) in the Output Generation of a year and is calculated as follows:

(40a) $$XG_{EGGS,POUL} = c\ SLH$$

The "Poultry for Fattening" production activity (POUL) produces the poultry meat in the Output Generation of a year as follows :

(40b) $$XG_{POUL,POUL} = NIP_{poultry} + EXP_{poultry} - XG_{EGGS,POUL}$$

where : XG : Output Generation, ABTA, physical component,
NIP : Net indigenous production of meat,
EXP : Exports,
SLH : Slaughtered hens (equation 33b),
c : Constant (average carcass weight, assumed 0,9 kg).

If data on the exports and net indigenous production of poultry meat used in equation 40b are not available, the "usable production" data of the supply balance sheet are used instead.

- **sheep/goat meat production of activities (MUTM, MUTT):**

The "Ewes and Goats" production activity (MUTM) covers the ewe and she-goat meat of a year in Output Generation and is calculated on the basis of equation 35a as follows :

(41a) $$XG_{MUTM,MUTM} = c\ SLEG$$

where: XG : Output Generation, ABTA, physical component,
$SLEG$: Slaughtered ewes and she-goats,
c : Constant (average carcass weight, assumed 40 kg).

The "Sheep and Goats for Fattening" production activity (MUTT) covers the lamb and kid meat of a year's Output Generation. It is calculated as follows :

(41b) $$XG_{MUTM,MUTM} = NIP_{total} + EXP_{total} - XG_{MUTM,MUTM}$$

where: XG : Output Generation, ABTA, physical component,
NIP : Net indigenous production of meat,
EXP : Exports,
$total$: Total sheep and goats.

The gross production of the specified meat products covered by the Output Generation of ABTA is calculatable as follows :

(42) $$\sum_i XG_{i,j} = NIP_j + EXP_j$$

where : XG : Output Generation, ABTA, physical component,
NIP : Net indigenous production of meat,
EXP : Exports,
i : Subscript, animal production activities, ABTA,
j : Subscript, meat products, ABTA.

3.3.4.1.2. Milk products

Milk production in agriculture is subdivided into:

- Milk produced by cattle production activities,
- Milk produced by ewe and she-goat production activities.

The statistics are retrieved from CRONOS (ZPA1) collection 11, whose periodicity is the calendar year.

Apart from the production of milk for sale to other sectors, account is also taken of milk for rearing young animals in order to be able to allocate the appropriate feedingstuffs to young animals as soon as they are born.

In cattle production activities, the product milk is produced by the production activity dairy cows and by the production activity other cows (suckler cows).

It is assumed that the milk produced by other cows is only used for feeding calves. The milk of dairy cows, on the other hand, is used for sale to other sectors.

To ensure complete coverage of sectoral milk production, buffalo milk is counted as dairy cow milk. The production volume is so low that there is no point in separating the two products. The Output Generation of cow milk is calculated in both cow production activities as follows :

- **Dairy cows, older than 24 months, (MILK):**

(43) $$XG_{MILK,MILK} = MI_{DCOW} + MI_{buffalo}$$

where : XG : Output Generation, ABTA, physical component,
MI : Milk, availability on farm,
$DCOW$: Subscript, product, dairy cows.

- **Other cows, older than 24 months, (CALV):**

(44a) $$XG_{CALV,MILK} = MF_{SCOW}$$

Figures for other cow milk for feeding are not available, therefore

(44b) $MF_{SCOW} = c\ LEVL_{CALV}$

where : XG : Output Generation, ABTA, physical component,
$LEVL$: Level of production activity,
MF : Milk for feeding,
c : Constant (milk for feeding, assumed 1500 kg),
$SCOW$: Subscript, product, other cows.

It is assumed that the milk produced by the **ewes and she-goat production activity** (MUTM) is used for both feeding lambs and kids and sale to other sectors. The Output Generation of milk in the sheep and goats breeding activity is calculated as follows:

(45a) $XG_{MUTM,MUTM} = MI_{ewes} + MI_{she-goats} + MF_{MUTM}$

Figures for ewes and she-goat milk for feeding are not available, therefore

(45b) $MF_{MUTM} = c\ LEVL_{MUTM}$

where: XG : Output Generation, ABTA, physical component,
$LEVL$: Level of production activity,
MI : Milk, availability on farm,
MF : Milk for feeding,
c : Constant (milk for feeding, assumed 50 kg).

Like the situation for cows' milk production as described above, the milk production figures given in the statistics exclude milk for feeding. Therefore the milk for feeding is estimated.

3.3.4.1.3. Other products

The Output Generation of the products eggs, raw wool and the residual product "Other" are calculated in this chapter:

- **Output Generation: EGGS**

Egg production arises from the production activity of laying hens (EGGS) and is specified by the usable production of eggs, as follows:

(46) $XG_{EGGS,EGGS}$ = *usable production of eggs (product weight)*

If the usable production in product weight (kg) is not available, the product weight data are calculated by using the numbers of produced eggs and an assumed egg weight of 0.06 kg.

- **Output Generation: WOOL**

Raw wool is a joint product of the production activity ewes and she-goats (MUTM) and is sold for final use outside the agricultural sector.

At Union level, there are no physical wool production data available. Therefore, the constant-price volume series from the EAA is used to measure wool production:

(47) $XG_{MUTM,WOOL}$ = *wool production value at constant prices*

- **Output Generation: other animal products**

The production activity Other animal products (OANI) covers in its Output Generation the residual final animal production which has not been mentioned already. The physical production of these products is measured in national currency at constant prices of a base year. It is calculated as follows:

(48) $$XG_{OANI,OANI} = Total - \sum_{j} \textit{animal production value at constant prices of product}_j$$

where: XG : Output Generation, ABTA, physical component,
$Total$: Total animal production value (EAA) at constant prices,
j : Subscript, final products (MILK, ..., POUL, WOOL).

3.3.4.2. Intermediate animal products

3.3.4.2.1. Cattle production activities

In cattle production activities, a year's production of the cattle groups or products

- calves (CALV), produced by activity (MILK and CALV),
- heifers (HEIF), produced by activity (RCAL),
- adult male cattle (BULL), produced by activity (RCAL),
- dairy cows (DCOW), produced by activity (MILK and HEIF),
- other cows (SCOW), produced by activity (CALV and HEIF),

is allocated to intermediate production. The results of the numerical specification of cattle production activity levels (chapter 3.3.3.1.) are used for the numerical specification of the Output Generation.

The calves production (CALV) of the activity MILK is calculated on the basis of equations (24a), (25a) and (29b):

(49a) $$XG_{MILK,CALV,t} = R_{DCOW,t}\left(CALV_{fattening,t-1} + CALV_{rearing,t-1}\right)$$

and the production of product CALV of activity CALV (equations 24a, 25a, 28b)

(49b) $$XG_{CALV,CALV,t} = R_{SCOW,t}\left(CALV_{fattening,t-1} + CALV_{rearing,t-1}\right)$$

where: XG : Output Generation, ABTA, physical component,
$CALV$: Calves born for fattening and rearing,
R : Distribution factor (equation 29b),
$DCOW$: Subscript, product, dairy cows,
$SCOW$: Subscript, product, suckler cows,
t : Subscript, year (t $\in$(73, ..., T)),
T : Subscript, last available year of reference period.

The heifer production (HEIF) of activity RCAL is calculated on the basis of equation (26a):

(50) $$XG_{RCAL,HEIF,t} = HEIF_t$$

where: XG : Output Generation, ABTA, physical component,
$HEIF$: Heifers, produced,
t : Subscript, year (t $\in$(73, ..., T)),
T : Subscript, last available year of reference period.

The adu*lt male* cattle production (BULL) of activity RCAL is calculated on the basis of equation (27a):

(51) $XG_{RCAL,BULL,t} = BULL_t$

where: XG : Output Generation, ABTA, physical component,
$BULL$: Adult male cattle produced,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The dairy cow production (DCOW) of activity HEIF is calculated on the basis of equation (29a):

(52a) $XG_{HEIF,DCOW,t} = DCOW_t$

where: XG : Output Generation, ABTA, physical component,
$DCOW$: Dairy cows produced,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

and the dairy cows of the activity MILK (equation 29a) :

(52b) $XG_{DCOW,MILK,t} = FS_{DCOW,t} - DCOW_t$

where: XG : Output Generation, ABTA, physical component,
FS : Final stock,
$DCOW$: Dairy cows produced,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

The other cow production (SCOW) of activity HEIF is calculated on the basis of the equation (28a):

(53a) $XG_{HEIF,SCOW,t} = SCOW_t$

where: XG : Output Generation, ABTA, physical component,
$SCOW$: Suckler cows produced,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

and the other cows of activity CALV (equation 28a):

(53b) $XG_{CALV,SCOW} = FS_{SCOW,t} - SCOW_t$

where: XG : Output Generation, ABTA, physical component,
FS : Final stock,
$SCOW$: Suckler cows produced,
t : Subscript, year (t ∈(73, ..., T)),
T : Subscript, last available year of reference period.

3.3.4.2.2. Other production activities

The intermediate products of production activities other than cattle are the young animals for replacement and fattening.

- **Piglet production (PIGL):**

Piglets are produced by the sows production activity (PIGL). No data are available on piglet production. Piglet production covers piglets for sow replacement and piglets for fattening. It is calculated on the basis of equations 30b and 31a as follows:

(54) $$XG_{PIGL,PIGL,t} = LEVL_{PORK,t} - IMP_{pigs,t} + YSO_t$$

where: XG : Output Generation, ABTA, physical component,
IMP : Imports,
YSO : Maiden gilts (equation 30b),
$LEVL$: Level of production activity,
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

Piglet losses are not covered by equation 54.

- **Lamb and kid production (LAMB):**

Lambs and kids are produced by the ewes and she-goats production activity (MUTM). No data are available for lamb and kid production, which covers lambs and kids for ewe and she-goat replacement as well as for fattening. It is calculated on the basis of equations 34a to 35 as follows:

(55) $$XG_{MUTM,LAMB,t} = LEVL_{MUTM,t} - IMP_{total,t} + SLEG_t + \Delta FS_{ewes,t} + \Delta FS_{she-goats,t}$$

where: XG : Output Generation, ABTA, physical component,
$LEVL$: Level of production activity,
IMP : Imports of sheep and goats for slaughter,
$SLEG$: Slaughtered ewes and she-goats(equation 34b),
ΔFS : Final stock changes (FS_t - FS_{t-1}),
$total$: Subscript, total slaughtered sheeps and goats,
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

Lamb and kid losses are not covered by equation 55.

- **Chick production (CHIC):**

Chicks are produced by the laying hens production activity (EGGS). Chick Output Generation is measured in eggs. Eggs for hatching are taken for numerical specification. Data also include hatching losses. The production of eggs for hatching covers use for replacement of laying hens and for fattening (see equations 32a to 33b):

(56a) $$XG_{EGGS,CHIC,t} = eggs\ for\ hatching_t$$

If data on the production of hatching eggs used in equation (56a) are not available, the production of chicks is calculated as follows (equations 32a to 33c):

(56b) $$XG_{EGGS,CHIC,t} = LEVL_{POUL,t} + CHI_t + \Delta FS_{hens,t} - IMP_{poultry,t}$$

where: XG : Output Generation, ABTA, physical component,
$LEVL$: Level of production activity,
CHI : Chicks for laying (equation 32b),
ΔFS : Final stock changes,
IMP : Imports (equation 33c),
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

3.3.4.2.3. Manure production

The intermediate and joint product manure is produced by all animal activities. Organic fertilizer (manure) production is important for specifying the interdependencies of animal and crop production activities.

There are several forms of organic fertilizers produced by animals:

- liquid manure, differentiated by the percentage of dry matter and content of the main nutrients N, P_2O_5 and K_2O;
- dry manure, widely varying in content and availability of nutrients N, P_2O_5, K_2O and humus.

Because of the lack of information in official statistics, technical information (CD-category) from several sources is used. It is difficult to verify the reported assumptions and estimates that have been established and simple formal procedures have therefore been established for calculating manure production.

Calculations are based on the idea that animals provide pure nutrients, in dry and liquid manure, as a function of the total energy and nutrients input. Assumptions are based on "average" sectoral technology and therefore the influence of the technology used to collect these nutrients, such as

- separation of the dry and liquid phases,
- addition of water or straw, etc.

are not taken into account. The intermediate product manure is divided into the three important components measured in pure nutrients:

- nitrogen (N) from manure (MANN),
- phosphate (P_2O_5) from manure (MANP) and
- potassium (K_2O) from manure (MANK).

Liquid manure is defined as having a dry matter content of:

- 10% for cattle, ewes and goats and other animals,
- 7.5% for sows and pigs and
- 14% for poultry and laying hens.

The nutrient content coefficients shown in Table 2, are used to calculate manure production.

Table 2: Nutrient content of liquid manure

Production activities	Yield in pure nutrients of liquid manure (kg/m^3)		
	MANN	MANP	MANK
Cattle[67], OANI MUTT, MUTM	4.6	2.4	5.6
PIGL, PORK	2.9	1.9	1.7
EGGS, POUL	9.8	8.3	4.8

Source: Faustzahlen für Landwirtschaft und Gartenbau, 10. Ausgabe, Frankfurt 1983, p. 209.

Production of liquid manure per livestock unit (LU) is estimated at 20 m^3 per year[68]. By combining these assumptions, production of pure nutrients is estimated as shown in Table 3.

[67] Cattle includes the production activities MILK, BEEF, CALV, HEIF, CALF, RCAL.

Table 3: Production of manure from animal production activities (pure nutrient content per activity unit in kg).

Production activity	LU [69]	MANN (N) kg/year	MANP (P_2O_5) kg/year	MANK (K_2O) kg/year
MILK	1.0	92.0	48.0	112.0
BEEF	0.7	64.4	33.6	78.4
HEIF	0.7	64.4	33.6	78.4
CALF	0.2	18.4	9.6	22.4
RCAL	0.2	18.4	9.6	22.4
CALV	1.0	92.0	48.0	112.0
OANI	0.7	64.4	33.6	78.4
MUTM	0.1	9.2	4.8	11.2
MUTT	0.05	4.6	2.4	5.6
PIGL	0.33	19.14	12.54	21.78
PORK	0.14	18.12	5.32	9.24
EGGS	0.0183	3.59	3.04	1.76
POUL	0.0017	0.333	0.282	0.163

Using the production coefficients shown in Table 3, the Output Generation of the product manure is numerically specified as follows:

(57) $$XG_{i,j} = LEVL_i \; PCM_{i,j}$$

where: XG : Output Generation, ABTA, physical component,
PCM : Coefficients of manure,
$LEVL$: Level of production activity,
i : Subscript, animal production activities, ABTA, (i = (MILK,..., PIGL)),
j : Subscript manure products (j = (MANN, MANP, MANK)).

The total, sectoral physical production, which can be interpreted as gross production, is available in SPEL/EU-Data for all products (final and intermediate). This gross production is calculated as follows:

(58) $$PROP_j = \sum_i XG_{i,j}$$

where : $PROP$: Gross production,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity, ABTA, (i = (1, ..., n)),
j : Subscript, products, ABTA, (j = (1, ..., m)).

[68] See Faustzahlen für Landwirtschaft und Gartenbau, 10. Ausgabe, Frankfurt 1983, page 211.
[69] Livestock unit, see Faustzahlen für Landwirtschaft und Gartenbau, 10. Ausgabe, Frankfurt 1983, page 3.

3.3.5. Animal Output Generation of MAC

The animal output coefficients (yield coefficients) of the Output Generation of MAC physical component, for a calendar year are calculated using the Output Generation data of ABTA of a product group and the animal production activity levels. These coefficients are calculated as follows:

$$(59) \qquad XMG_{i,j} = \frac{XG_{i,j}}{LEVL_i}$$

where:
- XMG : Output Generation, MAC, physical component,
- XG : Output Generation, ABTA, physical component,
- $LEVL$: Level of production activity,
- i : Subscript animal production activities (i = (MILK, ..., PIGL)),
- j : Subscript animal products (j = (MILK, ..., MANK)).

Depending on the product definitions and the numerical specification, yield coefficients are expressed in the following units:

- kg/head for meat products (BEEF, VEAL, PORK, MUTT),
- kg/1000heads for meat products (POUL),
- kg/head for milk products (MILK),
- kg/1000heads for milk product (MUTM),
- kg/(1000)head(s) for products (MANN, MANP, MANK),
- kg/ 1000 heads for product (EGGS),
- head/head for live animal products (DCOW, SCOW, CALV, HEIF, BULL, LAMB, PIGL)

and

- heads/1000heads for live animal product (CHIC) and
- NC_{BY}/head for products (WOOL, OANI).

where NC_{BY} is volume (constant prices) in national currency.

The flows for the Output Generation of the ABTA and MAC having been established, in the following chapters the Output Use and input parts of the ABTA and Input Use of the MAC can be numerically specified.

3.4. Output Use of agricultural products

Figure 10 illustrates the recursive solution pattern for Output Use of the ABTA, showing the work stage sequences and interrelationships between the various stages.

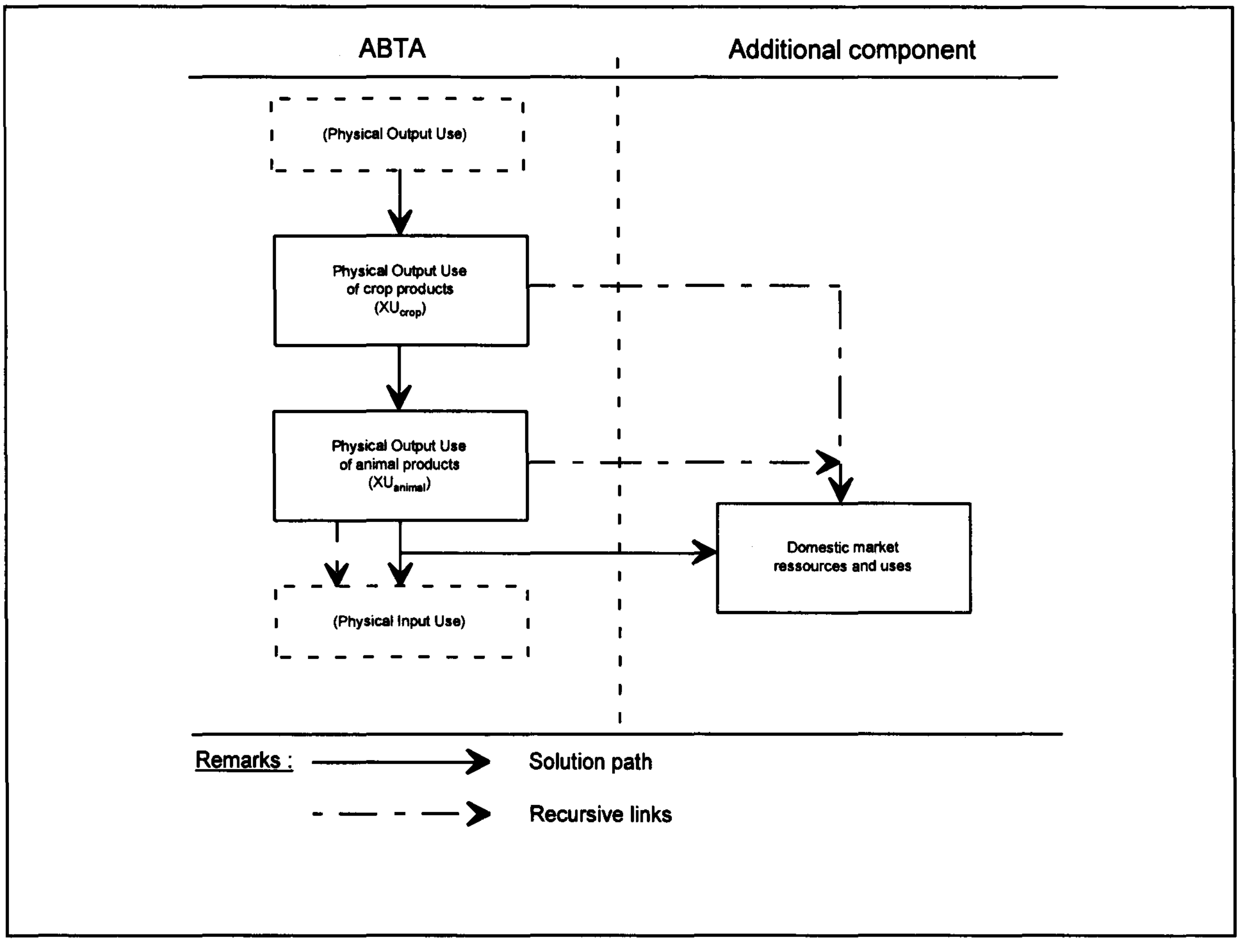
Figure 10 shows that the crop Output Uses are calculated first. The market flows of agricultural products depend on the solution of Output Use. These market flows are numerically specified in a further component: the demand component[70] (see chapter 3.4.4.).

The physical flows of agricultural products are calculated in close conjunction with the numerical specification of the Output Generation elements of the ABTA described in the previous chapters.

[70] see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

The statistical data are mainly based on the data published in the CRONOS databank, domain ZPA1. The supply balance sheet and some of the available product balances (e.g. raw milk, chicks) are also used for numerical specification.

Figure 10: Scheme of the recursive solution of Output Use of the ABTA



The crop products' resource and use headings of the supply balance sheets are published for crop years. In order to depict the crop product flows for a calendar year period, the crop data must be calculated for such periods, whereas the animal product data are already provided for a calendar year period. Therefore crop and animal use activities are calculated separately.

3.4.1. General concept of sectoral interaction

Sectoral interaction is divided into intrasectoral use activities and an intersectoral use activity (agricultural sales) for the agricultural sector. In order to represent all flows of agricultural products, market flows (including exports and imports) are also taken into account.

In this context, the entire supply balance sheet equation, in which the domestic resources are equal to the domestic uses, is satisfied for each agricultural product group[71].

[71] see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

Physical Output Use within the ABTA is depicted for the agricultural sector in the following equation:

$$(60) \qquad \sum_i XG_{i,j} = \sum_{k'} XU_{k',j} + XU_{PLOF,j} + XU_{PCOF,j} + XU_{PCSF,j} + XU_{TRAP,j}$$

where: XG : Output Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
$PLOF$: Subscript, use activity, losses : on farm,
$PCOF$: Subscript, use activity, human consumption : on farm,
$PCSF$: Subscript, use activity, stock changes : on farm,
$TRAP$: Subscript, use activity, sales,
i : Subscript, production activity, (i = (1, ..., n)),
j : Subscript, products, (j = (1, ..., m)),
k' : Subscript, use activity, intermediate product uses (k' = (SEEP, ..., CHIP)).

The intermediate uses of crop products for agricultural production are divided into seed use and animal feed use. The intermediate uses of animal products are subdivided into live animals for input, organic manure fertilizer for input, and use of the product milk as animal feed.

The stock changes for each product group are calculated by the final stocks of the present calendar year and the final stocks of the previous year as follows:

$$(61) \qquad XU_{PCSF,j,t} = FS_{j,t} - FS_{j,t-1}$$

where: XU : Output Use, ABTA, physical component,
FS : Final stock,
$PCSF$: Subscript, use activity, stock changes : on farm,
j : Subscript, products, (j = (1, ..., m)),
t : Subscript, year ($t \in (73, ..., T)$),
T : Subscript, last available year of reference period.

The agricultural use activities (equation 60) are supplemented, for physical flows only, with the market product flows, so that the whole agricultural product flow is depicted as follows:

$$(62) \qquad XU_{TRAP} + DR_{PIMT,j} = \sum_{k'} XU_{k',j} + XU_{PLOF,j} + XU_{PCOF,j} + XU_{PCFS,j} +$$

$$DU_{PEXT,j} + DU_{PCMS,j} + DU_{PCOM,j} + DU_{PFEE,j} +$$

$$DU_{PSEE,j} + DU_{PLOS,j} + DU_{PIND,j} + DU_{PPRO,j}$$

where: XU : Output Use, ABTA, physical component,
DR : Resources, demand, component, physical,
DU : Uses, demand, component, physical,
$PLOF$: Subscript, use activity, losses : on farm,
$PCOF$: Subscript, use activity, human consumption : on farm,
$PCSF$: Subscript, use activity, stock changes : on farm,
$TRAP$: Subscript, use activity, sales,
$PEXT$: Subscript, use activity, demand, exports,
$PIMT$: Subscript, resource activity, demand, imports,
$PCSM$: Subscript, use activity, stock changes : market,
$PCOM$: Subscript, use activity, human consumption : market,
$PFEE$: Subscript, use activity, animal feed : market,
$PSEE$: Subscript, use activity, seed : market,

PLOS : Subscript, use activity, losses : market,
PIND : Subscript, use activity, industrial use,
PPRO : Subscript, use activity, processing,
j : Subscript, products, (j = (1, ..., m)),
k' : Subscript, use activity, (k' = (SEEP, ..., CHIP)), intermediate product uses.

These market flows are calculated for raw agricultural products as well as for the derived processed products. These calculations are carried out in the additional "demand component" as explained in chapter 3.4.4..

3.4.2. Crop products

To represent the physical crop Output Use, the ZPA1 collection 3 (which also serves for the numerical specification of the Output Generation) of the CRONOS databank is used (see chapter 3.3.1.). If the supply balance sheets (collection 3) are not available for the specification of the use activities, the Output Generation data are broken down using other data (CD category) or on the basis of assumptions.

The original statistical data for crop products refer to a crop year period according to the time definition given previously in Table 1. Therefore, the data for use activities are normally recalculated for a calendar year period.

3.4.2.1. Time referencing

The various use activities (Output Use of the ABTA) of equation 60, which reflect the interaction of the agricultural sector, are generally calculated for the calendar year period with the available crop year based supply balance sheet data.

The calendar year data are calculated from chronologically complete crop year data, which fulfil the supply balance sheet equations. To the crop year data of t/(t+1) distribution factors ($r_{k,j,t}$) are applied. These factors represent the proportion of product j of use activity k which is consumed in the second half of the calendar year t. The proportion ($1-r_{k,j,t}$) not used in the calendar year t is assumed to be used in the first half of the calendar year t+1.

Both, ($r_{k,j,t}$) and ($1-r_{k,j,t}$) sum up to unity :

$$(63) \qquad 1 = r_{k,j,t} + (1 - r_{k,j,t})$$

The quantities used in a crop year period remain unchanged by the application of the distribution factors:

$$(64) \qquad SBS_{k,j,t/(t+1)} = r_{k,j,t}\ SBS_{k,j,t/(t+1)} + (1 - r_{k,j,t}) SBS_{k,j,t/(t+1)}$$

and for the calendar year period, the following applies on the basis of equation 64 for two crop years:

(65) $$XU_{k,j,t} = (1 - r_{k,j,t-1})SBS_{k,j,(t-1)/t} + r_{k,j,t}SBS_{k,j,t/(t+1)}$$

where: XU : Output Use, ABTA, physical component,
SBS : Supply balance sheet,
r : Distribution factor, $(0 \leq r \leq 1)$,
k : Subscript, use activity, ABTA, (k = (n+1,...,N)),
j : Subscript, product, ABTA, (j = (1,...,m)),
t : Subscript, calendar year,
$t/(t+1)$: Subscript, crop year.

Equation 65 covers the whole calendar year period and is numerically specified with data from two crop years. The first part of a calendar year is represented by the expression:

$$(1 - r_{k,j,t-1})\, SBS_{k,j,(t-1)/t}$$

and the second by the expression:

$$r_{k,j,t}\, SBS_{k,j,t/(t+1)}$$

By using time indexing, the distribution factor is intended as a means of incorporating information from quarterly or monthly statistics, if available, or from other studies, to allow variation from year to year. At the moment, however, these factors are kept constant over time.

With regard to the chronological allocation of the harvested production quantity (chapter 3.3.1.1., equation 12), the supply balance sheet equation (62) remains satisfied by the fact that the quantity of crop year t/(t+1) consumed in the calendar year t (calculated by applying the distribution factor) is allocated to the final stocks of the calendar year t. Consequently, the final stocks of a product are calculated as follows:

(66) $$FS_{j,t} = \sum_{k}(1 - r_{k,j,t})SBS_{k,j,t/(t+1)}$$

Therefore, by way of the calculation of the stock changes (equation 61) the crop year equations are satisfied, even in terms of chronological sequence, and the calendar year flow data are represented consistently with regard to the Output Generation of the ABTA.

3.4.2.2. Final crop products

For <u>cereals products</u>, the supply balance sheets of Eurostat are subdivided into farm balances and market balance sheets. For the numerical specification of the Output Use activities, the farm balance sheet use activities are adjusted to a calendar year basis by the method described above (chapter 3.4.2.1) without any additional calculations.

The other available supply balance sheets (CRONOS, domain ZPA1) contain only partial information about farm use activities. Further product-based assumptions have to be made to calculate individual farm uses of the outputs of individual production activities.

Where the balance sheets of the <u>other products</u> differentiate between "Total" and "Market" use activities, the difference between the two is interpreted as the quantity used on the farm (e.g. stock changes, feed use) and allocated to a specific period as described above. If the intrasectoral farm use activities cannot be calculated as a residual quantity in this way, they are generally regarded as negligible, except for the assumptions given in Table 4.

Table 4 shows the shares used to distribute the total use data of the supply balance sheets to the corresponding intrasectoral farm use activities.

Table 4: Assumptions for intrasectoral farm use activities of the ABTA

Product		XU_{PCOF}	XU_{FEEP}	XU_{SEEP}	XU_{PCSF}
pulses	(PULS)		10%		
potatoes	(POTA)	10%	100%	100%	50%
sugar beet	(SUGB)		100%		
cauliflowers	(CAUL)	(1)	100%		
tomatoes	(TOMA)	(1)	100%		
other vegetables	(OVEG)	20%	100%		
apples	(APPL)	(1)			
other fruits	(OFRU)	20%			
table grapes	(TAGR)	(1)			

Remarks:

(1) The difference between useable production and 'sales by professional producers' is assumed to be human consumption on the farm.

where: XU : Output Use, ABTA, physical component,
PCOF : Subscript, use activity ABTA, losses : on farm,
FEEP : Subscript, use activity, ABTA, animal feed : on farm,
SEEP : Subscript, use activity, ABTA, seed : on farm,
PCSF : Subscript, use activity, ABTA, stock changes : on farm.

The time reference calculations using the distribution factor (see equation 65) are yet to be taken into account in the assumptions on Table 4 ; they also indicate the quantities for the final stocks calculation.

The intersectoral use activity "sales" is numerically specified on the basis of the market balance sheet data "marketable domestic production" (see chapter 3.4.4). The time reference calculations are also applied to "marketable domestic production" as well as to the stock changes of the supply balance sheets.

The consistency between Output Generation and Output Use of the ABTA is obtained for each product, provided the extracted statistical data for both components of the ABTA are consistent.

For some products of some regions inconsistent data are extracted. Therefore, following up the specification of the use activities, a deviation between Output Generation and Output Use may be obtained. For consistency, this deviation will be taken into account inthe use activity "Losses : on farm".

The residual calculation of the "other" product groups (e.g. OVEG) is performed in the same way as the calculations for specifying the Output Generation of the ABTA (Chapter 3.3.1.2). The totals for individual product groups (e.g. APPL) are also calculated in this fashion.

In the case of those final crop products (e.g. OCRO) whose Output Generation is calculated using the EAA production values, the volume of the Output Generation is considered to be the same as farm sales, since these data, by virtue of the EAA definition, correspond to intersectoral use activity and apply to the calendar year period.

3.4.2.3. Intermediate crop products

For intermediate crop products (e.g. silage, hay), the gross production of Output Generation is generally allocated to the intrasectoral use activity "Animal Feed : on farm".

The time referencing calculations using the distribution factor (r) are also performed, giving us the following equation:

$$(67) \qquad XU_{FEEP,j,t} = FS_{j,t-1} + \sum_i XG_{i,j,t}\, r_{FEEP,j,t}$$

with: $$FS_{j,t-1} = \left(\sum_i XG_{i,j,t-1}\right)(1 - r_{FEEP,j,t})$$

where:
- XG : Output Generation, ABTA, physical component,
- XU : Output Use, ABTA, physical component,
- FS : Final stocks,
- r Distribution factor ($0 \leq r \leq 1$) (see equation 63),
- i : Subscript, production activity,
- j : Subscript, products, (j = (OROO,..., STRA)),
- t : Subscript, calendar year.

Consistency between Output Generation and Output Use is assured by the final stocks, which provide a year-to-year link.

3.4.3. Animal products

As with the numerical specification of the Output Generation part of the ABTA, for the Output Use of the ABTA, data are taken where possible, from the CRONOS databank (domain ZPA1).

For the calculation of the Output Use of intermediate products, the data sources and calculations relating to activity level (chapter 3.3.3) are taken into account.

For final products, the principles sketched out in chapter 3.3.4 are applied and information is added from available CRONOS statistics (e.g. supply balance sheets, mainly the ZPA1 collections 06, 07, 08, 09, 11, 12 and 14, depending on the type of product).

The statistical data for animal products are published with the required calendar year reference.

3.4.3.1. Final animal products

For the final animal products, it is assumed that at the end of the year there are no, or only negligible, final stocks in the agricultural sectors. The products are thus marketed directly without being put into temporary storage on the farms. Most of these products are of the highly perishable type (e.g. milk) which require special treatment or a special type of storage.

As already mentioned, for meat products it is not assumed that slaughterings are carried out on farms. The quantity of meat involved is only recorded as a reference quantity in order to obtain more detailed information on the production activity. Live animals for fattening are regarded as an intermediate product in terms of stock changes and are dealt with in the next chapter but one.

3.4.3.1.1. Meat products

For meat products, intrasectoral consumption is restricted to the use activity "Human Consumption: on farm". In CRONOS, there are no data on this subject and this item therefore has to be calculated using regional information. Where no such information is available, assumptions are based on a figure of 10% of gross production. The human consumption on farm is calculated as follows:

(68a) $$XU_{PCOF,j} = c\sum_{i} XG_{i,j}$$

The intersectoral sales can therefore be calculated as a residual quantity as follows:

(68b) $$XU_{TRAP,j} = \sum_{i} XG_{i,j} - XU_{PCOF,j}$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
c : Constant (0.1),
$TRAP$: Subscript, use activity, agricultural sales,
$PCOF$: Subscript, use activity, human consumption on farm,
i : Subscript, production activity,
j : Subscript, products.

The above two equations present the calculation and show at the same time the consistent link with the Output Generation of the ABTA for the meat products.

3.4.3.1.2. Milk products

Milk products are subdivided into cows' milk products and sheep and goats' milk.

As well as the intrasectoral use activity "Human Consumption : on farm", the activity "Animal Feed : on farm" has to be calculated. In order to make the EU-Model framework consistent with the CRONOS data on milk resources and uses, the use activity "Losses : on farm" is also specified, since the uses statistics (collection 11) specifies an item "differences and losses".

Unlike the resources side, the uses side does not provide the necessary product breakdown. These types of uses are allocated to the different products on the basis of the assumption that the use of the milk production contains the same relationship given in Output Generation for ewes' and goats' milk production and cows milk production:

(69) $$R_j = \frac{\sum_{i} XG_{i,j}}{\sum_{i}\sum_{j} XG_{i,j}}$$

where: R : Distribution factor,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity, (i = (MILK, CALV, MUTM)),
j : Subscript, products, (j = (MILK, MUTM)).

The use activities "Sales", "Losses : on farm" and "Human Consumption : on farm" of Output Use of the ABTA are calculated by using the distribution factor, as follows:

(70) $$XU_{k,j} = R_j \; SBS_{k,milk}$$

where:
- XU : Output Use, ABTA, physical component,
- R : Distribution factor,
- SBS : Supply balance sheet,
- k : Subscript, use activity, (k = (TRAP, PLOF, PCOF)),
- j : Subscript, products, (j = (MILK, MUTM)).

The sum of the statistical uses "milk for consumption", "farm cheese" and "butter" of collection 11 (ZPA1) is allocated to the use activity "Human Consumption : on farm" of the ABTA.

The positive figure calculated as a residual amount is interpreted as "Animal Feed : on farm" of the milk products. If the calculated amount is negative, it is allocated to use activity "Losses : on farm" and the feed use activity is set to zero.

For $\sum_i XG_{i,j} > \sum_k XU_{k,j}$

(71a) $$XU_{FEEP,j} = \sum_i XG_{i,j} - \sum_k XU_{k,j}$$

and for $\sum_i XG_{i,j} < \sum_k XU_{k,j}$ we have, on the basis of equation 70:

(71b) $$XU_{PLOF,j} = SBS_{PLOF,milk} R_j + \sum_i XG_{i,j} - \sum_k XU_{k',j}$$

and

(71c) $$XU_{FEEP,j} = 0$$

where:
- XU : Ouput Use, ABTA, physical component,
- XG : Output Generation, ABTA, physical component,
- SBS : Supply balance sheet,
- $FEEP$: Subscript, use activity, animal feed : on farm,
- R : Distribution factor,
- i : Subscript, production activities, (i = (MILK, CALV, MUTM)),
- k : Subscript, use activity, (k = (TRAP, PLOF, PCOF)),
- k' : Subscript, use activity, (k' = (TRAP, PCOF)),
- j : Subscript, milk products, (j = (MILK, MUTM)).

The Output Generation of the ABTA thus tallies with the Output Use of the ABTA.

3.4.3.1.3. Other products

The Output Generation of eggs contains eggs for consumption (see equation 46). The marketable domestic production of the market balance sheet is allocated to the use activity "Sales". The positive figure calculated as a residual amount is interpreted as "Human Consumption : on farm".

For $XG_{EGGS,EGGS} > XU_{TRAP,EGGS}$

(71a) $XG_{PCOF,EGGS} = XG_{EGGS,EGGS} - XU_{TRAP,EGGS}$

and for $XG_{EGGS,EGGS} \leq XU_{TRAP,EGGS}$

(71b) $XG_{PCOF,EGGS} = 0$

and for

(71c) $XG_{PLOF,EGGS} = XG_{EGGS,EGGS} - XU_{TRAP,EGGS}$

where: XG : Output Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component.

The Output Generation of the ABTA thus tallies with the Output Use of the ABTA.

The produced quantities of the other product groups:

- other animal products and
- raw wool,

which are measured at constant prices, are allocated to intersectoral "Sales" to give us the following:

(72) $XU_{TRAP,j} = \sum_i XG_{i,j}$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
$TRAP$: Subscript, use activity, agricultural sales,
i : Subscript, animal production activities, (i = (MUTM, OANI)),
j : Subscript, other final animal products (j = (OANI, WOOL)).

3.4.3.2. Intermediate animal products

Intermediate animal products are generally only for intrasectoral use. Numerical specification is based on the production activity level (chapter 3.3.3) and the Output Generation calculations (chapter 3.3.4.2). Live animal flows (e.g. heifers, piglets) are the main production activity interaction to be depicted via the Output Use.

However, any manure produced during animal production is made available to crop production activities as fertilizer broken down into its individual components (nitrogen, phosphate and potassium).

The statistical basis for the production activity level calculations (chapter 3.3.3) as well as for the associated calculations of animal Output Generation (chapter 3.3.4.2) and the calculations for specifying manure production (chapter 3.3.4.2.3) also applies to Output Use.

As already mentioned in the preceding chapters, there are no time referencing problems in this animal sector because available data refer to calendar years.

As a result of the simplifying assumption for time referencing in animal Output Generation, the calculation of the animal use activities is reduced to the inclusion of the animals produced in the previous year and the change in stock of the current year (final stocks minus initial stocks).

The intrasectoral live animal product use is restricted to the following products in the model:

- calves	(CALV)
- heifers	(HEIF)
- male adult cattle	(BULL)
- dairy cows	(DCOW)
- other cows	(SCOW)
- piglets	(PIGL)
- lambs	(LAMB)
- chicks	(CHIC)

For each of these products there is a use activity : CALP, HEIP, COWP, PIGP, BULP, LAMP and CHIP. The two cow groups, however, are combined into one use activity (COWP).

These use activities are specified by

(73) $$XU_{k,j,t} = \sum_i XG_{i,j,t-1}$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
k : Subscript, animal use activities, (k = (CALP, ..., CHIP)),
i : Subscript, animal production activities, (i = (MILK, ..., PIGL)),
j : Subscript, intermediate live animal products (j $\in$ (CALV, ..., SCOW)),
t : Subscript, year (t $\in$(73, ..., T)),
T : Subscript, last available year of reference period.

and the changes in stocks of these product groups are specified by:

(74) $$XU_{PCSF,j,t} = \sum_i XG_{i,j,t} - XU_{k,j,t}$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
$PCSF$: Subscript, use activity, ABTA, stock changes : on farm,
i : Subscript, animal production activities, (i = (MILK, ..., PIGL)),
k : Subscript, animal use activities (excluding PCSF), (k = (CALP, ..., CHIP)),
j : Subscript, intermediate live animal products (j $\in$ (CALV, ..., SCOW)),
t : Subscript, year (t $\in$(73, ..., T)),
T : Subscript, last available year of reference period.

As in the case of intermediate live animal products, use activities are also specified for the intermediate product manure but using the quantity produced in the current year as follows:

(75) $$XU_{k,j,t} = \sum_i XG_{i,j,t}$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
i : Subscript, animal production activities, (i = (MILK, ..., PIGL)),
k : Subscript, animal use activities, (k = (MANN, MANP and MANK)),
j : Subscript, intermediate products, (j = (MANN,MANP,MANK)),
t : Subscript, year (t $\in$(73, ..., T)),
T : Subscript, last available year of reference period.

As a result of the direct reference to Output Generation in the use of intermediate products, both sectors are depicted consistently in relation to each other.

3.4.4. Additional demand component of the ABTA

The numerical specification calculations for the product flows within the agricultural sector and the flow which leaves the agricultural sector are the subject of the previous chapter 3.4.3. In order to provide a full depiction of the product flows from their origin to their final consumption, this supply-based orientation of the ABTA has to be supplemented with a demand-based component: the "additional demand component".

The differentiated depiction of the final product flows outside the agricultural sector up to the different uses of final consumption is an important aspect of this additional component of the ABTA.

A further aspect of this component is the inclusion of non-agricultural product flows of agricultural products where agriculture is the customer. In most cases, intermediate products are involved which are used for the production of agricultural products. These mainly comprise seeds and feedingstuffs, the emphasis being on feedingstuffs in this context.

Apart from raw (primary) agricultural products, which are termed final products in the supply-oriented terminology, the most important processed (secondary) products are included[72]. The supply balance sheets of raw products are linked with the domestic resources of the processed products balance sheets via the use activity "processing", from which a "conversion coefficient residual" is derived.

The above two aspects refer to the physical product flows outside the agricultural sector of a national economy and are described as "market" flows for simplification.

The final consumption of agricultural products covers imported and domestically-produced product quantities, therefore both imports and exports of the product group concerned are included.

The agricultural use activity "Sales" contains the market resources of domestically produced quantities of raw products (see chapter 3.4.2.2). Purchases of agricultural inputs include the quantities of raw and processed products required on the market by agriculture (see also chapter 3.5 below).

The supply balance sheets[73] published by Eurostat were used for the most part for breaking down the physical market product flows of this component. Equation 62 shows the breakdown of agricultural product flows applied. The market flows contained in this equation:

$$
\begin{aligned}
DR_{MAPR,j} = {} & DU_{PEXE,j} + DU_{PEXW,j} + DU_{PCSM,j} + DU_{PCOM,j} + \\
& DU_{PFEE,j} + DU_{PSEE,j} + DU_{PLOS,j} + DU_{PIND,j} + \\
& DU_{PPRO,j} + DU_{PSAM,j} + DU_{PSAM,j} - DR_{PIME,j} - DR_{PIMW,j}
\end{aligned}
\tag{76a}
$$

The statistical adjustments of the supply balance sheets are assumed to be zero, so that

$$
DU_{PSAM,j} = 0.0 \tag{76b}
$$

The stock changes on market are residually calculated as follows:

[72] see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.
[73] see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

(76c)
$$DU_{PCSM,j} = DR_{MAPR,j} + DR_{PIME,j} + DR_{PIMW,j} - (DU_{PEXE,j} + DU_{PEXW,j} + DU_{PCOM,j})$$
$$DU_{PFEE,j} + DU_{PSEE,j} + DU_{PLOS,j} + DU_{PIND,j} + DU_{PPRO,j}$$

where: DR : Resources, demand,
DU : Uses, demand,
$MAPR$: Subscript, resource activity, demand, marketable production,
$PEXE$: Subscript, use activity, demand, exports, intra EU,
$PEXW$: Subscript, use activity, demand, exports, extra EU[74],
$PIME$: Subscript, resource activity, demand, imports, intra EU,
$PIMW$: Subscript, resource activity, demand, imports, extra EU[75],
$PCSM$: Subscript, use activity, demand, stock changes : market,
$PCOM$: Subscript, use activity, demand, human consumption : market,
$PFEE$: Subscript, use activity, demand, animal feed : market,
$PSEE$: Subscript, use activity, demand, seed : market,
$PLOS$: Subscript, use activity, demand, losses : market,
$PIND$: Subscript, use activity, demand, industrial use[76],
$PPRO$: Subscript, use activity, demand, processing,
$PSAM$: Subscript, use activity, demand, statistical adjustments,
j : Subscript, demand, agricultural products.

are numerically specified in the "Demand Component". Equation 62 together with equation 76 shows for raw final products that agricultural sales are equal to domestic marketable production.

(77) $$DR_{MAPR,j} = XU_{TRAP,j}$$

where: DR : Resources, demand,
XU : Output Use, ABTA, physical component,
$TRAP$: Subscript, use activity, ABTA, sales,
$MAPR$: Subscript, resource activity, demand, marketable production,
j : Subscript, agricultural final (raw) products, (j = (SWHE, ...,WOOL)).

The additional demand component's complementary role with regard to the supply-oriented ABTA becomes clear as a result.

As already described in chapters 3.4.1 and 3.4.2, the required data are extracted from the CRONOS databank, Domain ZPA1. Where the feedingstuff uses do not appear or are included as implausible figures in the supply balance sheets for crop products compared with Eurostat's feed resources statistics, the feed resources statistics are given precedence. This also applies to external trade statistics.

As already described in Chapter 3.4.2.1, the same calendar year calculations are carried out for the various raw and processed crop products as for the Output Use of the ABTA. In this connection it should be noted that before the time referencing calculations are carried out, for each crop year the extracted data are checked to see whether they constitute resources or use. In the unusual case that inconsistencies are found, the differences are regarded as "stock changes" (see equation 76c) in order not to have to correct the extracted data.

For some crop and animal final products there are no supply balance sheets data in the ZPA1 domain, e.g. flowers, other animal products. For these product groups, the agricultural sales on farm data (see

74 "Exports, extra-EU" are normally calculated by subtraction of "exports, intra-EU" from "total export" data.
75 "Imports, extra-EU" are normally calculated by subtraction of "imports, intra-EU" from "total import" data.
76 "Industrial use" relates to the quantities used by industry other than food or animal feed. The use of cereals (e.g. barley) to produce beer and alcohol is covered by industrial use.

equation 77) are treated as equal to the final use activity "Human Consumption : market" or "Industrial Use", and where necessary, taking into account the time referencing calculation (chapter 3.4.2.1).

3.5. Producer and purchase prices

After the physical data of the use activities of the ABTA become available in a form which is consistent with the Output Generation of the ABTA, the producer prices (purchase prices) for the evaluation of agricultural performance (costs) have to be calculated.

ABTA related prices are divided into three categories:

- farmgate prices (PRIC), which represent the prices received (output) or paid (input) per unit of a product, in a particular use, in intersectoral sales (purchases),
- internal use prices (PRIN) used for valuing products used within the sector and
- unit value prices (UVAL) needed for calculating incomes and ensuring consistency within the ABTA. The unit value price must be used if the identities embodied in the ABTA are to be satisfied [77], and is calculated as a weighted average of the use activity prices described above.

All three price categories are defined as calendar year averages.

Figure 7 below provides an overview of the interrelationships and sequence of stages in the calculation of producer prices.

The close link with the results of the Output Use part of the ABTA, as shown in Figure 11, is necessary in order to obtain weightings for calculating the unit value prices and to produce a physical production figure equivalent for calculating farmgate prices. By its definition, this physical equivalent corresponds to the production value of the EAA [78].

As well as from the data of the previously calculated quantities of the output use activities, for the final product price calculations, the EAA production values are extracted from the CRONOS databank, domain COSA, and where available, price data from the domain PRAG for specifying the internal use prices.

In addition to ABTA prices, price indices and the green parities are specified. For individual product groups, price indices (PRII) are calculated with the production figures from ABTA in order to obtain comparable values for plausibility checks (PRAG and COSA data) and to offer additional information to the user of the model results.

The green parities (GRPA) are taken from the Commission's publications. These green parities are used to distribute the CAP subsidies (measured in "green Ecu" (gEcu)) to the production activities measured in national currencies in order to calculate a "modified" gross value added at market prices (MGVA) as described in chapter 3.7.2.2. below.

3.5.1. Farmgate prices for agricultural sales

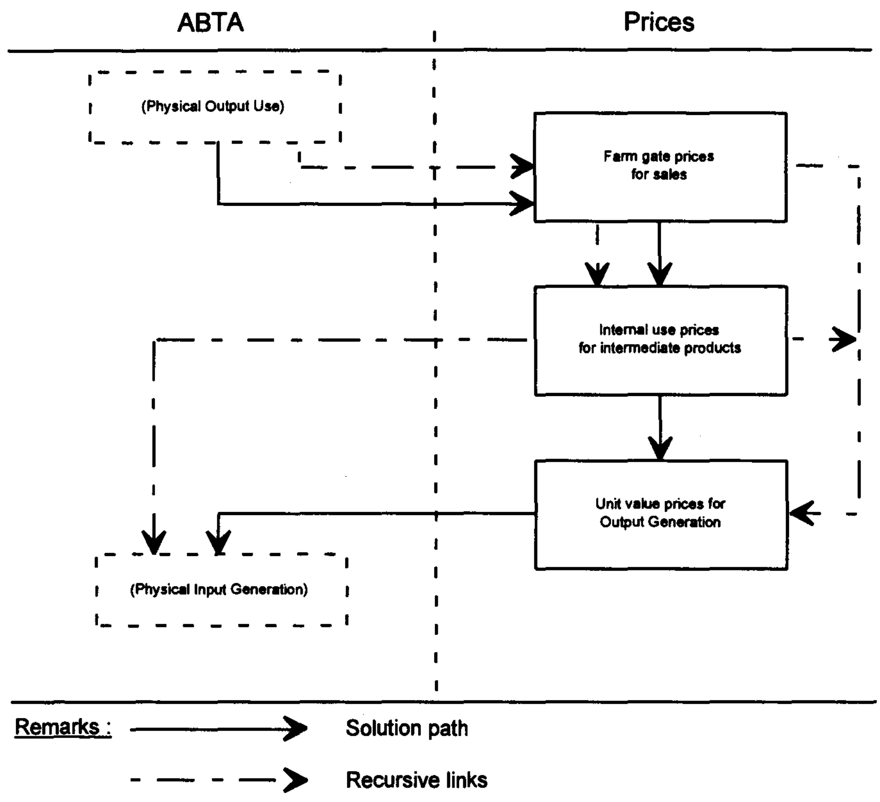
As already mentioned, farmgate prices are needed for valuing use activities corresponding to the EAA definition of the production value. The following use activities are involved:

77 see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, identity systems, figures 5 and 7.

78 see Eurostat, Manual on Economic Accounts for Agriculture and Forestry, Luxembourg 1989, p. 32.

- sales on farm (XU_{TRAP}),
- stock changes on farm (XU_{PCSF}),
- human consumption on farm (XU_{PCOF}).

Figure 11: Scheme of the solution of producer prices



Farm sales and stock changes on the farm are in line with the EAA definition. For animal products, the "own-account produced fixed capital goods" of the EAA definition are calculated as part of the stock changes of Output Use. "Own consumption" and "processing by producers" of the EAA definition are combined in the use activity "Human Consumption : on farm".

The farmgate price is calculated as follows on the basis of the production values (at current prices) of the EAA available for the final crop and animal product definitions :

(78) $$PU_{PRIC,j} = \frac{PV}{\sum_k XU_{k,j}}$$

where:
- PU : Production use price,
- PV : Production value, EAA, at current prices,
- XU : Output Use, ABTA, physical component,
- $PRIC$: Farm gate prices,
- k : Subscript, use activities, ABTA, (k = (TRAP, PCSF, PCOF)),
- j : Subscript, final products (j ∈ (1, ..., m)).

For animal products, stock changes are converted using specific assumptions for average slaughterweight in order to carry out the summation in equation 78.

It should be noted that for some products (e.g. OCRO) where the production value at constant prices was used as the physical unit of measurement, a price index results from this type of price calculation.

As a result of the annual changes in the quality and quantity of the product groups, the calculated farm-gate price (PRIC) is also in fact an average price.

3.5.2. Internal use prices for intermediate products

The internal use price provides the possibility of evaluating the intrasectoral use of intermediate products independently of the farmgate price. At the moment, this is only applied to feedingstuffs prices (e.g. barley) and young animals (e.g. piglets) which are available in the PRAG domain of the CRONOS databank. The opportunity of including price data which are available nationally is not used for the moment.

Any missing price data are estimated from farmgate prices by applying a reduction factor, c_j.

(79) $$PU_{PRIN,j} = c_j \, PU_{PRIC,j}$$

where:
- PU : Production use price,
- $PRIN$: Internal use price,
- $PRIC$: Farm gate price,
- c : Constant factor, with $0.8 \le c_j \le 0.95$,
- j : Subscript, crop and animal products.

For some intermediate product groups (e.g. silage) for which no farmgate price can be calculated and no price is available from official statistics, the internal use prices based on variable costs are calculated following the calculation of the Input Use parts of the ABTA.

3.5.3. Unit value prices for Output Generation

The unit value price is the weighted average of farmgate prices and internal use prices and is calculated as follows:

(80) $$PG_j = \frac{\sum_{k'} XU_{k',j} PU_{PRIC,j} + \sum_{k''} XU_{k'',j} PU_{PRIN,j}}{\sum_{k} XU_{k,j}}$$

where:
- PG : Production generation, unit value price (UVAL),
- PU : Production use price,
- XU : Output Use, ABTA, physical component,
- k : Subscript, use activities, ABTA and demand,
- k' : Subscript, use activities, ABTA, (k' = (TRAP, PCSF, PCOF)),
- k'' : Subscript, use activities, other than k' (k" = (PLOF, ..., CHIP)),
- j : Subscript, crop and animal products, (j = (1, ...,m)).

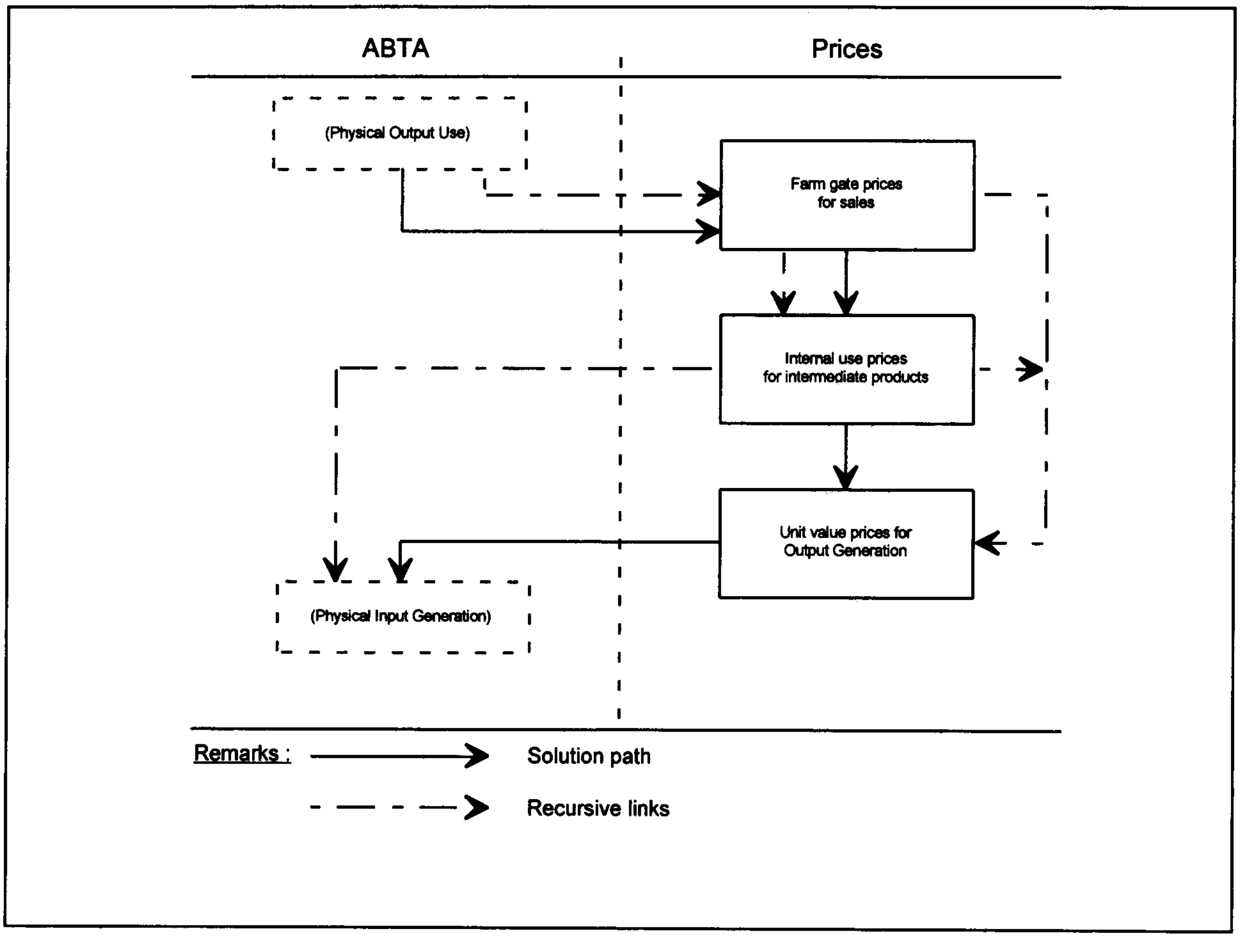
The unit value price is mainly used for evaluating the produced quantities in the Output Generation part of the ABTA. It corresponds to the farmgate prices when no produced quantities are re-used within the sector and corresponds to the internal use prices when no intersectoral interaction occurs.

3.5.4. Purchase prices

After the physical Input Generation part of the ABTA has been numerically specified (see chapter 3.6), the farmgate prices are calculated for the purchased intermediate inputs. For this purpose, as mentioned above, the EAA input values (at current prices) are taken and the same calculation is made as for the farmgate prices for final crop and animal products.

Figure 12 below provides a review of the interrelationships and the order of the various calculation stages.

Figure 12: Scheme of the solution of purchase prices



For some input items (e.g. fertilizers), the EAA contains aggregate values only. Any missing EAA input values (e.g. the value of nitrogenous fertilizer) are calculated using other data extracted from the PRAG domain or other national data sources and adjusted to the given input value of the EAA by proportional price corrections. These price corrections are sometimes necessary because the prices extracted from PRAG were collected for relatively homogeneous products and used as unit cost values for heterogeneous input categories. When such corrections are made the price ratios formed from the original statistics are maintained by means of proportional adjustment.

The previously calculated internal use prices are maintained unchanged for valuing intrasectoral resources.

As previously, a unit value price is also calculated for each type of cost to ensure consistency within the ABTA (in this case for valuing quantities involved in input use). This unit value price is also a weighted average of the internal use price and farmgate prices for the input sector.

3.5.5. Additional price information

Additional price information (price indices, green parities) and information on levies, subsidies, etc. are mainly used for plausibility checks in the Base Model. However, in all comparisons that are made, the price and product definition (variety of the product groups) should be taken into account.

The calculation of the price indices of the individual product groups, input items and aggregated product groups (input groups) are based on the same calendar year of the reference period which is also used to measure the EAA data at constant prices.

Administered prices (e.g. intervention prices) and information on levies and subsidies, could be required for simulating possible policy scenarios[79] and have therefore been included in the ABTA table structure but not specified for the reference period (SPEL/EU-Data).

3.6. Input Generation of the ABTA

In chapter 3.4, the various uses of agricultural products inside and outside the agricultural sector were considered. The completeness of agricultural product flows, from production to final consumption, is highly important in this context.

On the basis of this breakdown of uses, which is carried out in the Output Use of the ABTA, the intermediate products needed in the agricultural production process are compiled as period-related resources for the entire sector. These resources of intermediate products are used to produce the agricultural production depicted in the Output Generation of the ABTA.

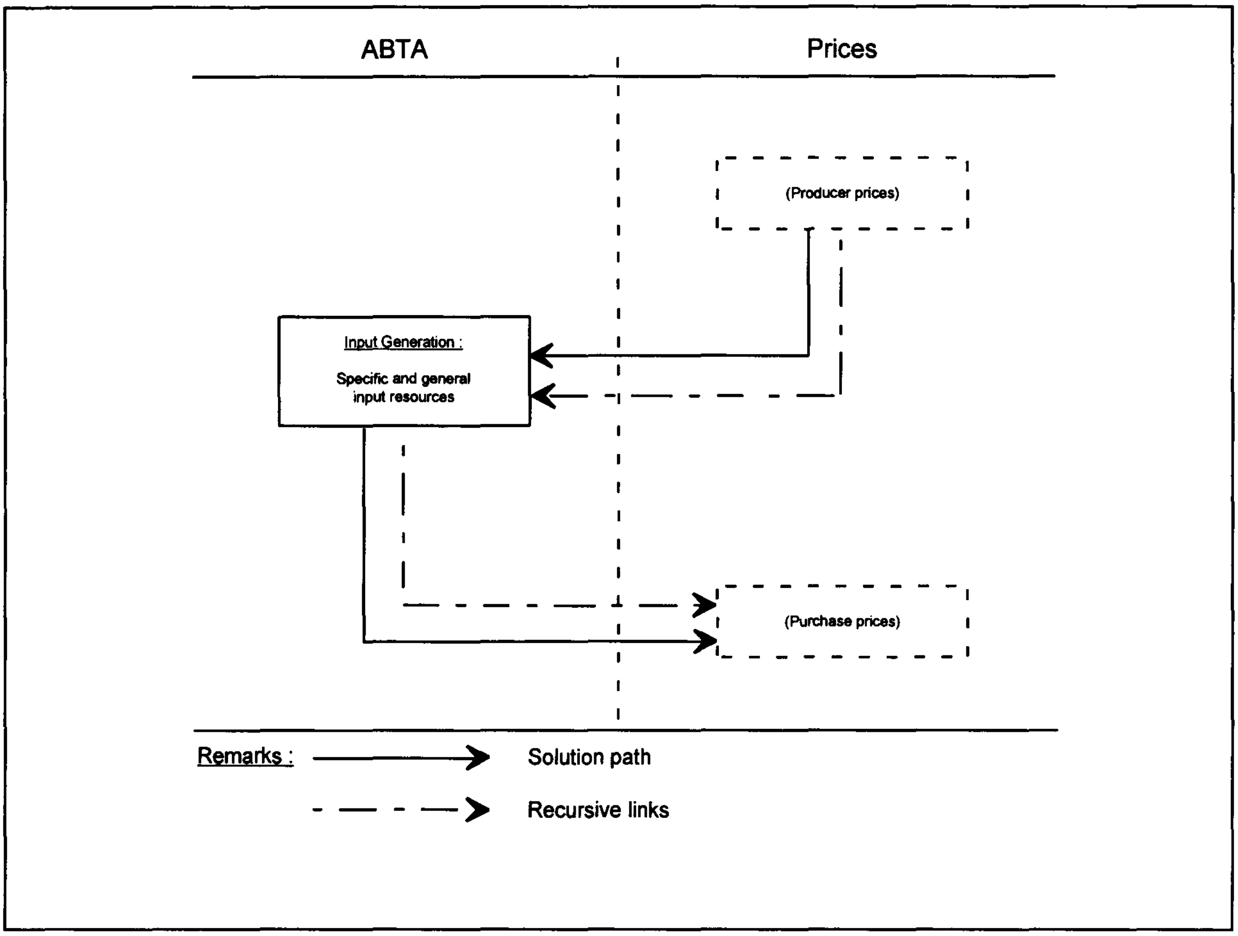
In the Input Use part of the ABTA (chapter 3.7) these resources are allocated to the different production activities. Figure 13 below provides a review of the interrelationships and the order of the calculations.

For the most part, use is made of the data on use activities described in chapter 3.4 for the numerical specification of the Input Generation parts (see Figure 13). The data for some non-agricultural intermediate inputs are extracted from the EAA or other Eurostat statistics referred to more specifically below.

The breakdown of intermediate inputs is based on the EAA and to it have been added intermediate inputs which are important for depicting the intrasectoral production interactions. A complete list of the various input types is given in Part 1: Basics, Annex 1 of this document.

79 see SPEL System, Methodological documentation (Rev. 1), Vol. 2: MFSS.

Figure 13: Scheme of the solution of Input Generation of ABTA



3.6.1. Specific inputs for crop production

The specific inputs for crop production are mainly seed, fertilizer and plant protection products, the quantities of seed and fertilizer consumed being supplied from intrasectoral as well as intersectoral flows. By contrast, the consumption of plant protection products is taken from intersectoral flows only.

The intersectoral purchases of plant protection products and seed are taken directly from the EAA, in constant prices. Mineral fertilizer purchases are taken from Eurostat's statistical yearbook and broken down into the pure nutrient contents of nitrogen, phosphate, potassium and lime.

Intrasectoral seed resources are evaluated on the basis of intersectoral purchases of the seed use activity and calculated with constant prices of a base year, as follows:

(81a) $$YG_{SEEP,SEEP,t} = \sum_j XU_{SEEP,j,t} PU_{PRIN,j,by}$$

(81b) $$YG_{TRAP,SEEP,t} = \sum_j DU_{PSEE,j,t-1} PU_{PRIC,j,by} + DU_{PSEE,Other,t}$$

with: $$DU_{PSEE,Other,t} = Total - \sum_j DU_{PSEE,j,t-1} PU_{PRIC,j,by}$$

where: YG : Input Generation, ABTA, physical component,
PU : Production use price,
XU : Output Use, ABTA, physical component,
DU : Uses, demand,
$Total$: Total purchased seed input (EAA) at constant prices,
$SEEP$: Subscript for seed use activity and input item seed,
$PSEE$: Subscript, marketseed use activity,
$TRAP$: Subscript, use/resource activity, ABTA, sales / purchases,
$PRIN$: Internal use price,
$PRIC$: Farm gate prices,
$Other$: Subscript, products not elswhere specified,
j : Subscript, crop products, ABTA,
t : Subscript, calendar year (t = (73, ..., T)),
T : Subscript, last available year of reference period,
by : Subscript, base year (by $\in$ (73, ...,T).

The sum of $YG_{SEEP,SEEP}$ and $YG_{TRAP,SEED}$ provides the overall sectoral seed resources.

The intrasectoral fertilizer (manure) resources are taken from the manure use activities allocated to their pure nutrient content input items of nitrogen, phosphate and potassium organic fertilizer, giving us the following:

(82) $$YG_{k,h} = XU_{k,j}$$

where: YG : Input Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
k : Subscript, use/resource activities (k = (MANN, MANP, MANK)),
h : Subscript, input items, (h = (NITM, PHOM, POTM)),
j : Subscript, intermediate product, (j = (MANN, MANP, MANK)).

The overall sectoral resources of the corresponding fertilizer breakdown, measured in pure nutrient content, is calculated from the intrasectoral and intersectoral resources.

3.6.2. Specific inputs for animal production

Specific inputs for animal production are feedingstuffs, live animals and pharmaceuticals. With the exception of the pharmaceutical input, the resources are drawn from both intrasectoral and intersectoral flows.

The sectoral feedingstuff resources are calculated on the basis of data from the ABTA's Output Use as well as from the additional Demand component figures.

In accordance with the feedingstuff input grouping, the available data on the feed use activity are compiled as product weights and allocated to the intrasectoral resources of the specific input group, as follows :

(83) $$YG_{FEEP,h'} = \sum_{j'} XU_{FEEP,j'}$$

where:
YG : Input Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
$FEEP$: Subscript, use/resource activity, ABTA, animal feed : on farm,
h' : Subscript, input items, feedingstuff groups (h' = (FCER, ..., FOTH)),
j' : Subscript, products allocated to a specific feedingstuff input group (j' ∈ (1, ..., m)).

The same procedure is applied for the calculation of intersectoral purchases, which are taken from the animal feed use activity of raw and processed products of the additional Demand component, as follows:

(84) $$YG_{TRAP,h} = \sum_{j'} DU_{PFEE,j'} + \sum_{d'} DU_{PFEE,d'}$$

where:
YG : Input Generation, ABTA, physical component,
DU : Uses, demand,
$TRAP$: Subscript, use/resource activity, ABTA, sales / purchases,
$PFEE$: Subscript, use activity, demand, animal feed : market,
h : Subscript, input items, feedingstuff groups (h = (FCER, ..., FOTH)),
j' : Subscript, raw products, allocated to feedingstuff input groups (j' ∈ (1, ..., m),
d' : Subscript, processed products, allocated to feedingstuff input groups.

In the case of resources of live animal inputs, live animal imports for slaughtering are allocated to the corresponding intersectoral purchase activity. Intrasectoral resources of live animal inputs are taken from the animal use activities:

(85a) $$YG_{TRAP,h} = \textit{animal imports for slaughtering of kind h}$$

(85b) $$YG_{k,h} = XU_{k,j}$$

where:
YG : Input Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
$TRAP$: Subscript, use/resource activity, intersectoral purchases, ABTA, sales / purchases,
k : Subscript, use/resource activity, intermediate live animal products,
h : Subscript, input items, live animal inputs,
j : Subscript, products, live animal products.

The intermediate live animal input "Cows" represents the sum of "Dairy cows" and "Suckler cows".

Pharmaceutical input resources are retrieved from the EAA, where they are expressed in constant prices, and allocated to intersectoral purchases.

(86) $$YG_{TRAP,IPHA} = \textit{Input value of EAA at constant prices}$$

where:
YG : Input Generation, ABTA, physical component,
$TRAP$: Subscript, use/resource activity, ABTA, sales / purchases,
$IPHA$: Subscript, input item, pharmaceutical input.

3.6.3. Other inputs

Other inputs consist of repair and energy costs and "other" input. The data for calculating these input items are taken from the EAA (intermediate input at constant prices, see equation 86). The input items "energy" and "other input" correspond to those of the EAA, and costs for "maintenance of machines and buildings" of the EAA are allocated to the cost item "repairs".

The division of these items of inputs into fixed and variable input components is already provided for in the input breakdown, although currently fixed input can only be calculated by rough assumptions (fixed rate of 10% of EAA data).

This division of categories of input should in future help in the calculation of gross margins for the total sector and for each production activity. However, it will be necessary to analyse more detailed information from various microeconomic or macroeconomic data sources.

3.7. Input Use of ABTA and MAC

The physical output for each production activity, the physical use of agricultural products and the total sectoral intermediate Input Generation used in past periods for calculating agricultural production are available in the form described and on a consistent basis.

In the Input Use of the ABTA, the input use figures are calculated which are needed for estimating agricultural outputs broken down by production activities.

The inputs available for the entire sector (see ABTA Input Generation) are allocated to the production activities concerned so that the identity system[80] is fulfilled for both Input and Output Generation of the ABTA.

As well as this mathematical consistency, the Input Use section, like the other ABTA components, must also satisfy plausibility criteria regarding both the economic and technical specification.

Figure 14 provides a review of the inter-relationships and of the sequence of the calculation steps.

The following chapters deal not only with data sources but also present some general methodological points before treating specific problems of individual input groups.

3.7.1. Data sources

The numerical specification of Input Use of the ABTA has been particularly difficult, compared with the other parts of the ABTA, because hardly any officially compiled data are available from official statistics at the required level of definition.

The agricultural standard gross margin calculations carried out by the Commission for the EU (SGM/EU) [81], which cover almost the entire area of the European Union, have a similar purpose to the SPEL standard gross margin calculations. In the past, in order to calculate the SGM/EU, a uniform

80 see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

81 Commission of the European Communities: Commission Decision of 7 June 1985 (85/377/EEC); Official Journal No L 220 of 17.8.1985.

system was developed for the entire Union[82], resulting in these calculations being introduced by national institutions in the Member States on the basis of a maximum level of harmonization.

The harmonization achieved between the Member States evidently only covers part of the fundamental calculation work. For the FR of Germany, for example, the data and calculation algorithms available for standard gross margin calculations (SGM/D)[83] are available with a much greater breakdown than those of SGM/EU. The situation is similar for other Member States.

The Farm Accountancy Data Network (FADN), too, compiles production and input data at the farm level for different types of farm by a method involving a maximum of Union harmonization[84].

The results of special preliminary studies[85] for the ABTA show that SGM/EU data used in conjunction with FADN data are suitable as a basis for the numerical specification of the Input Use of the ABTA. The SGM/EU data and aggregated FADN data available to Eurostat were used for the calculations.

On request, further information on the national SGM calculations were kindly provided for some Member States by competent national institutions[86].

However, according to the preliminary studies[87], for a satisfactory allocation of the feedingstuff resources to the animal production activities, these two data sources were not sufficient. For this reason, the calculations for feedingstuffs uses are based as far as possible on production and farm management data (CD category).

It is essential that the knowledge and judgement of national experts is used to check the assumptions and results of the ABTA Input Use component, and this is in fact planned for all Member States[88].

3.7.2. General solution approach

The definitional discrepancies between the model's internal data and available statistics call for a step-by-step approach to the numerical specification of the Input Use part of the ABTA (see scheme in figure 14 and following chapters).

3.7.2.1. Specific and general intermediate inputs

Using available statistical information, hypothetical input coefficients for the various types of inputs are calculated for each production activity as initial reference bases.The already consistent production data (see ABTA and MAC Output Generation) and the closely associated production activity levels are used for calculating these hypothetical input coefficients.

82 Commission of the European Communities: Commission Decision of 7 April 1978 establishing a Community typology for Agricultural Holdings (78/463/EEC); Official Journal of the European Union No L 148 of 5.6.1978, p. 1.

83 see Kuratorium für Technik und Bauwesen in der Landwirtschaft (Editor): Standarddeckungsbeiträge, verschiedene Jahrgänge (Standard Gross Margins, various years' results), Darmstadt, FR Germany.

84 Commission of the European Communities: Farm Accountancy Data Network, An A to Z of methodology, Luxembourg, 1989.

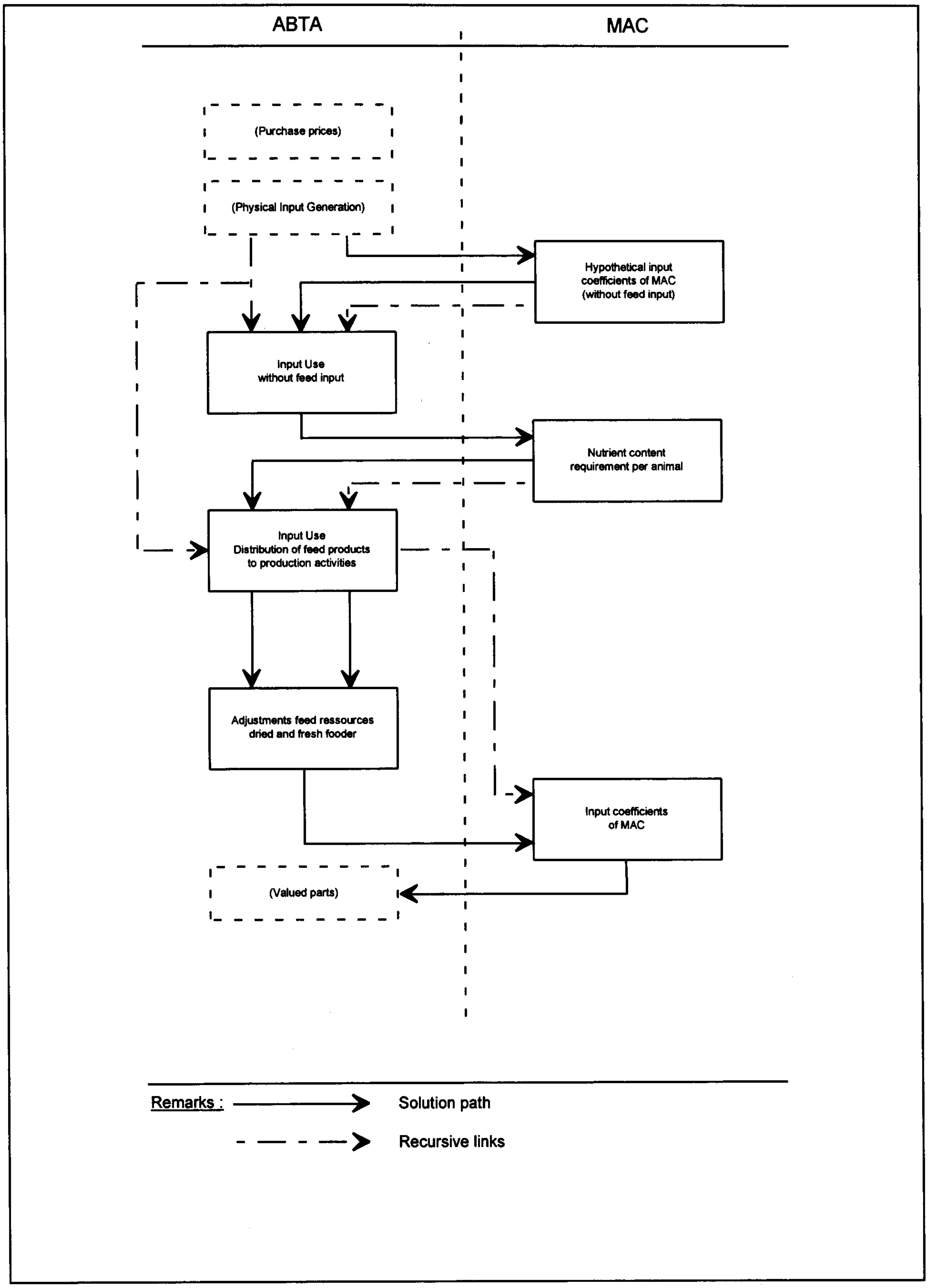
85 Preliminary studies were carried out on the problems of numerical specification of the input uses of the ABTA in 1990, on behalf of Eurostat, at the "Institut für Agrarpolitik" of the university of Bonn, by Ch. Böse and B.Dinglinger. The results were presented in a working paper of 30.11.1990.

86 Information was provided by the following institutions: Kuratorium für Technik und Bauwesen in der Landwirtschaft, FR Germany, Darmstadt; Landbouw-Economisch Instituut, Nederland, CL's Gravenhage; Institut Economique Agricole, Belgium, Brussels.

87 For the SPEL development work done on behalf of Eurostat, preliminary studies on the feedingstuffs use account were carried out at the Institut für Agrarpolitik der Universität Bonn by Th. Holtmann, H.P. Witzke and M. Kesting. The results of this work were presented in a working document on 15 May 1990. Further work has been carried out by Eurostat, Division F2, Animal Feed, Supply and demand feedingstuffs in the European Communities, Luxembourg, 1990.

88 National experts have already been called in from Spain, Portugal and Greece to help with checking. At the moment national experts are called in from Ireland and France.

Figure 14: Scheme of the solution of Input Use of ABTA/MAC



Furthermore, these figures are also subjected to plausibility checks based on agronomic criteria. In this way, a set of plausible data for the ex-post period are established at this calculation stage.

The hypothetical resource requirements are compared with the input resources available (see Input Generation) and are adjusted proportionally to ensure that the total requirement is equal to total resource avaibility.

The total sectoral, hypothetical input requirements are calculated as follows :

(87a) $$\sum_j YUH_{i,j} = \sum_i YMUH_{i,j} LEVL_i$$

The total, available, sectoral input resources are given by adding up the resource activities of Input Generation

$$\left(\sum_k YG_{k,h} \right)$$

The distribution factors, which are recorded for each period under consideration (e.g. calendar year) to provide a basis for checking, are calculated, as follows :

(87b) $$R_h = \frac{\sum_i YUH_{i,h}}{\sum_k YG_{k,h}}$$

The Input Use of the ABTA is calculated with equation 87a and 87b, as follows :

(88) $$YU_{i,h} = YMUH_{i,h} LEVL_i \frac{1}{R_h}$$

For the MAC it is calculated, as follows :

(89) $$YMUH_{i,h} = \frac{YU_{i,h}}{LEVL_i}$$

where:
YUH : Hypothetical Input Use, ABTA, physical component,
$YMUH$: Hypothetical Input Use, MAC, physical component,
$LEVL$: Production activity level,
YG : Input Generation, ABTA, physical component,
R : Distribution factor,
YU : Input Use, ABTA, physical component,
YMU : Input Use, MAC, physical component,
i : Subscript, production activity, (i = (1,..., n)),
h : Subscript, input item, (h = (m+1,..., M), excluding feed input),
k : Subscript, resource activity, (k = (n+1,..., N)).

3.7.2.2. Gross return to primary factors

After the Input Use calculation has been completed, the model-specific gross margins and gross value added at market prices are calculated for each production activity.The latter income indicator should be interpreted as the gross return to the primary factors of production (land, labour and capital). Gross value added at market prices is therefore taken to represent the value of the input services provided by these primary factors which are not explicitly included in the model.

For the ABTA and MAC, these indicators are calculated, as follows:

For the ABTA,

(90a) $$YU_{i,GRMA} = \sum_{j} XG_{i,j} PG_{UVAL,j} - \sum_{h'} YU_{i,h'} QU_{UVAL,h'}$$

and

(90b) $$YU_{i,GVAM} = \sum_{j} XG_{i,j} PG_{UVAL,j} - \sum_{h} YU_{i,h} QU_{UVAL,h}$$

and equation 90b corrected by the CAP related subsidies and taxes

(90c) $$YU_{i,MGVA} = YU_{i,GVAM} + \sum_{h''} YU_{i,h''}$$

For the MAC,

(91a) $$YMU_{i,GRMA} = \sum_{j} XMG_{i,j} PG_{UVAL,j} - \sum_{h'} YMU_{i,h'} QU_{UVAL,h'}$$

and

(91b) $$YMU_{i,GVAM} = \sum_{j} XMG_{i,j} PG_{UVAL,j} - \sum_{h} YMU_{i,h} QU_{UVAL,h}$$

and equation 90b corrected by the CAP related subsidies and taxes

(91c) $$YMU_{i,MGVA} = YMU_{i,GVAM} + \sum_{h''} YMU_{i,h''}$$

where:
YU : Input Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
PG : Output Generation price,
QU : Input Use price,
YMU : Input Use, MAC, physical component,
XMG : Output Generation, MAC, physical component,
i : Subscript, production activity, (i = (1,...,n)),
j : Subscript, agricultural products, (j = (1,...,m)),
h : Subscript, input item, (h = (m+1,...,M-1), excluding GVAM),
h' : Subscript, input item, (h' = variable input items, subset of h),
h'' : Subscript, CAP related subsidies and taxes,
$UVAL$: Subscript, unit value price (weighted average price),
$GRMA$: Subscript, gross margin,
$GVAM$: Subscript, gross value added at market prices,
$MGVA$: Subscript, "modified" gross value added at market prices.

The calculation of "modified" gross value added at market prices (equations 90c and 91c) includes estimates of non harmonized subsidies and tax data related to the CAP. This value added definition is not comparable with the gross value added at factor cost definition of the EAA.

These income indicators then undergo a plausibility check in which the available regional standard gross margins and their calculation algorithms provide important elements. Corrective adjustements to all components of the ABTA may be necessary following the results of the check.

In general, checked hypothetical input coefficients are available within the model, but they have to be given a detailed review from time to time.

When profound changes are subsequently applied to the original statistical time series used in the ABTA or MAC, these hypothetical Input Use data also have to be rechecked for plausibility and, if necessary, altered.

3.7.3. Comments on the basic assumptions (excluding feed use)

Neither the SGM/EU and individual national SGM data (e.g. SGM/D) nor FADN data can be used without modification for the numerical specification of the hypothetical input coefficients. The main reasons for this are:

Definitional discrepancies:

- between the SGM and FADN input headings,
- between the SGM and FADN production branches,
- between each of these sources and the ABTA (MAC) headings.

Regional discrepancies:

- The SGM/EU data are:
  - mainly average figures for NUTS II regions,
  - not available in full for all Member States,
- the available FADN data are average figures for specific types of farms, whereas in the model, sectoral averages for all EU Member States are required.

Chronological discrepancies:

- The SGM/EU data have different reference periods (crop or calendar years),
- the SGM/EU data have been calculated in part since 1975 but for most Member States data have been compiled only for the middle of the 1980s,
- the FADN data are only available for the years 1980 to 1988, whereas in the model, the calendar year data for the period 1973 until the present are required .

Annex 4 presents a table showing the allocation of SGM production branches and FADN specialized farm types to the production activities listed in the ABTA (MAC) structure.

Annex 5 shows the available SGM and FADN information on the different input items (not including feedingstuffs) of the ABTA (MAC). The following points should be made wit regard to Annex 5:

- The SGM/EU and FADN data indicate the overall financial expenditure on mineral fertilizers and contain no elements for a breakdown by individual types of nutrients. As a substitute, ratios can be derived for a breakdown into types of nutrients from the available German SGM data (SGM/D). The following calculation is carried out for the other Member States:

(92) $$YMUH_{MS,i,h} = YMUH_{D,i,h} \frac{COS_{MS,i}}{\sum_h QU_{MS,h} YMUH_{D,i,h}}$$

where: $YMUH$: Hypothetical Input Use, MAC, physical component,
COS : Total fertilizer cost per unit area,
QU : Input Use price,
MS : EU Member States (excl. D),
D : FR Germany ,
i : Subscript, production activity, (i = (1,..., n)),
h : Subscript, input item, (h = (NITF, PHOF, POTF, CAOF)).

- Figures for the use of organic fertilizers cannot be derived from the SGM/EU (or SGM/D) data or from the FADN data. Therefore, further information was obtained from other sources (see next chapter).

- Further information on a breakdown of pharmaceutical inputs by animal production activity is available only for the FR of Germany at the moment. For the time being, the German percentages of variable special costs are also being applied to the other sectors for breakdown purposes.

- A separate breakdown of variable and fixed costs for energy, repairs and other costs cannot be made with the available data because they include both cost components.

- Inputs for repairs and energy and other input cannot be identified with the SGM/EU data and are therefore approximated using FADN data.

- Available variable cost percentages taken from the German SGM/D data are temporarily being used until they can be replaced by national information from experts.

- Figures for water costs cannot be derived from the data either.

- The numerical specification of input coefficients for purchased seed, plant protection and other variable inputs, was based directly on SGM/EU data, and for some Member States directly on FADN data. The latter data were calculated back to the input per production activity unit (hectares or animal units).

- Since the input coefficients calculated from the FADN data show massive year-to-year fluctuations, the FADN data were "smoothed out" by averaging over several years. These fluctuations are caused by changes in relative numbers of farms in the different types of farm categories and by the calculation back to the reference variable: hectare or animal unit.

Annex 6 contains an example of the hypothetical input coefficients (mainly for the year 1985) currently used in the model.

Input coefficients beginning with year 1973 were filled in with the main product-related output coefficients and/or with trends in the data completion workstep, and checked as far as possible with national experts.

3.7.4. Use of organic fertilizers

The mineral fertilizer for each production activity is numerically specified with the hypothetical input coefficient (see previous chapter).

With regard to organic fertilizers (manure), it is assumed that they are only used for the following production activities:

- cereals (SWHE, DWHE, RYE, BARL, OATS, MAIZ, OCER),
- root crops (POTA, SUGB, OROO),

- oilseeds (RAPE, SUNF),
- flax and hemp (FLAX),
- vegetables (CAUL, OVEG) and
- fodder (GRAS, SILA).

For these production activities, the first stage involves calculating hypothetical total requirements for the different nutrient contents: nitrogen (N), phosphate (P), and potassium (K). The area under cultivation, yield per hectare, use of nutrient content for the harvested production and an increment for plant maintenance demand of 25% are taken into account giving us the following calculation:

(93) $$YUTH_{i,f} = (\sum_j XG_{i,j} nuc_{j,f})\ 1.25$$

where:
$YUTH$: Total hypothetical requirements,
XG : Output Generation, ABTA, physical component,
nuc : Nutrient content of crop products,
i : Subscript, production activity, (i = (1,..., n)),
j : Subscript, products, (j = (1,...,m)),
f : Subscript, fertilizer nutrient content, (f = (N,P,K)).

By reducing the hypothetical total requirements by means of the mineral fertilizer use, we obtain the total requirement of production activities in terms of organic fertilizer resources.

The nutrient content (nitrogen, in particular) of organic fertilizer is not absorbed by all types of crops to the same extent as it is applied. Therefore, for the production activities absorbing organic fertilizers, the quantity of nitrogen applied is supplemented by an "availability factor" to roughly take account of these individual crop characteristics.

For nitrogen content:

(94a) $$YUH_{i,NITM} = \frac{YUTH_{i,NIT} - YU_{i,NTF}}{avf_{i,NIT}}$$

For phosphate and potassium content:

(94b) $$YUH_{i,h''} = YUTH_{i,f'} - YU_{i,h'}$$

If the mineral fertilizer Input Use (nitrogen, phosphate, potassium) is already greater than 90% of the total hypothetical requirement of fertilizer, this gives us the following:

(94c) if $\frac{YU_{i,h'}}{YUTH_{i,f}} > 0.9$ then $YUH_{i,h''} = YUTH_{i,f}\ 0.1$

where:
YU : Input Use, ABTA, physical component,
YUH : Hypothetical Input Use, ABTA, physical component,
$YUTH$: Total hypothetical requirements,
XG : Output Generation, ABTA, physical component,
nuc : Nutrient content of crop products,
avf : Availability factor,
$NITM$: Subscript, input item, organic nitrogen fertilizer,
$NITF$: Subscript, input item, mineral nitrogen fertilizer,
NIT : Subscript, nitrogen nutrient content,

i : Subscript, production activity, (i = (1,...,n)),
j : Subscript, products, (j = (1,...,m)),
h' : Subscript, input items, mineral fertilizer, (h' = (PHOF, POTF)),
h'' : Subscript, input items, organic fertilizer (h" = (PHOM, POTM)),
f : Subscript, fertilizer nutrient content, (f = (N,P,K)),
f' : Subscript, fertilizer nutrient content, (f' = (P,K)).

Consequently, at least 10% of the total hypothetical requirements are covered by organic fertilizer.

The nutrient content per harvested production unit and the rate of fertilizer availability to the plant are given in Table 5. These data remain unchanged for the period under consideration although progress in biotechnology would require a modification in time.

Table 5: Nutrient of harvested production and nitrogen availability to plants from organic fertilizer

Production activities	kg pure nutrients per t/ha harvest			availability of N (%)
	N	P_2O_5	K_2O	
SWHE	23.0	11.0	21.0	40
DWHE	26.0	11.0	22.0	50
RYE	20.0	11.0	21.0	40
BARL	20.0	11.0	21.0	40
OATS	15.0	11.0	22.0	50
MAIZ	23.0	14.0	31.0	50
OCER	22.0	11.0	22.0	40
POTA	3.5	2.2	7.5	50
SUGB	2.6	2.0	6.0	50
OROO	2.0	1.0	3.9	50
RAPE	51.0	28.0	62.0	40
SUNF	12.0	23.0	57.0	50
FLAX	3.0	8.0	15.0	40
CAUL	7.0	1.9	7.9	20
OVEG	7.0	1.9	7.9	20
GRAS	20.0	8.0	29.0	50
SILA	3.2	2.0	4.4	40

Source: Based on: Landwirtschaftskammer Rheinland, System and Basic Data for Fertilizer Planning, March 1990.

In principal, the Input Use of organic fertilizer (nitrogen, phosphate, potassium) is proportionally adjusted to the resources data available in Input Generation of ABTA as follows :

(95) $$YU_{i,h''} = \frac{YUH_{i,h''}}{R_{h''}}$$

where: YU : Input Use, ABTA, physical component,
YUH : Hypothetical Input Use, ABTA, physical component,
R : Distribution factor (∃ equation 96a, 96b, 96c),
i : Subscript, production activities,
k : Subscript, resource activity, (k = (MANN,MANP,MANK)),
h'' : Subscript, input item, organic fertilizer, (h" = (NITM,PHOM, POTM)).

To avoid an excessive over-application (under-application) of organic fertilizers, the distribution factor is calculated under the general rule that no more (less) than double (half) the calculated hypothetical organic fertilizer use is allowed.

If $$0.5 \le \frac{\sum_i YUH_{i,h''}}{\sum_k YG_{k,h''}} \le 2.0$$ then

(96a) $$R_{h''} = \frac{\sum_i YUH_{i,h''}}{\sum_k YG_{k,h''}}$$

If $$\frac{\sum_i YUH_{i,h''}}{\sum_k YG_{k,h''}} < 0.5$$ then

(96b) $$R_{h''} = \frac{\sum_i YUH_{i,h''}}{\sum_k YG_{k,h''} 0.5}$$

If $$\frac{\sum_i YUH_{i,h''}}{\sum_k YG_{k,h''}} > 2.0$$ then

(96c) $$R_{h''} = \frac{\sum_i YUH_{i,h''}}{\sum_k YG_{k,h''} 2.0}$$

where: R : Distribution factor,
YU : Input Use, ABTA, physical component,
YUH : Hypothetical Input Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
i : Subscript, production activities (i = (i, ..., n)),
k : Subscript, resource activity, (k = (MANN,MANP,MANK)),
h'' : Subscript, input item, organic fertilizer, (h" = (NITM,PHOM, POTM)).

If the distribution factor is calculated by equation 96b or 96c, the manure data of Input Generation, Output Use and Output Generation are also adapted in a feedback procedure, in order to maintain the ABTA consistency[89]. Therefore, the input and output data of manure (organic fertilizers) represent the used organic fertilizers (manure) without losses.

Since the manure resources are based on estimates and several important aspects (e.g. water content) had to be neglected, the manure resources are subjected to the above subsequent check and possible adjustment.

The Input Use of MAC is calculated by using the production activity levels as presented in equation 89.

3.7.5. Feedingstuffs

As for the other types of input, the overall sectoral resource data of the Input Generation of the ABTA are allocated to the production activities. The resources for the different types of feedingstuffs are allocated to the animal production activities on the basis of animal production.

Since no official statistics are available for this purpose, this breakdown is based on production data (farm management data).

3.7.5.1. Solution method

The sectoral feedingstuffs resources are allocated to the animal production activities by the application of a non-linear (quadratic) programming approach, which minimizes the sectoral feed cost deviation of a calendar year (t) depending on an optimal solution of the previous calendar year (t-1) used to generate the gross animal production of calendar year (t).

The solution method reflects farmers' behavior when determining the feed menus for production activities given the levels concerning activity levels (herd sizes), output coefficients, internal prices and purchase prices of feedingstuffs and the total sectoral feed resource quantities. The feed resource quantities are mostly available by statistics (supply balance sheets and feed statistics of Eurostat).

The quadratic deviation of the previous year[90] feed menus per production activity for each feed input group avoid chronologically excessive changes in the allocation of the feed inputs to the animal production activities. These quadratic deviations of animal menues are minimized (equation 97) according to nutrient and production constraints.

The feed prices in equation 97 are used to reflect the relativ price changes of feed resources. The dry matter requirement weights insures, that the production activities will be considered independently from the quantity of level (herd size) and the kind of activity (e.g. cows, ewes). The following equation system (objective function and constraints) is minimized:

[89] see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.
[90] The calculation of the first optimal solution by linear programming approach is described in annex 7.

(97) $$MIN!_{(\Delta YU)} \quad TSC_t = \sum_i \sum_h \left(\Delta YU_{i,h,t}\right)^2 QU_{i,h,t} \frac{\sum_i RDM_{i,t}}{RDM_{i,t}}$$

with:

$$\Delta YU_{i,h,t} = YU_{i,h,t} - YU^*_{i,h,t}$$

$$YU^*_{i,h,t} = YMU_{i,h,t-1} FA_{i,t}$$

$$RDM_{i,t} = FA_{i,t} REQ_{i,drymatter,t}$$

where:
ΔTSC : Hypothetical total sectoral feed cost deviation,
ΔYU : Input Use deviation, ABTA, physical component,
YU : Input Use, ABTA, physical component,
YMU : Input Use, MAC, physical component,
QU : Input Use price,
RDM : Dry matter requirements per activity,
REQ : Total nutrient requirements per animal (see chapter 3.7.5.3),
FA : Fed animals,
t : Subscript, calendar year (t = (73, ..., T)),
T : Subscript, last available year of reference period,
i : Subscript, production activities, (i = (MILK,...,PIGL)),
h : Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)).

The total sectoral feed cost deviations (equation 97) are minimized subject to the following constraints :

- All animals used for production in the calendar year are fed :

(98) $$FA_{i,t} = LEVL_{i,t}$$

- The distribution of the marketable feed inputs is equal to the feed resources :

(99a) $$\sum_i YU_{i,h',t} = \sum_k YG_{k,h',t}$$

- The distribution of the not marketable feed inputs is limited (bounded):

(99b) $$0.5 \sum_k YG_{k,h'',t} \leq \sum_i YU_{i,h'',t} \leq 1.5 \sum_k YG_{k,h'',t}$$

- The energy, protein and dry matter contents required for animal production are met in full,

(100a) $$\sum_h RQP_{i,h,f,t} \geq REQ_{i,f,t}$$

and

- The minimum (maximum) requirement restrictions for feed products are adhered to in each animal production activity:

(100b) $$c_{h,t} \sum_i YU_{i,h,t} \geq REQ_{i,drymatter,t} factor_{i,\min} LEVL_{i,t}$$

and

(100c) $c_{h,t}\sum_{i} YU_{i,h,t} \leq REQ_{i,drymatter,t} factor_{i,\max} LEVL_{i,t}$

and

(100d) $c_{h,t}\, YMU_{i,h,t} \leq RFP_{i,h,max,t}$

where : $LEVL$: Production activity levels,
FA : Fed animals,
YU : Input Use, ABTA, physical component,
YMU : Input Use, MAC, physical component,
YG : Input Generation, ABTA, physical component,
RQP : Nutrient content per feed product,
REQ : Total nutrient requirements per animal, (chapter 3.7.5.3),
RFP : Dry matter requirement per animal (exogenously set),
c : Dry matter content coefficient,
$factor$: Constant factor (see Table 6),
i : Subscript, production activities, (i = (MILK,...,PIGL)),
h : Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)),
h' : Subscript, input items, marketable feedingstuffs, (h' = (FCER,...,FMIL, FOTH)), excluding h",
h'' : Subscript, input items, non marketable feedingstuffs, (h" = (FDRY,FFSI)),
k : Subscript, resource activity (k = (n+1,..., N)),
f : Subscript, content of energy, protein, dry matter.

According to the dry matter requirements of the animal production activities (see chapter 3.7.5.3.), the requirement restrictions (equations 100b and 100c) are formulated by using a constant factor shown in Table 6.

The requirement restrictions (equation 100d) are expressed in feed product weight per animal in order to allow consideration of any information available on the use of individual feed quantities for specific animal categories. Upper and lower diet limits for animal feeding obtained from farm management data are generally used for specifying these restrictions.

The input use of MAC is calculated by using the production activity levels as presented in equation 89.

Table 6: Restriction factors for dry matter requirements

Production activities		Factor min.	Factor max.
Dairy Cows	(MILK)	0.8	1.3
Male adult Cattle for Fattening	(BEEF)	0.7	1.4
Calves for Fattening	(CALF)	0.9	1.5
Pigs for Fattening	(PORK)	0.8	1.2
Ewes and Goats	(MUTM)	0.8	1.5
Sheep and Goats for Fattening	(MUTT)	0.8	1.2
Poultry for Fattening	(POUL)	0.8	1.2
Laying Hens	(EGGS)	0.8	1.2
Heifers	(HEIF)	0.7	1.3
Calves, Rearing	(RCAL)	0.9	1.4
Pigs Breeding	(PIGL)	0.8	1.2
Other Cows	(CALV)	0.8	1.4

3.7.5.2. Nutrient content of feed products

In order to establish the nutrient content of feedingstuffs for the different animal categories, the following ingredients of the individual feed products are calculated:

- the energy content, measured in metabolizable energy, and for lactating animals, in net energy (in megajoules (MJ)),
- the protein content, measured in crude protein (in kg) and
- the dry matter (in kg).

Weighted nutrient content coefficients have been calculated for each of the individual feed product groups on the basis of the available quantities of the sub-groups (see annex 3).

The nutrient content coefficients of these subgroups are currently assumed to be constant over time, for simplification purposes, although technical changes in processing and biotechnological progress in relation to crop types would suggest a tendency towards a change over time.

3.7.5.3. Nutrient requirements

This chapter presents a short explanation of the requirement functions used to obtain a breakdown by animal production activity for calculating

- the energy requirement (EN), measured in metabolizable energy (ME) or net energy (NEL)[91] (in the case of lactating animals) in megajoules (MJ),

[91] The metabolizable energy (ME) for lactating is converted into net energy (NEL) with a utilization coefficient of 0.6 (see Menke / Huss, page 94).

- the protein requirements (PT), measured in kg and
- the dry matter requirements (DM) measured in kg

per animal unit. The listed parameters of the functions were for the most part derived from published studies on the feeding of agricultural productive livestock[92].

As a rule, the following requirement functions take into account animal requirements for :

- survival (basic requirement),
- work and
- replacement

insofar as this is required by the animal category.

3.7.5.3.1. Cattle

Dairy and suckler cows:

For cows, the requirement functions include milk production and its average fat content, calf production and an average liveweight.

(101a)

$$REQ_{i,EN} = 0.293\ AW^{0,75}\,365 + 1163\,XMG_{i,CALV} + (0.386\,FAT + 1.626)(XMG_{i,MILK} + 320)$$

(101b)

$$REQ_{i,PT} = 0.0037\ AW^{0,75}\,365 + 10.85\frac{XMG_{i,CALV}}{0,42} + 0.085(XMG_{i,MILK} + 320)$$

(101c)

$$REQ_{i,DM} = (0.077\,AW^{0,75} + 0.4\,MD_i - 0.0033\ MD_i^2)(365 - 42\,XMG_{i,CALV}) + 10\ \ XMG_{i,CALV}\ \ 42$$

where:
- REQ : Requirements per head,
- XMG : Output coefficient,
- AW : Average liveweight,
  for dairy cows : 600 kg,
  for suckler cows : 550 kg,
- FAT : Average fat content in milk (4%),
- MD : Milk production per lactation day,
  with: MD_i = ($XMG_{i,milk}$ +320) / (365 - $XMG_{i,CALV}$ 42),,
- i : Production activities (MILK, CALV),
- EN : Energy (NEL),
- PT : Protein,
- DM : Dry matter.

[92] The coefficient and basic assumptions are mostly taken from the following publications: K.H. Menke, W. Huss, Tierernährung und Futtermittelkunde, Stuttgart, 3. Aufl., 1987; M.Kirchgessner, Tierernährung, Frankfurt a. M., 7. Aufl., 1987; G. Burgstaller, Praktische Rinderfütterung, Stuttgart 1983; J.W. Becker, Aggregation in Landwirtschaftlichen Gesamtrechnungen über physische Maβstäbe - Futtergersteneinheiten als Generalnenner, Giessen, 1988; DLG-Merk-blatt 146, Fütterungshinweise für Geflügel mit Mischfutter nach DLG-Standard, Frankfurt 1982; DLG-Futterwerttabellen für Pferde, Frankfurt 1984; Kuratorium für Technik und Bauwesen in der Landwirtschaft, KTBL-Taschenbuch Landwirtschaft, Darmstadt 1984; Jahrbuch der Geflügelwirtschaft 1988; E. Reisch, J. Zeddies, Einführung in die Landwirtschaftliche Betriebslehre, spezieller Teil; Stuttgart, 2. Aufl., 1983; C. Gall, Ziegenzucht, Stuttgart, 1982; H. Späth, O. Thume, Ziegenhaltung, Stuttgart, 1986.

Adult male cattle for fattening:

Since the model, for simplification, only deals with one adult male cattle fattening production activity, and also for simplification it is assumed that all bulls in the course of the production period (one year) are used for meat production, only a simplified requirement function can be taken into account.

As a result, animals can only be fattened in the model for a maximum of 12 months. On the basis of an assumed initial weight of 350 kg and a daily increase of 1 kg (dw = 1), a maximum (minimum) final liveweight of 715 kg (360 kg) at the age of 2 (1) years can be reached. By applying a utilization coefficient of 0.54, the weight of the carcasses can lie between 195 and 386 kg: a realistic and acceptable range of fluctuation for the sectoral average.

In order to calculate the requirement functions, the fattening period is first calculated:

$$(102a) \quad DUF = \frac{XMG_{BEEF,BEEF} \, / \, 0.54 - 350}{dw_{fattening}}$$

and at least 10 days', or a maximum of 365 days' fattening period is allowed:

$$10 < DUF < 365$$

The animal requirements are then calculated as follows:

$$(102b) \quad REQ_{BEEF,EN} = 0.112\left(\left(350 + \frac{DUF\, dw}{2}\right)^{0.75} + 42.8\, dw + rc - 20\right)DUF$$

$$(102c) \quad REQ_{BEEF,PT} = REQ_{BEEF,EN}\left(0.015 - 0.00001\left(350 + \frac{DUF\, dw}{2}\right)^{0.75}\right)$$

$$(102d) \quad REQ_{BEEF,DM} = 0.075\left(350 + \frac{DUF\, dw}{2}\right)^{0.75} DUF$$

where:
- REQ : Requirements per head,
- XMG : MAC output coefficient,
- DUF : Fattening period (days),
- dw : Daily weight increase (kg),
- rc : Breed constant (3, ..., 10)
  with: 3 for Deutsche Schwarzbunte
  10 for British Fresian, Charolais, etc,
- EN : Energy, metabolisable,
- PT : Protein,
- DM : Dry matter.

Heifers for breeding and fattening:

Since for simplicity the model only deals with one heifer's production activity, and all animals are used for meat production and breeding in the course of the production period (1 year), the requirement function must be regarded as a simplified one.

As a result, animals can only be fattened for a maximum of 12 months according to the model. On the basis of an assumed initial liveweight of 300 kg and daily increase of 0.82 kg, a maximum (minimum) final liveweight at the age of two (one) of approximately 600 kg (310 kg) can be reached. On the basis of a utilization coefficient of 0.54, the weight of the carcass can vary between 166 kg and about 324 kg: a realistic and acceptable range of fluctuation for the sectoral average.

In the case of heifers for breeding, a feeding period of 365 days is assumed. The daily weight increase is split up. For female cattle in the age between 12 to 24 months (heifers), which are designated to become dairy cows with an average live weight of 600 kg (see equation 101) a daily weight increase of 0.82 kg is assumed. For heifers, which become other cows, a daily weight increase of 0.685 kg is assumed.

The following requirement functions for heifers are subdivided into three components :

- requirement for fattening,
- requirement for breeding dairy cows and
- requirement for breeding other cows.

According to the Output Generation of the ABTA for the production activity "Heifers", the used heifers have to be separated as follows :

(103a) $$HLEV_{DCOW} = XG_{HEIF,DCOW}$$

and

(103b) $$HLEV_{SCOW} = XG_{HEIF,SCOW}$$

and

(103c) $$HLEV_{BEEF} = LEVL_{HEIF} - HLEV_{DCOW} - HLEV_{SCOW}$$

In order to calculate the requirement function of slaughtered heifers, the average fattening weight and then the fattening period are calculated.

Fattening weight:

(104a) $$ACW_{HEIF} = \frac{XG_{HEIF,BEEF}}{HLEV_{BEEF}}$$

Fattening period :

(104b) $$DUF = \frac{ACW_{HEIF} / 0.54 - 300}{dw_{fattening}}$$

Between a minimum of 10 days to a maximum of 365 days is allowed for the fattening period.

$$10 < DUF < 365$$

The nutrient requirements of the heifers' production activity are firstly calculated for each separated part and secondly added to a weighted average requirement per animal.

- requirements for fattening :

(105a) $$REQ_{HEIF,EN,BEEF} = 0.112\left(300 + \frac{DUFdw}{2}\right)^{0.75} + 42.8\ dw_{fattening} + rc - 20$$

(105b) $$REQ_{HEIF,PT,BEEF} = 0.015 - 0.00001\left(300 + \frac{DUF\ dw}{2}\right)^{0.75}$$

(105c) $$REQ_{HEIF,DM,BEEF} = 0.075\left(300 + \frac{DUF\ dw}{2}\right)^{0.75}$$

- requirements for breeding:

(106a) $$REQ_{HEIF,EN,cow} = 0.112\left(300 + \frac{AW_{cow}}{2}\right)^{0.75} + 42.8\ dw_{cow} + rc - 20$$

(106b) $$REQ_{HEIF,PT,cow} = REQ_{HEIF,EN,cow}\left(0.015 - 0.00001\left(300 + \frac{AW_{cow}}{2}\right)^{0.75}\right)$$

(106c) $$REQ_{HEIF,DM,cow} = 0.075\left(300 + \frac{AW_{cow}}{2}\right)^{0.75}$$

- weighted requirement for heifers :

(107) $$REQ_{HEIF,f} = REQ_{HEIF,f,BEEF} DUF\ HLEV_{BEEF} + 365 \sum_{COW} REQ_{HEIF,f,COW}\ HLEV_{COW}$$

where:
REQ : Requirements per head,
XG : Output generation, ABTA, physical component,
$LEVL$: Production activity levels,
$HLEV$: Heifers' activity level, subdivision of LEVL,
ACW : Average carcass weight,
AW : Average live weight, ($AW_{DCOW} = 300$; $AW_{SCOW} = 250$)
DUF : Fattening period (days),
dw : Daily weight increase (kg), ($dw_{BEEF} = 0{,}82$; $dw_{DCOW} = 0{,}82$; $dw_{SCOW} = 0{,}685$)
rc : Breed constant (3, ..., 10)
with: 3 for Deutsche Schwarzbunt
10 for British Friesian, Charolais, etc.,
$HEIF$: Subscript, production activity heifers,
$BEEF$: Subscript, cattle meat product,
$DCOW$: Subscript, dairy cows,
$SCOW$: Subscript, suckler cows,
cow : Subscript, cows (cow = (DCOW, SCOW)),
EN : Subscript, nutrient content, energy,
PT : Subscript, nutrient content, protein,
DM : Subscript, nutrient content, dry matter,
f : Subscript, nutrient content, (f = (EN,PT,DM)).

Fattening of calves:

Since for simplicity the model only deals with a production activity for calf fattening for the period of a year, the requirement function must be regarded as a simplified one.

Consequently, the animals can only be fattened for a maximum of 12 months in the model. On the basis of an assumed initial liveweight of 65 kg and a daily increase of 1.4 kg, a maximum (minimum) final liveweight of about 576 kg (79) can be reached after one year. On the basis of a utilization coefficient of 0.60, the weight of the carcasses can vary from 47 kg to about 300 kg: a realistic and acceptable range of fluctuation for the sectoral average.

In order to calculate the requirement functions, the average fattening weight and fattening period are calculated for the slaughtered calves:

average carcass weight:

(108a) $$ACW_{CALF} = XMG_{CALF,VEAL}$$

average fattening period:

(108b) $$DUF = \frac{ACW_{VEAL} / 0.6 - 65}{dw}$$

and at least 10 days, or a maximum of 365 days fattening period is allowed:

$$10 < DUF < 365$$

The animal feed requirements are then computed for fattening, as follows :

(109a) $$REQ_{CALF,EN} = \left(0.52\left(65 + \frac{DUF\,dw}{2}\right)^{0.75} + 15dw\right) DUF$$

(109b) $$REQ_{CALF,PT} = \left(0.002857\left(65 + \frac{DUF\,dw}{2}\right)^{0.75} + 0.3857dw\right) DUF$$

(109c) $$REQ_{CALF,DM} = \frac{REQ_{CALF,EN}}{18.5}$$

where:
- REQ : Requirements per head,
- XMG : Output coefficient of MAC,
- ACW : Average carcass weight,
- DUF : Fattening period (days),
- dw : Daily weight increase (kg),
- $CALF$: Subscript, activity, cattle younger than 12 months for fattening,
- $VEAL$: Subscript, product, veal,
- EN : Subscript, nutrient content, energy,
- PT : Subscript, nutrient content, protein,
- DM : Subscript, nutrient content, dry matter.

Rearing of calves :

For rearing of calves the nutrient requirement includes the rearing of calves into heifers and male adult cattle (bulls). It is assumed that the period in which a calf is fed by a cow covers 42 days. The raising period of the production activity "Calves, rearing" begins on the 43rd day. This raising period is split into two subperiods : in the first one (143 days), the calves are raised from an initial live weight of 65 kg, with a daily weight increase of 0.7 kg; in the second one (180 days), they are raised with a daily weight increase of 0.7 kg for females and 1.0 kg for males. With these daily weight increases they have reached the initial liveweight for the production activities of male and female cattle older than 12 months. The daily weight increase is assumed :

$$\begin{aligned} &dw_{all} && = 0.7 \; for \; 143 \; days \\ &dw_{male} && = 1.0 \; for \; 180 \; days \\ &dw_{female} && = 0.7 \; for \; 180 \; days \\ &initial\ live\ weight = 65kg \end{aligned}$$

The nutrient requirements calculated as follows :

- first 143 days :

(110a) $$REQ1_{RCAL,EN} = \left(0.52\left(65 + \frac{100}{2}\right)^{0.75} + 15 \; dw_{all}\right) 143$$

(110b) $$REQ1_{RCAL,PT} = \left(0.003279\left(65 + \frac{100}{2}\right)^{0.75} + 0{,}2879 \; dw_{all}\right) 143$$

- last 180 days :

(110c) $$REQ2_{RCAL,EN,female} = \left(0.112\left(165 + \frac{135}{2}\right)^{0.75} + 42.8 \; dw_{female} \; XMG_{RCAL,HEIF}\right) 180$$

(110d) $$REQ2_{RCAL,EN,male} = \left(0.153\left(165 + \frac{185}{2}\right)^{0.75} + 31.7 \; dw_{male} \; XMG_{RCAL,BULL} + rc - 20\right) 180$$

(110e) $$REQ2_{RCAL,PT,female} = REQ2_{RCAL,EN,female}\left(0.015 - 0.00001\left(165 + \frac{135}{2}\right)^{0.75}\right)$$

(110f) $$REQ2_{RCAL,PT,male} = REQ2_{RCAL,EN,male}\left(0.015 - 0.00001\left(165 + \frac{185}{2}\right)^{0.75}\right)$$

- whole raising period :

(111a) $$REQ_{RCAL,f} = REQ1_{RCAL,f} + REQ2_{RCAL,f,female} + REQ2_{RCAL,f,male}$$

(111b) $$REQ_{RCAL,DM} = \frac{REQ_{RCAL,EN}}{10}$$

where: REQ : Requirements per head,
$REQ1$: Requirements per head (first 143 days),
$REQ2$: Requirements per head (last 180 days),
XMG : Output coefficient of MAC,
DUF : Fattening period (days),
dw : Daily weight increase (kg),(dw_{all} = 0.7; dw_{male} = 1.0; dw_{female} = 0.7)
$RCAL$: Subscript, activity, rearing of calves,
$HEIF$: Subscript, product, heifers,
$BULL$: Subscript, product, male adult cattle,
EN : Subscript, nutrient content, energy,
PT : Subscript, nutrient content, protein,
DM : Subscript, nutrient content, dry matter,
rc : Breed constant (3, ..., 10)
with: 3 for Deutsche Schwarzbunt
10 for British Friesian, Charolais, etc,
f : Subscript, nutrient content, (f = (EN,PT)).

3.7.5.3.2. Pigs

Pig Breeding

The requirements for "Pig Breeding" they do not only contain the nutrient demand of sows. According to the definition of the production activity, it also cover the feed requirements for young sows, piglets and boars (assumed 1 %), according to the ratio of these animals relative to sows.

In order to calculate the requirement functions, the average replacement rate of a sow for the year is calculated on the basis of equation 20b :

$$\text{(112a)} \quad RYSO = \frac{(YSO_a + YSO_b + YSO_c)/3}{LEVL_{PIGL}}$$

The animal requirements are then calculated as follows:

$$\text{(112b)} \quad REQ_{PIGL,EN} = (9184 + 4729\ RYSO + 533\ XMG_{PIGL,PIGL})(1 + BOARS / LEVL_{PIGL})$$

$$\text{(112c)} \quad REQ_{PIGL,PT} = (88.4 + 52.4\ RYSO + 6.99 XMG_{PIGL,PIGL})(1 + BOARS / LEVL_{PIGL})$$

$$\text{(112d)} \quad REQ_{PIGL,DM} = (1005 + 411\ RYSO + 19.5\ XMG_{PIGL,PIGL})(1 + BOARS / LEVL_{PIGL})$$

where: REQ : Requirements per head,
$LEVL$: Production activity levels,
XMG : Output coefficient of MAC,
$RYSO$: Annual average of replacement,
$BOARS$: Livestock data for boars,
YSO : Maiden gilts,
a,b,c : Subscript, observation month April, August, December,
$PIGL$: Subscript, activity, sows and product pigletts,
EN : Subscript, nutrient content, energy,
PT : Subscript, nutrient content, protein,
DM : Subscript, nutrient content, dry matter.

Pigs for Fattening

Pig fattening is based on an initial liveweight of 20 kg, a daily weight increase of 0.55 kg and a utilization coefficient of 0.80.

To calculate the requirement functions, the fattening period is calculated for the slaughtered pigs as follows:

(113a) $$DUF = \frac{XMG_{PORK,PORK} / 0.8 - 20}{dw}$$

A minimum of 10 days and maximum of 365 days fattening period is allowed:

$$10 < DUF < 365$$

A maximum of 100 kg of liveweight is assumed by the calculation of the protein requirements:

$$AWP = \left(20 + \frac{DUFdw}{2}\right)^{0.75}$$

with: $AWP \leq 100$

The animal requirements are then calculated as follows:

(113b) $$\mathrm{REQ_{PORK,EN}} = \left(0.228\left(20 + \frac{\mathrm{DUF\ dw}}{2}\right)^{0.75} + 21.6\,\mathrm{dw} - 1.83\right)\mathrm{DUF}$$

(113c) $$REQ_{PORK,PT} = (0.18\,AWP\ \ 0.00055)REQ_{PORK,DM}$$

(113d) $$REQ_{PORK,DM} = \left(0.095\left(20 + \frac{DUF\ dw}{2}\right)^{0.75}\right) DUF$$

where:
- REQ : Requirements per head,
- XMG : Output coefficient of MAC,
- DUF : Fattening period (days),
- AWP : Average live weight for protein requirements,
- dw : Daily weight increase (kg),
- $PORK$: Subscript, product pork and activity pig fattening,
- EN : Subscript, nutrient content, energy,
- PT : Subscript, nutrient content, protein,
- DM : Subscript, nutrient content, dry matter.

3.7.5.3.3. Poultry

Laying hens:

For laying hens, calculations are based on an average liveweight of 1.9 kg and a replacement rate of 0.8 (ratio of young hens to laying hen livestock).The requirement functions are therefore calculated as follows:

(114a) $$REQ_{EGGS,EN} = (0.475(1.9^{0.75}) + 0.018)365 + 104.02(0.8) + 9.6\,XMG_{EGGS,EGGS}$$

(114b) $$REQ_{EGGS,PT} = (0.0035(1.9^{0.75}))365 + 1.33(0.8) + 0.25\,XMG_{EGGS,EGGS}$$

(114c) $$REQ_{EGGS,DM} = 0.11(365) + 8.14(0.8)$$

where: REQ : Requirements per head,
XMG : Output coefficient of MAC,
$EGGS$: Subscript, product eggs and activity laying hens,
EN : Subscript, nutrient content, energy,
PT : Subscript, nutrient content, protein,
DM : Subscript, nutrient content, dry matter.

Poultry for Fattening

The requirement function for poultry fattening production activity shows the nutrient demand for an average animal (weighted average for broilers, geese, ducks and turkeys). An average utilization coefficient of 0.8 is taken as a basis so that the requirement functions are calculated as follows:

(115a) $$REQ_{POUL,EN} = 0.0063\left(1000\left(\frac{XMG_{POUL,POUL}}{0.8}\right)^{0.75}\right)^{1.186}$$

(115b) $$REQ_{POUL,PT} = 0.0907\left(1000\left(\frac{XMG_{POUL,POUL}}{0.8}\right)^{0.75}\right)^{1.22}$$

(115c) $$REQ_{POUL,DM} = 0.1940\left(1000\left(\frac{XMG_{POUL,POUL}}{0.8}\right)^{0.75}\right)^{1.2936}$$

where: REQ : Requirements per head,
XMG : Output coefficient of MAC,
$POUL$: Subscript, production activity, poultry for fattening,
EN : Subscript, nutrient content, energy,
PT : Subscript, nutrient content, protein,
DM : Subscript, nutrient content, dry matter.

The coefficients of the functions (115) are defined as yields (in grams).

3.7.5.3.4. Sheep and goats

Ewes and mother goats

In the model, ewes and mother goats are combined into one production activity (MUTM). Calculations are based on an average liveweight of 65 kg per animal and an additional grazing movement requirement of 20%.The requirement functions are therefore calculated as follows:

(116a) $$REQ_{MUTM,EN} = 0.4\,(65^{0.75})\,1.20\;\;365 + 320\,XMG_{MUTM,LAMB} + 2941\frac{LAMB}{LEVL_{MUTM}} + 7.5\,XMG_{MUTM,MUTM}$$

(116b)

$$REQ_{MUTM,PT} = 0.004\ (65^{0.75})\ 1.20\ \ 365 + 2\frac{\mathrm{XMG}_{\mathrm{MUTM,LAMB}}}{0.42} + 30.596\frac{\mathrm{LAMB}}{\mathrm{LEVL}_{\mathrm{MUTM}}} + 0.056\frac{XMG_{MUTM,MUTM}}{0.42}$$

(116c) $$REQ_{MUTM,DM} = (0.5 + 0.01\ (65^{0.75})\ 1.20)\ 365 + 123.5 + \frac{\mathrm{XMG}_{\mathrm{MUTM,MUTM}}}{10}$$

where:
- REQ : Requirements per head,
- XMG : Output coefficient of MAC,
- $LAMB$: Lambs and kids for replacement (equation 34b),
- $LEVL$: Production activity level,
- $MUTM$: Subscript, ewes and goats activity and product milk,
- $LAMB$: Subscript, lambs and kids,
- EN : Subscript, nutrient content, energy,
- PT : Subscript, nutrient content, protein,
- DM : Subscript, nutrient content, dry matter.

Fattening of sheep and goats:

Fattening of sheep and goats is based on an initial liveweight of 5 kg, a daily increase in weight of 0.25 kg and a utilization coefficient of 0.60 and an additional grazing movement requirement of 20%.

To calculate the requirement functions, the fattening period is calculated for the slaughtered lambs and kids as follows:

(117a) $$DUF = \frac{XMG_{MUTM,MUTM} / 60 - 5}{dw}$$

The fattening period can be a minimum of 10 days and a maximum of 365 days:

$$10 \le DUF \le 365$$

The animal requirements are then calculated as follows:

(117b) $$REQ_{MUTT,EN} = \left(0.430\left(5 + \frac{DUF\ dw}{2}\right)^{0.75} 1.20 + 20\ dw \right) DUF$$

(117c) $$REQ_{MUTT,PT} = \left(0.004\left(5 + \frac{DUF\ dw}{2}\right)^{0.75} + 0.16\ \frac{dw}{0.42} \right) DUF$$

(117d) $$REQ_{MUTT,DM} = \left(0.1\left(5 + \frac{DUF\ dw}{2}\right)^{0.75} 1.20 \right) DUF$$

where:
- REQ : Requirements per head,
- XMG : Output coefficient of MAC,
- DUF : Fattening period (days),
- dw : Daily weight increase (0.25 kg),
- $MUTT$: Subscript, activity sheep and goats fattening and of product sheep and goats meat,

EN : Subscript, nutrient content, energy,
PT : Subscript, nutrient content, protein,
DM : Subscript, nutrient content, dry matter.

3.7.5.3.5. Other animals

The production activity "other animals" reflects the requirements for horses on a constant basis:

(118a) $$REQ_{OANI,EN} = 23434$$

(118b) $$REQ_{OANI,PT} = 259.93$$

(118c) $$REQ_{OANI,DM} = 2399$$

where: REQ : Requirements per head,
$OANI$: Subscript, activity other animal products,
EN : Energy requirements,
PT : Protein requirements,
DM : Dry matter requirements.

The nutrient requirements of the animals used for annual animal production are set out in the above equations in such a way as to allow the input coefficients to be specified within the framework of the NLP described above.

3.7.5.3.6. Consideration of imported animals

In principle, the imports of animals for slaughter are considered in the ABTA, MAC and the production activity levels. A lot of information is still unavailable about these animal imports (e.g. initial carcass liveweight, feeding period, etc...) and thus the calculation of the nutrient requirements. Therefore, only domestically much produced animals are fed in the EU-Model.

For consistency between the ABTA (MAC) components, the levels of production activity have to include imported animals (see chapter 3.3.3). On the other hand, feed costs for each activity would be overestimated if the feed use for imported animals was calculated with the same requirement function as that for the domestic animals.

Therefore, if animals are imported, the nutrient requirements are adjusted with a correction factor :

If $YG_{TRAP,h'} > 0$,

then

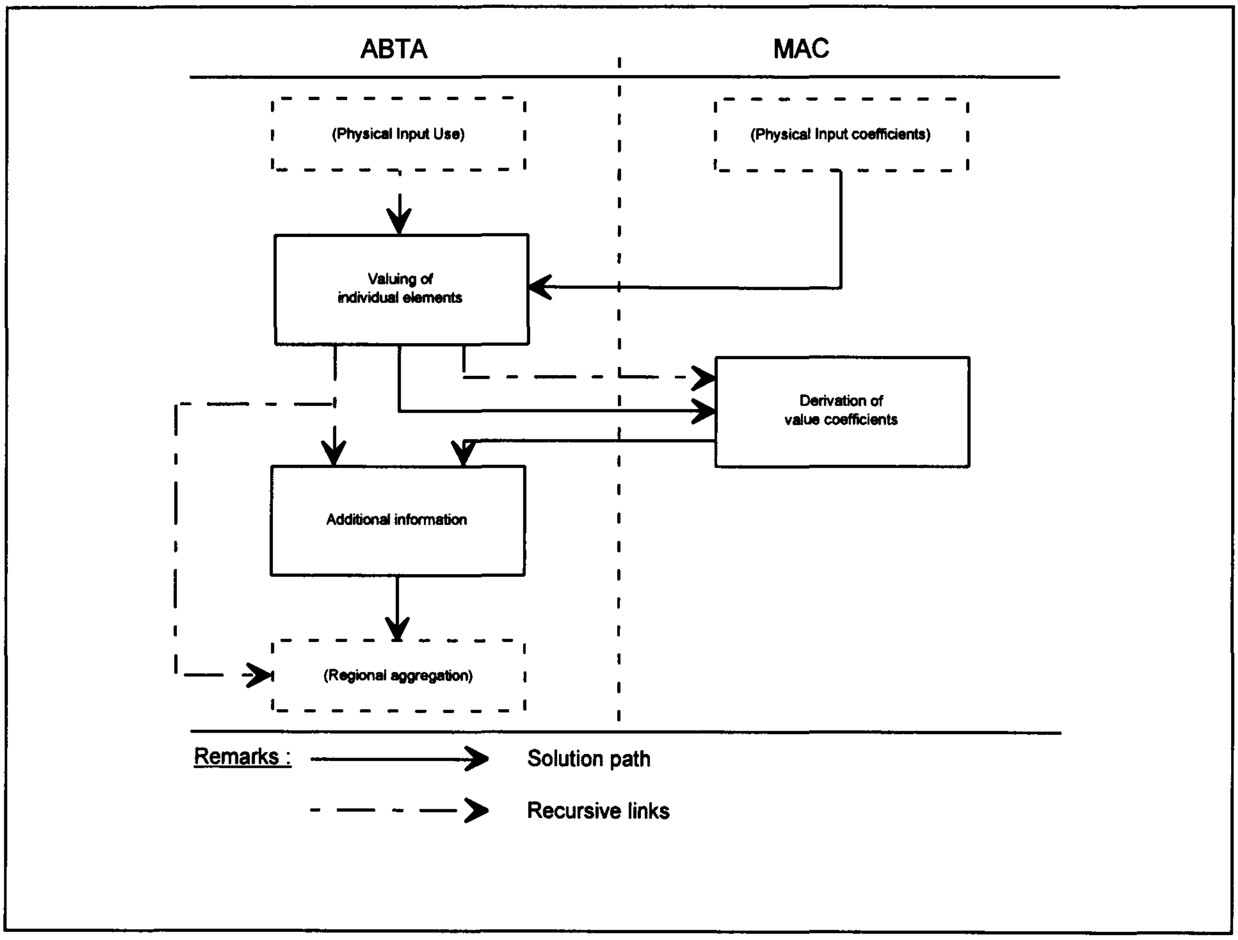
(119) $$R_{h'} = 1 - \frac{\mathrm{YG}_{\mathrm{TRAP,h'}}}{\sum_{\mathrm{k'}} \mathrm{YG}_{\mathrm{k',h'}}}$$

where: R : Factor to adjust the nutrient requirements,
YG : Input Generation, ABTA, physical component,
$TRAP$: Subscript, resource activity, purchases,
h' : Subscript, input items, live animals, (h' = (ICAL, ..., ICHI)),
k' : Subscript, resource activity, live animals on farm, (k' = (CALP,..., CHIP)).

In accordance with activity level calculations (chapter 3.3.3), this factor for live animals is applied to the related requirements of production activity.

3.8. Value components of ABTA and MAC

Figure 15: Scheme of the solution of the valued components of ABTA/MAC



All elements measured in physical units:

- Output Generation for ABTA and MAC (XG, XMG),
- Output Use for ABTA (XU),
- Input Generation for ABTA and (YG),
- Input Use for ABTA and MAC (YU, YMU)

are available in a consistent numerically specified form. In this context, "consistent" means that the data mathematically satisfy the equation system (PART 1, Basics, figures 5 and 7) and are plausible and realistic in both economic and production technological terms.

The producer and purchase prices for the sectoral average are also available: for the intersectoral interactions (farmgate price) and intrasectoral interactions (internal use price). From the latter two, the weighted average price (unit value price) was formed which is used for evaluating the Output Generation (ABTA and MAC) and the Input Use (ABTA and MAC) in order to be able to calculate a consistent gross value added at market prices (GVAM) [93].

Figure 15 illustrates the inter-relationships and sequence of the other stages involved in producing the ABTA and MAC for the EU Member States.

Since they have the same structure, the valued components of the ABTA and MAC are calculated, like the physical components by multiplying the physical elements with the corresponding prices, so that for equation systems of ABTA and MAC we have the following:

for the ABTA:

(120a) $$OG_{i,j} = XG_{i,j} PG_j$$

(120b) $$OU_{k,j} = XU_{k,j} PU_{k,j}$$

(120c) $$IG_{k,h} = YG_{k,h} QG_{k,h}$$

(120d) $$IU_{i,h} = YU_{i,h} QU_h$$

for the MAC:

(121a) $$OMG_{i,j} = \frac{OG_{i,j}}{LEVL_i}$$

(121b) $$IMU_{i,h} = \frac{IU_{i,h}}{LEVL_i}$$

where:
- XG : Output Generation, ABTA, physical component,
- XU : Output Use, ABTA, physical component,
- YG : Input Generation, ABTA, physical component,
- YU : Input Use, ABTA, physical component,
- OG : Output Generation, ABTA, valued component,
- OU : Output Use, ABTA, valued component,
- IG : Input Generation, ABTA, valued component,
- IU : Input Use, ABTA, valued component,
- XMG : Output Generation, MAC, physical component,
- YMU : Input Use, MAC, physical component,
- OMG : Output Generation, MAC, valued component,
- IMU : Input Use, MAC, valued component,
- PG : Unit value producer price for Output Generation,
- PU : Producer prices for Output Use,
- QG : Purchase prices for Input Generation,
- QU : Unit value purchase prices for Input Use,
- i : Subscript, production activity, ABTA, ((i = (1, ..., n)),
- j : Subscript, products, ABTA (j = (1, ..., m)),

[93] These GVAM data should be interpreted as income indicators and reflect the gross payments to the primary factors (land, labour and capital).

k : Subscript, use activity, ABTA, (k = (n+1,..., N)),
h : Subscript, input items, ABTA, (h = (m+1,..., M)).

In a final stage, because of the structure of the equation systems, the mathematical consistency is checked by adding the evaluated column and line elements of the evaluated ABTA, and any discrepancies are identified for manual revision.

3.9. Additional aggregates and other information

Past experience in working with SPEL/EU-Data has shown that a need for additional data aggregations and further information often arises in the course of particular applications. To meet this need, aggregated data and further information have been provided for the ex-post period as part of the SPEL/EU-Data.

These include the following:

- all EAA data ranging from the different production values and intermediate input, subsidies, etc. for calculating sectoral gross and net value added, to net value added at factor cost;
- the agricultural workforce is measured in annual work units (AWU) for the whole sector;
- ECU exchange rates for the national currencies;
- various data from the integrated economic accounts, such as:

gross domestic product (GDP)
GDP price index
GDP physical production volume index
purchasing power standards (PPS)
number of inhabitants of the Member States
consumer expenditure on food.

These data come from the appropriate domains of the CRONOS databank and have been added to the SPEL/EU-Data.

According to the ABTA definition, individual aggregates are provided in physical terms or as calculations. The following should be mentioned in particular:

- gross production value for the whole sector and for each item produced and used,
- the physical equivalents of the EAA production and intermediate input aggregate definitions,
- total land use data,
- aggregated market demand and resources of raw and processed products.

This additional information simplifies ex-post analytical work based on the SPEL/EU-Data and is partly used for the ex-ante simulations based on the SPEL/EU-Data[94].

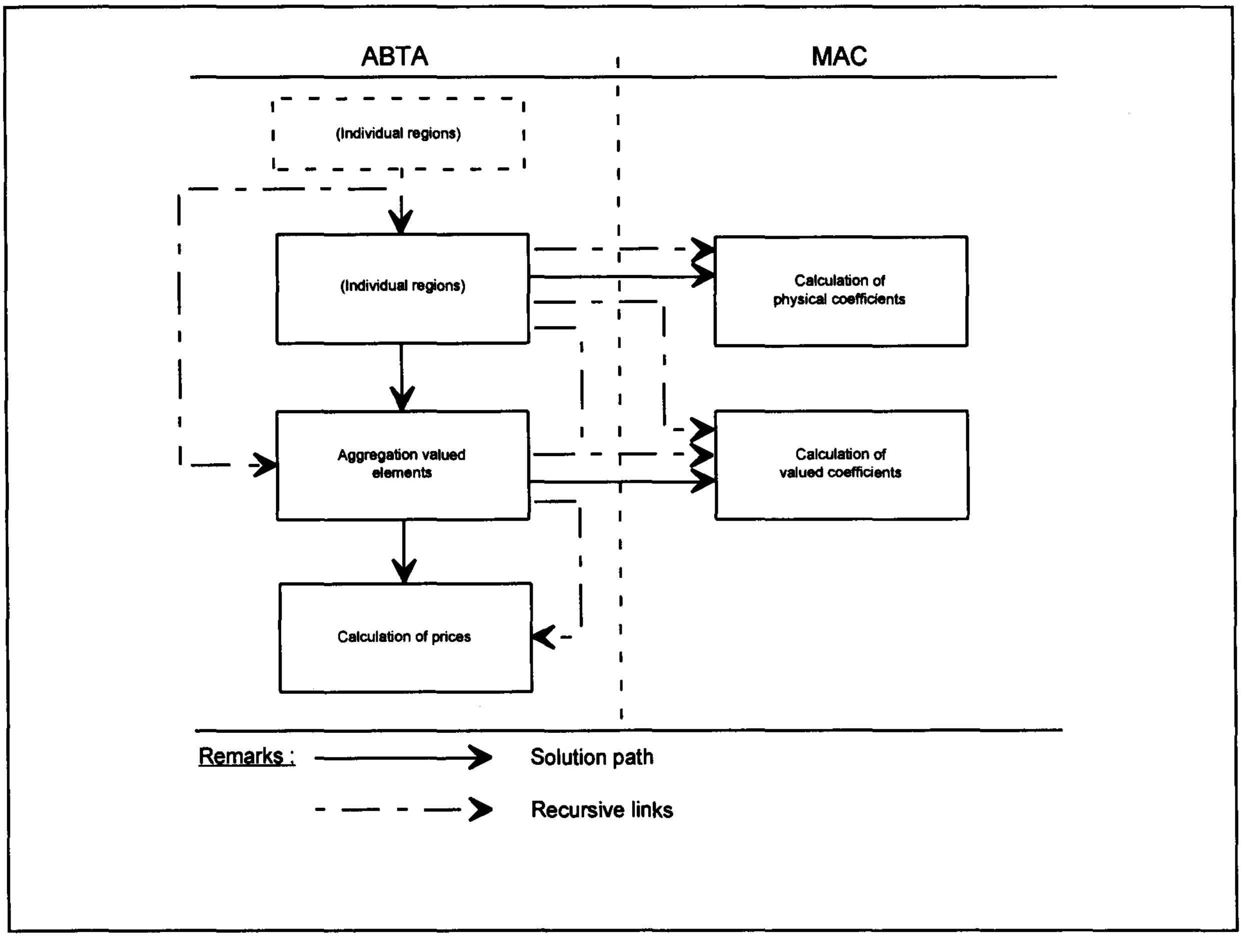
[94] see SPEL System, Methodological documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 3: SFSS and see SPEL System, Methodological documentation (Rev. 1), Vol. 2: MFSS.

3.10. Regional aggregation

The work described so far on numerical specification of the physical and valued ABTA and MAC is without exception implemented sequentially for each agricultural sector of the EU.

Figure 16 provides a review of the interrelationships and sequence of the regional aggregation stages for producing the ABTA and MAC for the EU as a whole.

Figure 16: Scheme of the solution of regional aggregation of ABTA/MAC



The aggregation of these ABTAs and MACs for the EU Member States is performed after completion and checking of the previous steps. The aggregation of these regional ABTAs and MACs is performed for the current EU as a whole[95].The calendar years 1973 up to 1990 represent Germany within the frontiers before third of October 1990. Beginning with the year 1991 the unified Germany is represented. Therefore the EU as a whole envolves this unification break, too.

95 Work is currently under way on the inclusion in the three new EU Memberstates since 1 st of January 1995.

3.10.1. ABTA and MAC physical components

Since they use the same unit of measure (kg, hectare, etc.) the ABTA and MAC physical component can be calculated for the aggregates EUR 12 and EUR 15 by simple addition. Since the basic figures are consistent and plausible, it can be assumed that the aggregated data will be consistent and plausible. This gives us the following for each calendar year:

for the ABTA:

(122a) $$XG_{EU,i,j} = \sum_{MS} XG_{MS,i,j}$$

(122b) $$XU_{EU,\mathrm{k},j} = \sum_{MS} XU_{MS,k,j}$$

(122c) $$YG_{EU,\mathrm{k},\mathrm{h}} = \sum_{MS} YG_{MS,k,h}$$

(122d) $$YU_{EU,\mathrm{i},\mathrm{h}} = \sum_{MS} YU_{MS,i,h}$$

and for the additional demand component:

(122e) $$DR_{EU,r,p} = \sum_{MS} DR_{MS,r,p}$$

(122f) $$DU_{EU,\mathrm{u},p} = \sum_{MS} DU_{MS,\mathrm{u},p}$$

for the MAC, the production activity levels are added up and then the aggregated parts of the ABTA divided as follows:

(123a) $$LEVL_{EU,i} = \sum_{\mathrm{MS}} LEVL_{MS,i}$$

(123b) $$XMG_{EU,i,j} = \frac{\mathrm{XG}_{\mathrm{EU,i,j}}}{\mathrm{LEVL}_{\mathrm{EU,i}}}$$

(123c) $$YMU_{EU,i,h} = \frac{\mathrm{YU}_{\mathrm{EU,i,j}}}{\mathrm{LEVL}_{\mathrm{EU,i}}}$$

where:
- XG : Output Generation, ABTA, physical component,
- XU : Output Use, ABTA, physical component,
- YG : Input Generation, ABTA, physical component,
- YU : Input Use, ABTA, physical component,
- DR : Resources, demand component of ABTA, physical,
- DU : Uses, demand component of ABTA, physical,
- XMG : Output Generation, MAC, physical component,
- YMU : Input Use, MAC physical component,
- $LEVL$: Production activity level,
- MS : Subscript, EU Member States,

i : Subscript, production activity, ABTA, (i = (1, ..., n)),
j : Subscript, products, ABTA, (j = (1, ..., m)),
k : Subscript, use activity, ABTA, (k = (n+1,...,N)),
h : Subscript, input items, ABTA, (h = (m+1,...M)),
r : Subscript, resource activity, demand component (all),
p : Subscript, raw and processed products, demand component (all),
u : Subscript, use activity, demand component (all).

It should also be noted that the elements of the ABTA and MAC part measured in constant prices are converted before aggregation with the exchange rates (ecu/national currency) of the base year into ecus at a constant exchange rate.

3.10.2. Value parts of ABTA and MAC

Because they are expressed in national currency (NC), the value components of the ABTA and MAC must be converted into ECUs before aggregation to EUR 12 and EUR 15 level. This is done each calendar year as follows:

for the ABTA:

(124a) $$OG_{EU,i,j} = \sum_{MS} OG_{MS,i,j} EXRA_{MS}$$

(124b) $$OU_{EU,k,j} = \sum_{MS} OU_{MS,k,j} EXRA_{MS}$$

(124c) $$IG_{EU,k,h} = \sum_{MS} IG_{MS,k,h} EXRA_{MS}$$

(124d) $$IU_{EU,i,h} = \sum_{MS} IU_{MS,i,h} EXRA_{MS}$$

for the MAC, the aggregated valued parts of the ABTA are divided by the aggregated production activity levels:

(125a) $$OMG_{EU,i,j} = \frac{OG_{EU,i,j}}{LEVL_{EU,i}}$$

(125b) $$IMU_{EU,i,j} = \frac{IU_{EU,i,h}}{LEVL_{EU,i}}$$

where:
OG : Output Generation, ABTA, valued component,
OU : Output Use, ABTA, valued component,
IG : Input Generation, ABTA, valued component,
IU : Input Use, ABTA, valued component,
OMG : Output Generation, MAC, valued component,
IMU : Input Use, MAC, valued component,
$LEVL$: Production activity level,
$EXRA$: Exchange rate (ECU/NC),
MS : Subscript, EU Member States,
i : Subscript, production activity, ABTA, (i = (1, ..., n)),
j : Subscript, products; ABTA, (j = (1, ..., m)),
k : Subscript, use activity, ABTA, (k = (n+1,..., N)),
h : Subscript, input items, (h = (m+1,..., M)),
NC : National Currency.

The prices are subsequently calculated on a consistent basis from the regionally aggregated components.

3.10.3. Prices

The prices for evaluating intra- and intersectoral interaction are calculated from the regionally aggregated parts of the ABTA in order to satisfy the equation systems of ABTA and MAC and to obtain, for the regionally aggregated level, weighted price data which are comparable with the sub-regions (Member States).

The calculation is as follows:

(126a) $$PG_{EU,j} = \frac{\sum_{i} \mathrm{OG}_{\mathrm{EU,i,j}}}{\sum_{i} \mathrm{XG}_{\mathrm{EU,i,j}}}$$

(126b) $$PU_{EU,\mathrm{k},j} = \frac{\mathrm{OU}_{\mathrm{EU,k,j}}}{\mathrm{XU}_{\mathrm{EU,k,j}}}$$

(126c) $$QG_{EU,\mathrm{k},j} = \frac{\mathrm{IG}_{\mathrm{EU,k,h}}}{\mathrm{YG}_{\mathrm{EU,k,h}}}$$

(126d) $$QU_{EU,\mathrm{h}} = \frac{\sum_{i} \mathrm{IU}_{\mathrm{EU,i,h}}}{\sum_{i} \mathrm{YU}_{\mathrm{EU,i,h}}}$$

where:
XG : Output Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
YU : Input Use, ABTA, physical component,
OG : Output Generation, ABTA, valued component,
OU : Output Use, ABTA, valued component,
IG : Input Generation, ABTA, valued component,
IU : Input Use, ABTA, valued component,
PG : Unit value producer prices for Output Generation,
PU : Producer prices for Output Use,
QG : Purchase prices for Input Generation,
QU : Unit value purchase prices for Input Use,
i : Subscript, production activity, ABTA, (i = (1, ..., n)),
j : Subscript, products; ABTA, (j = (1, ..., m)),
k : Subscript, use activity, ABTA, (k = (n+1,...,N)),
h : Subscript, input items, ABTA, (h = (m+1,...,M)),
EU : Subscript, regional aggregates, (EUR 12, EUR 15).

The result of these regional aggregations are a consistent data base for the EU as a whole.Comparisons of analytical and simulation results between Member States, and between the Member States and the EU as a whole can therefore be performed.

3.11. Summary

The SPEL/EU Base Model (BM) constitutes the basis for the different model versions of the SPEL/EU-Model. It integrates the various sources of information (official statistics, farm survey data, calculation data, etc.), but it is more than a "data bank"; it is itself a "model", designed to describe the production structure and flows within the agricultural sector.

The model is based on the concept of sectoral accounting in the framework of the Activity Based Table of Accounts (ABTA) and the Matrix of Activity Coefficients (MAC)[96]. It specifies the yearly ABTA and MAC for the ex-post period (beginning with 1973). The Base Model can be understood as the core of a Social Accounting Matrix (SAM) focusing on the agricultural sectors of the EU Member States and the EU as a whole.

The Base Model cannot be numerically specified directly on the basis of official statistical data. The sets of input and output coefficients, activity levels, intra- and intersectoral product flows, input and output prices have to be derived step by step using in an interactive approach, applying various principles and categories of data[97] and using consistency checking and data processing procedures.

[96] see SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.
[97] see SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

ANNEXES

ANNEX 1

LIST OF ABBREVATIONS

4. ANNEX 1: LIST OF ABBREVATIONS

ABTA	=	Activity Based Table of Account
ACW	=	Average carcass weight
AW	=	Average live weight
a,b,c	=	Subscript, observation month, April, August, December
avf	=	Availability factor
BR	=	Use of eggs, broilers
BULL	=	Male adult
by	=	Base year
CALV	=	Calves born for fattening
CAP	=	Common Agricultural Policy
CHI	=	Chicks for laying
COS	=	Total fertilizer cost per unit area
CRONOS	=	Data bank of Eurostat
CYL	=	Main areas crop year data
CYP	=	Crop year production data
c	=	Constant factor
DCOW	=	Dairy cows produced
DM	=	Subscript, nutrient content, dry matter
DP	=	Data Preparation of the SPEL/EU-Model
DS	=	Use of eggs, ducks
DU	=	Uses, demand component of ABTA, physical
DUF	=	Fattening period (days)
dw	=	Daily weight increase (kg)
EAA	=	Economic Accounts for Agriculture
EU	=	European Union
ECU	=	European Currency Unit
EXP	=	Exports
EXRA	=	Exchange rate (ECU/NC)
FA	=	Fed animals
FADN	=	Farm accountancy data network
FAT	=	Average fat content in milk (4 %)
FS	=	Final stock
f	=	Subscript, nutrient content
GDP	=	Gross Domestic product
GIP	=	Gross indigenous production

GO	=	Use of eggs, geese
h	=	Subscript input items, ABTA (h = (m+1, ..., M))
HLEV	=	Heifers' activity level, subdivision of LEVL
IG	=	Input Generation ABTA, valued component
IMP	=	Imports
IMU	=	Input Use of MAC, valued component
IU	=	Input Use of ABTA, valued component
i	=	Subscript, production activity, ABTA, (i = (1, ..., n))
j	=	subscript for products (lines)
k	=	Subscript use activity (k = (n+1, ..., N))
LAM	=	Lambs and kids for replacement,
LEVL	=	Production activity level
LU	=	Livestock unit
M	=	Subscript, number of products and input items, table lines
MAC	=	Matrix of Activity Coefficients
MD	=	Milk production per lactation day
MF	=	Milk for feeding
MFSS	=	Medium-term Forecast and Simulation System
MS	=	Subscript EU Member State
m	=	Subscript, number of products, table lines
NIT	=	Subscript, nitrogen nutrient content
NIP	=	Net indigenous production
n	=	Subscript, number of production activities, table columns
nuc	=	Nutrient content of crop products
OG	=	Output Generation of ABTA, valued component
OMG	=	Output Generation of MAC, valued component
PCM	=	Coefficient of manure
PG	=	Unit value, producer prices for Output Generation
PIME	=	Resource activity, intra EU imports
PPS	=	Purchasing Power Standards
PT	=	Subscript, nutrient content, protein
PU	=	Producer prices for Output Use
PV	=	Producer value, EAA, at current prices
QC	=	Price of Standard ratio
QG	=	Purchase prices for Input Generation
QU	=	Unit value purchase price for Input Use
R	=	Distribution factor

REQ	=	Total nutrient requirements per animal
RFP	=	Dry matter requirement
RLEVL	=	Activity level for SR
RQP	=	Nutrient content per feed product
RYSO	=	Animal average of replacement
r	=	Distribution factor, constant
rc	=	Breed constant (3, ..., 10)
SBS	=	Supply balance sheet
SCOW	=	Suckler cows produced
SEC1	=	CRONOS domain, National accounts aggregates
SFSS	=	Short-term Forecast and Simulation System
SGM	=	Standard gross margin
SLH	=	Hens slaughtered
SPEL	=	Sektorales Produktions- und Einkommensmodell der Landwirtschaft (Sectoral Production and Income Model of Agriculture)
SPEL/EU	=	SPEL for the European Union
SPEL/EU-Data	=	Results of the SPEL/EU-Model, consistent data
SR	=	Fed dry matter content by Standard ratio
SSO	=	Sows slaughtered
TSC	=	Total sectoral costs for feedingstuff
TU	=	Use of chicks, turkey
t	=	Subscript, calendar year
t/t+1	=	Subscript, crop year
U	=	Subscript, number of use activities, demand, table columns
u	=	Subscript for market use activity
usr	=	Scaled dry matter feed coefficient
XG	=	Output Generation, ABTA, physical component
XMG	=	Output Generation, MAC, physical component
XU	=	Output Use, ABTA, physical component
YG	=	Input Generation, ABTA, physical component
YMU	=	Input Use, MAC, physical component
YMUH	=	Hypothetical Input Use, MAC, physical component
YSO	=	Maiden gilts
YU	=	Input Use, ABTA, physical component
YUH	=	Hypothetical Input Use, ABTA, physical component
YUTH	=	Total hypothetical requirements
ZPA1	=	CRONOS domain; production, balances and foreign trade of agricultural products

ANNEX 2

LIST OF CODES FOR DATA EXTRACTION
OF THE
SPEL/EU-MODEL

5. ANNEX 2: LIST OF CODES FOR DATA EXTRACTION OF THE SPEL/EU-MODEL

5.1. Preface:

As far as possible, the EU-Model data for the representing period, beginning with 1973 to the current year, so called SPEL/EU-Data is based on statistically observed data.

In the Data Preparation work step of the EU-Model these statistical data are extracted from several sources, mainly the CRONOS data bank of Eurostat. The whole list for extraction is available in the SPEL group, Eurostat. In the following of this annex an example is shown. If available, the listed data are extracted for each region (Member State) and for each year of the representation period. These data are used in the Base Model to generate the consistent data for ex-post representation (SPEL/EU-Data).

The following list is sorted accordingly to the supply and demand oriented tables, crop and animal data, and the different statistical sources (mainly SPEL/EU code is given and also the original one available and if a long text description).

For standardization of the measurement unit some times a factor is used, which is given in the column just before ";". By interpretation of the long text, this factor has to be taken into account, e.g. the "PROP TWIN" data is converted by data instruction from "1.000 hectolitre" to "10.000 hectolitre" to met a multiple of 10^3 of the basic unit "litre".

5.2. Supply-oriented component

```
*****************************************************************************
*  Crop production
*****************************************************************************
*  LEVL                          *** main crop area ***
*  *** individual crop
   C LEVLSWHE   =  ZPA13112020   ; SOFT WHEAT AND SPELT:    MAIN AREA          1000 HECTARES
   C LEVLDWHE   =  ZPA13113020   ; DURUM WHEAT:             MAIN AREA          1000 HECTARES
   C LEVLRYE    =  ZPA13114020   ; RYE AND MASLIN:          MAIN AREA          1000 HECTARES

   ...

   C SPROCERT   =  ZPA13105011   ; CEREALS(EXCL. RICE):     SEC. PROD.         1000   TONS
   C SPROOILS   =  ZPA13141011   ; OILSEEDS:                SEC. PROD.         1000   TONS
   C SPROINDU   =  ZPA13140011   ; INDUSTRIAL CROPS:        SEC. PROD.         1000   TONS
*****************************************************************************
*  Animal production
*****************************************************************************
   C LEVLVEAL   =  ZPA12316550   ; GROSS INDIGENOUS PROD.   CALVES             1000   HEADS
   C LEVLHEIF   =  ZPA12314550   ; GROSS IND. PROD.         HEIFERS            1000   HEADS
   C PROPSCOW   =  ZPA12313550   ; GROSS IND. PROD.         COWS               1000   HEADS

   ...

   C PROPEGGS   =  ZPA10470012   ; BAL.SHEETS. EGGS TOTAL   USABLE PRODUCTION  1000   TONS
   C HPROEGGS   =  ZPA10470098   ; CAL. BAL.- EGGS:         USABLE PRODUCTION  MIO    PIECES
   C MPROEGGS   =  ZPA10470052   ; CAL. BAL.- EGGS:         EGGS INCUBATION    1000   TONS
*
*****************************************************************************
*  EAA data at current prices
*****************************************************************************
*  *** single crop products
   C PEAVSWHE   =  COSA5091121   ; AGR NET VAT   CURR PR TOTAL   SOFT WHEAT    MIO  NAT.CURR.
   C PEAVDWHE   =  COSA5091131   ; AGR NET VAT   CURR PR TOTAL   DURUM WHEAT   MIO  NAT.CURR.
   C PEAVRYE    =  COSA5091141   ; AGR NET VAT   CURR PR TOTAL   RYE + MESLIN  MIO  NAT.CURR.

   ...

   C PEACNAGG   =  COSA9993999   ; ANNUAL CONVERSION RATE   - 1 PPS = ...DM          NAT.CURR.
*  *** LABOUR IN AWU
   C PROPLABO   =  COSA4000110   ; TOTAL AGR. LABOUR INPUT     -AWU           1000
   C PROPLABN   =  COSA4000310   ; NOT FAMILY AGR. LABOUR INPUT -AWU          1000
```

```
***************************************************************************
*  NATIONAL ECONOMIC ACCOUNT DATA OF DOMAIN SEC1
***************************************************************************
  C PRICGRMA    =  SEC11181600       ; GROSS DOMESTIC PRODUCT MKT PR. CUR.PR + PPS    1000 MIO   PPS
  C PRICGVAM    =  SEC11181000       ; GROSS DOMESTIC PRODUCT MKT PR. CURR. PRICES    1000 MIO   N.C.
  C PRICGVAF    =  SEC11183003   10.; GROSS DOMESTIC PRODUCT MKT PR. VOLUME           1985 = 100
  C PRICNVAF    =  SEC11189933   10.; GROSS DOMESTIC PRODUCT MKT PR. PRICES           1985 = 100
  C PRICNAGG    =  SEC11189933 1000.; GROSS DOMESTIC PRODUCT MKT PR. PRICES           1985 = 100
***************************************************************************
*  feedingstuff resource data from Eurostat
***************************************************************************
*    (FCER)     ************ Fodder: cereals (incl. rice)
  C PROPAWHE    =  FEEC1011110       ; WHEAT GRAIN             -TOT.RES.      1000       TONS
  C PROPABAR    =  FEEC1011130       ; BARLEY  GRAIN           -TOT.RES.      1000       TONS
  C PROPARYE    =  FEEC1011120       ; RYE GRAIN               -TOT.RES.      1000       TONS

    ...

  C PROPASTR    =  FEEC1023100       ; STRAW AND CHAF          -TOT.RES.      1000       TONS
  C PROPAOFE    =  FEEC1024400       ; OTHER FEED N.E.S.       -TOT.RES.      1000       TONS
  C PROPALEA    =  FEEC              ;
*
***************************************************************************
*  selling price data
***************************************************************************
    *** crop products
  C PRICAPPS    =  PRAG1022111 10.  ; PROD.PRICE:D.01 DESSERT APPLES:ALL VARIETIES      NAT. CURR.
  C PRICPEAR    =  PRAG1022131 10.  ; PROD.PRICE:D.04 DESSERT PEARS:ALL VARIETIES       NAT. CURR.
  C PRICPEAC    =  PRAG1022181 10.  ; PROD.PRICE:D.07 PEACHES:ALL VARIETIES             NAT. CURR.

    ...

  C SPROPHOF    =  PRAG1027674 10.  ; AGRI. P.P.:I.03 TRIPELPHOSPHATE (46%)             NAT. CURR.
  C PRICPOTF    =  PRAG1027681 10.  ; AGRI. P.P.:J.01 MURIATE OF POTASH                 NAT. CURR.
  C SPROPOTF    =  PRAG1027685 10.  ; AGRI. P.P.:J.02 SULPHATE OF POTASH                NAT. CURR.
```

5.3. Demand-oriented component

```
* USE ACTIVITIES
  C PEXESWHE  = ZPA11117134  ; CROP BAL.- COMMON WHEAT,MKT:       EXPORTS INT.12   1000  TONS
  C PEXEDWHE  = ZPA11117234  ; CROP BAL.- DURUM WHEAT,MARKET:     EXPORTS INT.12   1000  TONS
  C PEXERYE   = ZPA11118134  ; CROP BAL.- RYE+MASLIN,MARKET:      EXPORTS INT.12   1000  TONS

   ...

  C PPROFRUI  = ZPA11191065      ; CROP BAL.- SOFT AND TOP FRUIT: PROCESSING       1000  TONS
  C PPROWINT  = ZPA11200065 0.1  ; CROP BAL.- WINE TOTAL:         PROCESSING       1000  HL
  C PPROCHEE  = ZPA10446065      ; BAL.SHEETS. CHEESE             PROCESSING       1000  TONS

* RESOURCE ACTIVITIES

  C MAPRSWHE  = ZPA11117169  ; CROP BAL.- COMMON WHEAT,MKT:       BOUGHT FR.FARM   1000  TONS
  C MAPRDWHE  = ZPA11117269  ; CROP BAL.- DURUM WHEAT,MKT:        BOUGHT FR.FARM   1000  TONS
  C MAPRRYE   = ZPA11118169  ; CROP BAL.- RYE+MESLIN,MARKET:      BOUGHT FR.FARM   1000  TONS

   ...

  C PIMECOMI  = ZPA10442023  ; BAL.SHEETS. CONCENTR.MILK   IMP. FROM EUR-12   1000  TONS
  C PIMECREA  = ZPA10441223  ; BAL.SHEETS. CREAM           IMP. FROM EUR-10   1000  TONS
  C PIMECHEE  = ZPA10446023  ; BAL.SHEETS. CHEESE          IMP. FROM EUR-10   1000  TONS

*  AGGREGATES

  C PIMTSWHE  = ZPA11117120  ; CROP BAL.- COMMON WHEAT,MKT:    IMPORTS TOTAL  1000  TONS
  C PIMTDWHE  = ZPA11117220  ; CROP BAL.- DURUM WHEAT,MARKET:  IMPORTS TOTAL  1000  TONS
  C PIMTRYE   = ZPA11118120  ; CROP BAL.- RYE+MASLIN,MARKET:   IMPORTS TOTAL  1000  TONS

   ...

  C PLOTCREA  = ZPA10441253  ; BAL.SHEETS. CREAM           LOSSES   1000  TONS
  C PLOTCOMI  = ZPA10442053  ; BAL.SHEETS. CONCENTR.MILK   LOSSES   1000  TONS
  C PLOTCHEE  = ZPA10446053  ; BAL.SHEETS. CHEESE          LOSSES   1000  TONS
```

5.4. Other

```
* ************************************************************************
* A. SERIES TO BE UPDATED EACH YEAR
* --------------------------------
*
* A.1 Feedingstuff prices
* A.2 Mineral fertilizer resources
*
* B. SERIES NOT TO BE UPDATED EACH YEAR
* ------------------------------------
*
* B.1 Nutrient contents of feedingstuff resource data
* B.2 Nutrient contents of harvested production
* B.3 Nitrogen availability factor for production activities
* B.4 Hypothetical input coefficients per unit of production activities
* B.5 Distribution factors for the calculation of calendar year data for
*    crop year data
*
* ************************************************************************
*
* A.1 Feedingstuff prices (NC/mt)
*
*    (FRO)     ************ Fodder: rich protein
  C PRICASOY    =  ......EXPCS 10.   ;SOYABEAN CAKE
  C PRICARAP    =  ......EXPCS 10.   ;RAPESEED CAKE
  C PRICASUF    =  ......EXPCS 10.   ;SUNFLOWER CAKE

    ...

  C PRICAOOI    =  ......EXPCS 10.   ;OTHER PROD. OF VEGET. ORIGIN
  C PRICAAOF    =  ......EXPCS 10.   ;ANIMAL OILS AND FATS
  C PRICAOFE    =  ......EXPCS 10.   ;OTHER FEED N.E.S
*
* A.2 Mineral fertilizer ressources (1000 mt pure nutrients)
*
  C PROPNITF    =  ......EXPCS       ;MINERAL FERTILIZER NITROGEN (N)
  C PROPPHOF    =  ......EXPCS       ;MINERAL FERTILIZER PHOSPHATE (P2O5)
  C PROPPOTF    =  ......EXPCS       ;MINERAL FERTILIZER POTASSIUM (K2O)
* B.1 Nutrient contents of feedingstuff resource data from EUROSTAT
*
*  a) Net energy lactation (MJ/kg)
*
*    (FCER)     ************ Fodder: cereals (incl. rice)
  C ENNEAWHE    =  ......EXPCS       ;WHEAT GRAIN
  C ENNEABAR    =  ......EXPCS       ;BARLEY GRAIN
  C ENNEARYE    =  ......EXPCS       ;RYE GRAIN
    ...
```

```
*  F) CRUDE PROTEIN (KG/KG)
*
*   (FCER)     ************* FODDER: CEREALS (INCL. RICE)
  C CRPRAWHE    =  ......EXPCS       ;WHEAT GRAIN
  C CRPRABAR    =  ......EXPCS       ;BARLEY GRAIN
  C CRPR...
  ...
  C CRPR...
  ...
  C CRPRAOFE    =  ......EXPCS       ;OTHER FEED N.E.S
*
* B.2 NUTRIENT CONTENTS OF HARVESTED PRODUCTION
*
  C SWHENITM    =  ......EXPCS       ;KG NITROGEN (N) PER T OF SOFT WHEAT
  C DWHENITM    =  ......EXPCS       ;KG NITROGEN (N) PER T OF DURUM WHEAT
  C ....NITM    =  ......EXPCS       ;KG NITROGEN (N) PER T OF ...

   ...

  C DWHEPOTM    =  ......EXPCS       ;KG POTASSIUM (K2O) PER T OF D. WHEAT
  C ....POTM    =  ......EXPCS       ;KG POTASSIUM (K2O) PER T OF ...
  C SILAPOTM    =  ......EXPCS       ;KG POTASSIUM (K2O) PER T OF SILAGE
*
* B.3 NITROGEN AVAILABILITY FACTOR FOR PRODUCTION ACTIVITES (%/100)
*
  C SWHESILA    =  ......EXPCS       ;N AVAILABILITY FOR ACT. SOFT WHEAT
  C DWHESILA    =  ......EXPCS       ;N AVAILABILITY FOR ACT. DURUM WHEAT
  C ....SILA    =  ......EXPCS       ;N AVAILABILITY FOR ACT. ...
  C SILASILA    =  ......EXPCS       ;N AVAILABILITY FOR ACT. FODDER PLANTS
                 ON ARABLE LAND
* B.4 HYPOTHETICAL INPUT COEFFICIENTS PER UNIT OF PRODUCTION ACTIVITIES
*
  C SWHENITF    =  ......EXPCS       ;KG MINERAL N FOR ACT. SOFT WHEAT
  C DWHENITF    =  ......EXPCS       ;KG MINERAL N FOR ACT. DURUM WHEAT
  C ....NITF    =  ......EXPCS       ;KG MINERAL N FOR ACT. ...

   ...

  C DWHEINPO    =  ......EXPCS       ;OVERH. O. I. F. ACT. D. WH. (NC 1985)
  C ....INPO    =  ......EXPCS       ;OVERHEADS OTHER INPUTS F. ACT. ...
  C PIGLINPO    =  ......EXPCS       ;OVERH. O. I. F. ACT. PIG BR. (NC 1985)
*
* B.5 DISTRIBUTION FACTORS FOR THE CALCULATION OF CALENDAR YEAR DATA FOR
*     CROP YEAR DATA (%/100)
```

```
* A) USE ACTIVITES
*
  C REXESWHE    =  ......EXPCD      ;EXPORTS, EUR-12, SOFT WHEAT
  C REXEDWHE    =  ......EXPCD      ;EXPORTS, EUR-12, DURUM WHEAT
  C REXE....    =  ...

   ...

  C RIMWDWHE    =  ......EXPCD      ;IMPORTS, WORLD, DURUM WHEAT
  C RIMW....    =  ...
  C RIMWOTHC    =  ......EXPCD      ;IMPORTS, WORLD, OTHER OILCAKES
```

ANNEX 3

NUTRIENT CONTENT COEFFICIENTS FOR THE EXTRACTED FEED PRODUCT GROUPS OF THE SPEL/EU-MODEL

6. ANNEX 3: NUTRIENT CONTENT COEFFICIENTS FOR THE EXTRACTED FEED PRODUCT GROUPS OF THE SPEL/EU-MODEL

The nutrient content coefficients of the extracted feed product groups are listed in the following table. The yearly weight average coefficients of the seven feed product groups :

- Fodder, cereals (incl. rice),
- Fodder, rich protein,
- Fodder, rich energy,
- Fodder, milk and milk products,
- Fodder, dried (not marketable),
- Fodder, fresh and ensilaged (not marketable), and
- Fodder, other

of the SPEL/EU-Data are calculated with the following listed nutrient coefficients.

These coefficients are used in the Base Model (see chapter 3 of this documentation) constant over time and constant also for each agricultural sector of the EU-Model.

The columns of the following table are distinguished to the nutrient requirements of the animal categories covered in the EU-Model.

Table A3 : Nutrient content coefficients

FEED PRODUCT	CODE	ENNE	ENMR	ENMP	ENMC	ENMH	CRPR	DRMA
6.1. Fodder: cereals (incl. rice) (FCER)								
-WHEAT GRAIN	AWHE	5.02	11.80	13.67	12.92	12.10	0.12	0.89
-BARLEY GRAIN	ABAR	7.23	11.17	12.51	11.02	12.14	0.10	0.89
-RYE GRAIN	ARYE	7.57	10.81	12.34	11.10	12.23	0.10	0.87
-OATS GRAIN	AOAT	6.27	11.07	9.56	10.73	11.07	0.11	0.90
-MAIZE GRAIN	AGRM	7.88	11.63	13.92	14.47	10.42	0.10	0.88
-SORGHUM GRAIN	ASOR	7.36	11.95	13.55	13.96	11.28	0.12	0.89
-OTHER CEREALS (excl. rice)	AOCE	6.46	11.10	13.11	13.11	12.55	0.17	0.89
-RICE (BROKEN)	ARIC	7.23	11.21	10.87	11.21	10.05	0.09	0.89
6.2. Fodder: rich protein (FPRO)								
-SOYABEAN CAKE	ASOY	7.02	12.34	12.56	10.28	10.28	0.45	0.91
-RAPESEED CAKE	ARAP	6.36	11.74	10.93	8.35	8.35	0.35	0.92
-SUNFLOWER CAKE	ASUF	5.69	12.32	11.45	11.45	11.45	0.35	0.95
-LINSEED CAKE	AFLA	7.09	11.16	11.69	6.59	6.59	0.35	0.91
-MAIZE GERM CAKE	AMAI	7.20	11.80	10.97	11.80	11.80	0.12	0.91
-SESAME CAKE	ASES	6.87	11.12	12.59	9.28	9.28	0.43	0.92
-GROUNDNUT CAKE	AGNU	6.93	11.28	14.82	10.35	10.35	0.50	0.92
-COPRA / COCONUT CAKE	ACOP	7.08	12.34	14.13	6.24	6.24	0.22	0.91
-COTTONSEED CAKE	ACOT	5.72	9.98	9.90	9.02	9.02	0.38	0.91
-OLIVE OILCAKES	AOLI	0.10	4.04	4.04	4.04	4.04	0.10	0.92
-OTHER OILCAKES	AOOC	6.73	11.62	12.24	8.62	8.62	0.32	0.92
-DRIED PULSES	ADRP	7.34	12.06	12.68	9.75	13.47	0.26	0.90
-GLUTEN	AGLU	8.19	12.80	14.12	6.05	6.05	0.58	0.90
-GLUTEN FEED	AGLF	6.86	11.57	11.04	6.05	6.05	0.26	0.91
-PRODUCTS OF MARINE ANIMALS	APMA	6.50	11.84	10.36	11.27	11.27	0.63	0.91
-PRODUCTS OF LAND ANIMALS	APLN	6.13	10.55	9.95	9.68	9.68	0.48	0.93
6.3. Fodder: rich energy (FENE)								
-MANIOC-CASSAVA	AMAN	7.66	12.63	12.95	12.30	12.30	0.02	0.87
-BY-PRODUCTS OF MILLING INDUST.	ABMI	6.45	9.26	9.87	5.39	7.50	0.16	0.89
-BY-PRODUCTS OF BREWING INDUST.	ABBR	1.94	4.42	3.56	3.56	3.56	0.10	0.28
-BY-PRODUCTS OF DISTIL. INDUST.	ABDI	1.00	1.10	1.10	1.10	1.10	0.03	0.08
-BY-PRODUCTS OF STARCH INDUSTRY	ABSI	3.24	3.52	2.10	2.05	2.05	0.30	0.35
-BY-PRODUCTS OF SUGAR INDUSTRY	ABSU	6.66	10.05	11.00	4.23	9.75	0.05	0.88
-OTHER BY-PRODUCTS	AOBP	6.14	10.22	11.15	5.60	10.09	0.06	0.89

FEED PRODUCT	CODE	ENNE	ENMR	ENMP	ENMC	ENMH	CRPR	DRMA
6.4. Fodder: milk and milk products (FMIL)								
-LIQ. COWS MILK	AMCO	1.75	2.69	2.46	2.46	2.46	0.03	0.12
-LIQ. SHEEP MILK	AMSH	1.75	4.24	4.24	4.24	4.24	0.03	0.18
-LIQ. GOATS MILK	AMGO	1.75	2.89	2.89	2.89	2.89	0.03	0.13
-SKIMMED MILK	AMSK	0.73	1.05	1.60	1.05	1.05	0.03	0.10
-LIQUID WHEY	AMLW	0.76	1.10	0.89	0.89	0.89	0.01	0.07
-WHOLE MILK POWDER	AMPT	14.66	18.37	16.40	16.40	16.40	0.27	0.94
-SKIMMED MILK AND BUTTERMILK POWDER	AMPC	8.25	11.79	13.15	8.13	8.13	0.35	0.93
-WHEY POWDER	AMPW	8.75	11.79	13.15	8.13	8.13	0.14	0.93
6.5. Fodder: dried (FDRY) not marketable)								
-HAY	AHAY	4.24	8.19	7.00	7.00	7.00	0.09	0.89
-STRAW AND CHAFF	ASTR	2.00	3.00	3.50	0.00	0.00	0.01	0.86
6.6. Fodder: fresh and ensilaged (FFSI) (non marketable)								
-ROOTCROPS	AROO	1.11	1.39	1.58	1.99	1.31	0.02	0.11
-SILAGE	ASIL	1.87	2.51	3.00	3.20	3.20	0.05	0.28
-LEAVES AND TOPS	ALEA	1.00	2.04	1.08	2.23	2.23	0.02	0.20
-PERENNIAL FODDER CROPS	AFPE	1.10	1.63	2.00	1.63	2.25	0.03	0.22
-FODDER MAIZE	AFMA	2.00	3.47	4.00	4.50	2.07	0.03	0.34
-OTHER GREEN FODDER	AOGF	1.10	2.58	2.00	1.63	2.25	0.14	.23
6.7. Fodder: other (FOTH)								
-POTATOES	APOT	.77	2.96	3.40	3.00	3.19	0.03	0.23
-SUGAR	ASUG	6.66	16.20	15.74	15.12	9.75	0.01	0.99
-VEGETABLE FATS AND OILS	AVOI	20.00	38.11	31.85	38.11	38.11	0.01	0.99
-PROCESSED GREE FODDER	APGF	4.90	8.51	6.80	5.20	8.51	0.19	0.92
-OTHER PROD. OF VEGET. ORIGIN (incl.oilseeds)	AOOI	5.89	9.45	9.55	15.12	8.35	0.22	0.90
-ANIMAL OIL AND FATS	AAOF	18.77	35.62	31.85	31.81	31.81	0.01	0.99
-OTH. FEED N.E.S.	AOFE	3.20	6.43	7.34	4.55	4.55	0.07	0.53

Remarks :

ENNE	:	Net energy (lactation) in megajoule per kilogram (MJ/kg),
ENMR	:	Metabolizable energy (ruminants) in megajoule per kilogram (MJ/kg),
ENMP	:	Metabolizable energy (pigs) in megajoule per kilogram (MJ/kg),
ENMC	:	Metabolizable energy (chickens) in megajoule per kilogram (MJ/kg),
ENMH	:	Metabolizable energy (horses) in megajoule per kilogram (MJ/kg),
CRPR	:	Crude protein in kilogram per kilogram (kg/kg),
DRMA	:	Dry matter in kilogram per kilogram (kg/kg).

ANNEX 4

ALLOCATION OF STANDARD GROSS MARGIN PRODUCTION BRANCHES

AND

FARM ACCOUNTING DATA NETWORK FARM TYPES

TO THE

SPEL/EU-MODEL PRODUCTION ACTIVITIES

7. ANNEX 4: ALLOCATION OF STANDARD GROSS MARGIN PRODUCTION BRANCHES AND FARM ACCOUNTING DATA NETWORK FARM TYPES TO THE SPEL/EU-MODEL PRODUCTION ACTIVITIES

Table 1: Crop production activities

SPEL/EU		SGM/EU		FADN	
Code	**Production activity**	**Code**	**Production branches**	**Code**	**Type of Farming**
SWHE	Soft Wheat	D01	Common Wheat, Spelt	111	Specialist Cereals
DWHE	Durum Wheat	D02	Durum Wheat		
RYE	Rye and Meslin	D03	Rye		
BARL	Barley	D04	Barley		
OATS	Oats	D05	Oats		
MAIZ	Maize	D06	Grain Maize		
OCER	Other Cereals (excl. rye)	D08	Other Cereals		
PARI	Paddy Rice	D07	Rice	112	Specialist Rice
PULS	Pulses	D09	Dried Vegetables	124	Various Field Crops
POTA	Potatoes	D10	Potatoes	121	Specialist Root Crops
SUGB	Sugar Beets	D11	Sugar Beets		
RAPE	Rape, Turnip Rape Seed	D13	Other Oilseed,	124	Various Field Crops
		D13 d1	Fibre Plants		
SUNF	Sunflower Seed				
SOYA	Soya Beans				
OOIL	Other Oilseeds				
OLIV	Olives for Oil	G03	Olive Plantations	330	Specialist Olives
FLAX	Flax and Hamp				
TOBA	Tobacco Unmanu-factured	D13 a	Tobacco		
		D13 b	Hops		
OIND	Other Ind. Crops	D13 c	Cotton		
		D13 d2	Other Industrial Crops		
CAUL	Cauliflowers	D14	Fresh Vegetables	123 / 201	
		D14/15	Melons, Straw-berries		Specialist Field Vegetables
TOMA	Tomatoes				Specialist Market Garden Vegetables
OVEG	Other Vegetables				
APPL	Apples, Pears and Peaches	G01	Fresh Fruit, incl. Berries	321	Specialist Fruits (Other than Citrus)
OFRU	Other Fruits	G01 b	Nuts		
CITR	Citrus Fruits	G02	Citrus Plantations	322	Specialist Citrus Fruits
TAGR	Table Grapes				
TABO	Table Olives	G03	Olive Plantations	330	Specialist Olives

Cont. Table 1:

SPEL/EU		SGM/EU		FADN	
Code	**Production activity**	**Code**	**Production branches**	**Code**	**Type of Farming**
TWIN OWIN	Table Wine Other Wine	G04	Vineyards	312 311	Specialist Wine (not Quality) Specialist Quality Wine
NURS FLOW	Nursery Plants Flowers, Ornamental Plants, etc.	G05 D16/17	Nurseries Flowers and Ornamental Plants	202	Specialist Flowers and Ornamentals
OCRO	Other final Crop Products	D19/20	Arable Land Crops	124	Various Field Crops
OROO	Other Root Crops	D12	Forrage Roots, Tubers	121	Specialist Root Crops
GRAS SILA	Grass/Grazings Fodder Plants on Arable Land	F01/02 D18	Permanent Pastures and Meadows Rough Grazings Forrage Plants	811 - 814 124	Field Crops Grazing Livestock, or Various Field Crops

Sources : Modelled on table from Eurostat: Farm Structure, Methodology of Union surveys, Luxembourg, 1986; Commission of the EU: Farm accountacy DATA NETWORK, an A to Z of Methodology, Luxemburg 1990

Table 2: Animal production activities

SPEL/EU		SGM/EU		FADN	
Code	**Production activity**	**Code**	**Production branches**	**Code**	**Type of Farming**
MILK	Dairy Cows	J07	Dairy Cows	411	Milk Production
BEEF CALF	Male Adult Cattle for Fattening Calves for Fattening	J03/05 J02	Male Bovine Animals (> 1 Year) Bovine Animals (< 1 Year)	422	Cattle (Mainly Fattening)
PORK	Pigs for Fattening	J13	Other Pigs	501	Specialist Pigs
MUTM MUTT	Ewes and Goats Sheep and Goat for Fattening	J09a/10a J09b/10b	Ewes and Goats (Breeding Fem.) Sheep and Goats (Other)	441 - 444	Sheep, Goats and other Grazing Livestock
EGGS POUL	Laying Hens Poultry for Fattening	J15 J14/16	Laying Hens Broilers and Other Poultry	502	Specialist Poultry
OANI	Other Animals	J01	Equidae	444	Various Grazing Livestock
CALV	Suckling Calves	J08	Other Cows	712	Mixed Livestock (Mainly Grazing)
RCAL	Calves, rearing	J02	Bovine Animals (< 1 year)	412	Specialist Milk Production with Cattle Rearing
HEIF	Heifers	J04/06	Female Bovine Animals (> 1 Year); Heifers	422	Specialist Cattle (Mainly Fattening)
PIGL	Pig Breeding	J11/12	Piglets and Breeding Sows	501	Specialist Pigs

Sources : Modelled on table from Eurostat: Farm Structure, Methodology of Union surveys, Luxembourg, 1986; Commission of the EU: Farm accountacy DATA NETWORK, an A to Z of Methodology, Luxembourg 1990

ANNEX 5

ALLOCATION OF SGM AND FADN INTERMEDIATE INPUTS TO THE INPUT ITEMS (excluding feed use)

OF THE ABTA (MAC)

8. ANNEX 5: ALLOCATION OF SGM AND FADN INTERMEDIATE INPUTS TO THE INPUT ITEMS (excluding feed use) OF THE ABTA (MAC)

SPEL/EU		SGM/EU	FADN
NITF PHOF POTF CAOF	Nitrogenous mineral Fertilizer Phosphatic mineral Fertilizer Potassium mineral Fertlizer Lime Fertilizer	Total fertilizer input (nitrogen, phosphate, potassium and lime) in valued terms	Total fertilizer input (nitrogen, phosphate, potassium and lime) in valued terms
NITM PHOM POTM	Nitrogen from Manure Phosphate from Manure Potassium from Manure		Information about crop production processes of specialist animal farm types
SEEP	Seed Inputs	Seed Inputs	Seed Inputs
PLAP	Plant Protection	Plant Protection	Plant Protection
IPHA	Pharmaceutical Input	Included in other proportional costs	Included in other costs of animal production
REPV	Variable Costs Repairs		
ENEV	Variable Costs Energy		
WATV	Variable Costs Water		
INPV	Variable Costs Other Inputs	Other proportional costs	Other costs
ENEO	Overheads Energy		Energy costs
REPO	Overheads Repairs		Costs for maintenance of machinery and buildings
INPO	Overheads Other Inputs		Costs for wages and other direct inputs

Sources : Modelled on table from Eurostat: Farm Structure, Methodology of Union surveys, Luxembourg, 1986; Commission of the EU: Farm accountacy DATA NETWORK, an A to Z of Methodology, Luxembourg 1990

ANNEX 6

HYPOTHETICAL INPUT USE COEFFICIENTS OF MAC
(excluding feed use)

FOR MEMBER STATE: FRANCE
(as an example)

FOR YEAR 1985

9. ANNEX 6: HYPOTHETICAL INPUT USE COEFFICIENTS OF MAC (excluding feed use) FOR MEMBER STATE: FRANCE (as an example) FOR YEAR 1985

Preface :

For one Member State (France) the hypothetical input coefficients are shown in the following table. These coefficients are the results of the calculations based on national standard gross margin (SGM) data and Farm Accounting Data Network (FADN) reflected in chapter 7 of the above Base Model documentation. For each Member State these hypothetical input coefficients will be further checked state by state by national experts.The listed coefficients for France are therefore preliminary and only the coefficients for one Member State are listed. Also the completion in time of these input coefficients will also be checked by national experts.

For simplification, the completion in time is done by extrapolation of the listed hypothetical coefficients based on trend estimation (OLS) of the main product yield coefficient of each production activity as follows:

$$YMUH_{i,h,t} = \frac{YMUH_{i,h,85}\, XMG^{*}_{i,j,t}}{XMG^{*}_{i,h,85}}$$

where : $YMUH$: Hypothetical Input Use, MAC, physical component,
XMG^* : Output Generation, MAC, physical component (trend estimates),
i : Subscript, production activities, (i = (1,..,n)),
h : Subscript, input items, (h = (m+1,..,M)),
j : Subscript, main products, (j = i),
t : Subscript, calendar year, (t = (73,..,T)),
85 : Subscript, calendar year 1985.

	Code	Unit	SWHE	DWHE	RYE	BARL	OATS	MAIZ	OCER	PARI	PULS
1. VARIABLE INPUT: 1.1. SPECIFIC CROP INPUT											
NITROGENOUS MINERAL FERTILIZER	NITF	kg.PN	139.85	139.85	103.21	120.02	102.62	172.63	116.43	125.60	58.63
PHOSPHATIC MINERAL FERTILIZER	PHOF	kg.PN	64.54	64.54	64.81	64.67	64.81	97.10	64.70	57.96	87.94
POTASSIC MINERAL FERTILIZER	POTF	kg.PN	91.44	91.44	91.81	91.62	91.81	118.68	91.66	82.09	124.59
LIME FERTILIZER	CAOF	kg.PN	150.60	150.60	88.21	150.90	96.56	151.05	96.56	135.26	205.20
NITROGEN FROM MANURE	NITM	kg.PN	23.00	26.00	20.00	20.00	15.00	23.00	22.00		
PHOSPHATE FROM MANURE	PHOM	kg.PN	11.00	11.00	11.00	11.00	11.00	14.00	11.00		
POTASSIUM FROM MANURE	POTM	kg.PN	21.00	22.00	21.00	21.00	22.00	31.00	22.00		
SEED INPUTS	SEEP	NC,CP	485.45	485.45	386.64	382.97	361.32	560.08	404.09	507.00	502.00
PLANT PROTECTION	PLAP	NC,CP	835.55	835.55	457.53	681.34	417.33	591.77	597.94	1603.00	627.00
1.2. SPECIFIC ANIMAL INPUT 1.3. GENERAL INPUT											
VARIABLE COSTS REPAIRS	REPV	NC,CP									
VARIABLE COSTS ENERGY	ENEV	NC,CP									
VARIABLE COSTS WATER	WATV	NC,CP									
VARIABLE COSTS OTHER INPUTS	INPV	NC,CP	17.27	17.27	17.27	17.27	17.27	17.27	14.18	467.00	20.93
2. FIXED INPUT											
OVERHEADS REPAIRS	REPO	NC,CP	406.00	406.00	406.00	406.00	406.00	406.00	406.00	336.00	442.00
OVERHEADS ENERGY	ENEO	NC,CP	371.00	371.00	371.00	371.00	371.00	371.00	371.00	60.00	389.00
OVERHEADS OTHER INPUTS	INPO	NC,CP	594.00	594.00	594.00	594.00	594.00	594.00	594.00	3781.00	720.00

Remarks:
- PN Pure Nutrient
- kg Kilogram
- NC National Currency
- CP Constant Prices
- EA Economic Agricultural Account

Codes:
- SWHE : production activity, soft wheat
- DWHE : production activity, durum wheat
- RYE : production activity, rye and meslin
- BARL : production activity, barley
- OATS : production activity, oats
- MAIZ : production activity, maize
- OCER : production activity, other cereals
- PARI : production activity, paddy rice
- PULS : production activity, pulses

	Code	Unit	POTA	SUGB	RAPE	SUNF	SOYA	OLIV	OOIL	FLAX	TOBA
1. VARIABLE INPUT: 1.1. SPECIFIC CROP INPUT											
NITROGENOUS MINERAL FERTIL.	NITF	kg.PN	172.41	180.07	137.70	137.70	58.63	14.00	137.70	43.03	172.12
PHOSPHATIC MINERAL FERTIL.	PHOF	kg.PN	117.15	110.04	55.47	55.47	87.94	8.50	55.47	21.51	129.09
POTASSIC MINERAL FERTILIZER	POTF	kg.PN	160.06	160.06	76.03	76.03	124.59	26.00	76.03	21.51	118.33
LIME FERTILIZER	CAOF	kg.PN	105.30	140.05	97.07	97.07	97.70	14.00	97.07	37.65	150.60
NITROGEN FROM MANURE	NITM	kg.PN	3.50	2.60	51.00	12.00				3.00	
PHOSPHATE FROM MANURE	PHOM	kg.PN	2.20	2.00	28.00	23.00				8.00	
POTASSIUM FROM MANURE	POTM	kg.PN	7.50	6.00	62.00	57.00				15.00	
SEED INPUTS	SEEP	NC,CP	1798.00	1798.00	502.00	502.00	502.00	234.00	502.00	502.00	502.00
PLANT PROTECTION	PLAP	NC,CP	1174.00	1174.00	627.00	627.00	627.00	94.00	627.00	627.00	627.00
1.2. SPECIFIC ANIMAL INPUT 1.3. GENERAL INPUT											
VARIABLE COSTS REPAIRS	REPV	NC,CP									
VARIABLE COSTS ENERGY	ENEV	NC,CP									
VARIABLE COSTS WATER	WATV	NC,CP									
VARIABLE COSTS OTHER INPUTS	INPV	NC,CP	0.01	54.48	20.93	20.93	20.93	38.00	20.93	46.00	46.00
2. FIXED INPUT											
OVERHEADS REPAIRS	REPO	NC,CP	591.00	591.00	442.00	442.00	442.00	166.00	442.00	442.00	442.00
OVERHEADS ENERGY	ENEO	NC,CP	534.00	534.00	389.00	389.00	389.00	247.00	389.00	389.00	389.00
OVERHEADS OTHER INPUTS	INPO	NC,CP	1874.00	1874.00	720.00	720.00	720.00	243.00	720.00	720.00	720.00

Remarks:
- PN Pure Nutrient
- kg Kilogram
- NC National Currency
- CP Constant Prices
- EA Economic Agricultural Account

Codes:
- POTA : production activity, potatoes
- SUGB : production activity, sugar beet
- RAPE : production activity, rape & turnip rape seed
- SUNF : production activity, sunflower seed
- SOYA : production activity, soya beans
- OLIV : production activity, olives for oil
- OOIL : production activity, other oil seeds
- FLAX : production activity, flax and hemp
- TOBA : production activity, tobacco unmanufactured

	Code	Unit	OIND	CAUL	TOMA	OVEG	APPL	OFRU	CITR	TAGR	TABO
1. VARIABLE INPUT : 1.1. SPECIFIC CROP INPUT											
NITROGENOUS MINERAL FERTIL.	NITF	kg.PN	101.65	316.85	316.85	316.85	21.51	129.08	67.21	48.57	44.00
PHOSPHATIC MINERAL FERTIL.	PHOF	kg.PN	69.31	228.13	228.13	228.13	53.79	88.01	53.76	40.47	44.00
POTASSIC MINERAL FERTILIZER	POTF	kg.PN	110.89	253.48	253.48	253.48	26.89	117.35	64.52	72.85	77.00
LIME FERTILIZER	CAOF	kg.PN	115.52	177.43	177.43	177.43	107.57	82.14	67.21	56.66	44.00
NITROGEN FROM MANURE	NITM	kg.PN		7.00		7.00					
PHOSPHATE FROM MANURE	PHOM	kg.PN		1.90		1.90					
POTASSIUM FROM MANURE	POTM	kg.PN		7.90		7.90					
SEED INPUTS	SEEP	NC,CP	502.00	3073.00	3073.00	3073.00	309.00	309.00	561.00	158.00	54.00
PLANT PROTECTION	PLAP	NC,CP	627.00	1447.00	1447.00	1447.00	2226.00	2226.00	1533.00	1126.00	353.00
1.2. SPECIFIC ANIMAL INPUT 1.3. GENERAL INPUT											
VARIABLE COSTS REPAIRS	REPV	NC,CP									
VARIABLE COSTS ENERGY	ENEV	NC,CP									
VARIABLE COSTS WATER	WATV	NC,CP									
VARIABLE COSTS OTHER INPUTS	INPV	NC,CP	46.00	3067.50	3067.50	123.54	2062.00	2062.00	3650.00	344.00	488.00
2. FIXED INPUT											
OVERHEADS REPAIRS	REPO	NC,CP	442.00	2374.50	2374.50	2374.50	1390.00	1390.00	3573.00	761.00	491.00
OVERHEADS ENERGY	ENEO	NC,CP	389.00	2987.00	2987.00	2987.00	1374.00	1374.00	2681.00	503.00	348.00
OVERHEADS OTHER INPUTS	INPO	NC,CP	720.00	4249.00	4249.00	4249.00	4701.00	4701.00	5242.00	2040.00	469.00

Remarks:

- PN Pure Nutrient
- kg Kilogram
- NC National Currency
- CP Constant Prices
- EA Economic Agricultural Account

Codes:

- OIND : production activity, other ind. crops
- CAUL : production activity, cauliflowers
- TOMA : production activity, tomatoes
- OVEG : production activity, other vegetables
- APPL : production activity, apples, pears and peaches
- OFRU : production activity, other fruits
- CITR : production activity, citrus fruits
- TAGR : production activity, table grapes
- TABO : production activity, table olives

	Code	Unit	TWIN	OWIN	NURS	FLOW	OCRO	OROO	GRAS	SILA
1. VARIABLE INPUT:										
1.1. SPECIFIC CROP INPUT										
NITROGENOUS MINERAL FERTIL.	NITF	kg.PN	48.57	72.81	568.11	754.56	101.65	178.02	110.96	125.62
PHOSPHATIC MINERAL FERTIL.	PHOF	kg.PN	40.47	60.67	473.42	387.57	69.31	111.50	55.48	55.83
POTASSIC MINERAL FERTILIZER	POTF	kg.PN	72.85	109.21	852.16	611.64	110.89	154.88	83.22	55.83
LIME FERTILIZER	CAOF	kg.PN	56.66	84.94	662.79	856.30	115.52	157.46	110.96	97.70
NITROGEN FROM MANURE	NITM	kg.PN						2.00	20.00	3.20
PHOSPHATE FROM MANURE	PHOM	kg.PN						1.00	8.00	2.00
POTASSIUM FROM MANURE	POTM	kg.PN						3.90	29.00	4.40
SEED INPUTS	SEEP	NC,CP	158.00	310.00	61270.00	61270.00	502.00	1798.00	373.00	373.00
PLANT PROTECTION	PLAP	NC,CP	1126.00	1425.00	5037.00	5037.00	627.00	1174.00	405.00	405.00
1.2. SPECIFIC ANIMAL INPUT										
1.3. GENERAL INPUT										
VARIABLE COSTS REPAIRS	REPV	NC,CP								
VARIABLE COSTS ENERGY	ENEV	NC,CP								
VARIABLE COSTS WATER	WATV	NC,CP								
VARIABLE COSTS OTHER INPUTS	INPV	NC,CP	344.00	2356.00	12361.00	12361.00	46.00	54.48	20.93	20.93
2. FIXED INPUT										
OVERHEADS REPAIRS	REPO	NC,CP	761.00	1734.00	10886.00	10886.00	442.00	591.00	442.00	442.00
OVERHEADS ENERGY	ENEO	NC,CP	503.00	766.00	32782.00	32782.00	389.00	534.00	389.00	389.00
OVERHEADS OTHER INPUTS	INPO	NC,CP	2040.00	4317.00	16081.00	16081.00	720.00	1874.00	720.00	720.00

Remarks:
PN Pure Nutrient
kg Kilogram
NC National Currency
CP Constant Prices
EA Economic Agricultural Account

Codes:
TWIN : production activity, table wine
OWIN : production activity, other wine
NURS : production activity, nursery plants
FLOW : production activity, flowers, ornamental plants, etc.
OCRO : production activity, other final crop products
OROO : production activity, other root crops
GRAS : production activity, gras / grazings
SILA : production activity, silage

	Code	Unit	MILK	BEEF	CALF	PORK	MUTM	MUTT	EGGS	POUL
1. VARIABLE INPUT: 1.1. SPECIFIC CROP INPUT 1.2. SPECIFIC ANIMAL INPUT										
ANIMAL IMPORTS (EAA)	IAIM	NC,CP								
PHARMACEUTICAL INPUT	IPHA	NC,CP	134.27	27.32	30.05	21.12	10.48	16.31	0.59	0.34
1.3. GENERAL INPUT										
VARIABLE COSTS REPAIRS	REPV	NC,CP								
VARIABLE COSTS ENERGY	ENEV	NC,CP								
VARIABLE COSTS WATER	WATV	NC,CP								
VARIABLE COSTS OTHER INPUTS	INPV	NC,CP	22.47	24.2295	8.49	2.67	2.06	1.52	0.05	0.01
2. FIXED INPUT										
OVERHEADS REPAIRS	REPO	NC,CP	428.97	264.96	132.48	58.68	40.14	43.05	0.94	0.67
OVERHEADS ENERGY	ENEO	NC,CP	353.52	206.463	103.23	56.14	27.04	56.14	2.07	1.48
OVERHEADS OTHER INPUTS	INPO	NC,CP	773.01	438.452	219.23	91.88	45.59	52.38	1.85	0.41

Remarks:
- PN Pure Nutrient
- kg Kilogram
- NC National Currency
- CP Constant Prices
- EA Economic Agricultural Account

Codes:
- MILK : production activity, dairy cows
- BEEF : production activity, male adult cattle for fattening
- PORK : production activity, pigs for fattening
- MUTM : production activity, ewes and goats
- MUTT : production activity, sheep and goats for fattening
- EGGS : production activity, laying eggs
- POUL : production activity, poultry for fattening

	Code	Unit	OANI	CALV	RCAL	HEIF	PIGL
1. VARIABLE INPUT: 1.1. SPECIFIC CROP INPUT 1.2. SPECIFIC ANIMAL INPUT							
ANIMAL IMPORTS (EAA)	IAIM	NC,CP					
PHARMACEUTICAL INPUT	IPHA	NC,CP	145.66	89.16	30.05	50.64	53.25
1.3. GENERAL INPUT							
VARIABLE COSTS REPAIRS	REPV	NC,CP					
VARIABLE COSTS ENERGY	ENEV	NC,CP					
VARIABLE COSTS WATER	WATV	NC,CP					
VARIABLE COSTS OTHER INPUTS	INPV	NC,CP	16.85	10.65	8.49	25.01	4.12
2. FIXED INPUT							
OVERHEADS REPAIRS	REPO	NC,CP	401.81	314.07	132.48	331.23	97.80
OVERHEADS ENERGY	ENEO	NC,CP	300.09	250.93	103.23	276.65	93.57
OVERHEADS OTHER INPUTS	INPO	NC,CP	579.44	376.24	219.23	551.61	141.56

Remarks:
PN Pure Nutrient
kg kilogram
NC National Currency
CP Constant Prices
EA Economic Agricultural Account

Codes:
OANI : production activity, other animals
CALV : production activity, other cows
HEIF : production activity, heifers
PIGL : production activity, pig breeding

ANNEX 7

SOLUTION METHOD OF FEED DISTRIBUTION FOR A BASIC YEAR

10. ANNEX 7: SOLUTION METHOD OF FEED DISTRIBUTION FOR A BASIC YEAR

The sectoral feedingstuffs resources are allocated to the animal production activities for a basic year by the application of a linear programming approach, which minimizes the sectoral feed costs of a calendar year used to generate the gross animal production. These resultant data represents the basic solution for the non-linear programming approach described in chapter 3.7.5.1..

In addition to the used feed costs, the total sectoral feed costs contain also the valued deviations from exogenously defined and scaled feed ratios for each feed input group, the so-called "Standard ratios". To avoid chronologically excessive jumps in the allocation of the feed inputs to the animal production activities, these "Standard ratios" are added to the feed distribution optimization algorithm. The following equation is minimized under constraints :

(A7.1) $$Min!_{(YU,-SR)} \quad TSC = \sum_{i}\sum_{h} QU_h \, YU_{i,h} - \sum_{h} SR_h \, QC$$

where:
- TSC : Total sectoral costs for feedingstuff,
- QU : Input Use price,
- YU : Input Use, ABTA, physical component,
- QC : Price (profit) of the used Standard ratio unit,
- SR : Fed (used) Standard ratio,
- i : Subscript, production activities, (i = (MILK,...,PIGL)),
- h : Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)).

The "Standard ratios" are based on exogenously set input coefficients for each feed input group. These coefficients are scaled for each input group over the activities as follows :

(A7.2) $$usr_{i,h} = \frac{fq_{i,h} \, LEVL_i}{\sum_{i} fq_{i,h} LEVL_i}$$

By the summation of these scaled coefficients, the quantity of 1 kg dry matter content for each feed input group is represented:

(A7.3) $$1 = \sum_{i} usr_{i,h}$$

The Standard ratio of equation A5.1 contains the quantity of dry matter, which is distributed to the production activities according to the exogenous input coefficients, as follows:

(A7.4) $$SR_h = \sum_{i} usr_{i,h} \, fq_{i,h} \, RLEVL_i$$

with : $$fq_{i,h} = REQ_{i,dry\,matter} \; factor_{i,\min} \; r_{i,h}$$

and $$1 = \sum_{h} r_{i,h}$$

where:
- SR : Fed dry matter content by Standard ratio,
- usr : Scaled dry matter feed coefficient,
- $RLEVL$: Realized (by optimization) production activity level for SR,

with : $RLEVL_i \leq LEVL_i$,

$LEVL$: Production activity level, animal,
fq : Exogenous feed quantity for level unit in dry matter,
REQ : Total nutrient requirements per animal (chapter 3.7.5.3),
$factor$: Restriction factor (table 6),
r : Exogenous set factor ($0 \leq r_{i,h} \leq 1$),
i : Subscript, production activities, (i = (MILK,...,PIGL)),
h : Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)).

The price for Standard ratio (equation A5.1) constitutes the reduced dry matter price of the lowest Input Use price, in order to minimize also the use of the cheapest input use group. It is a gain from realizing the Standard ratio.

(A7.5) $$QC = \left(\frac{QU_h}{c_h}\right)_{\min!} 0.4$$

where: QC : Price of the Standard ratio,
QU : Input Use price,
c : Dry matter content coefficient,
h : Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)).

The reduction of the price (60%) is assumed to force the reaction of the optimization algorithm.

The realised dry matter content by Standard ratios of a feed input is lower than the dry matter content of distributed feed input:

(A7.6) $$\sum_i YU_{i,h} c_h \geq SR_h$$

where: YU : Input Use, ABTA, physical component,
SR : Fed dry matter content by Standard ratio,
c : Dry matter content coefficient,
i : Subscript, production activities, (i = (MILK,...,PIGL)),
h : Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)).

The total sectoral feed costs (equation A5.1) are minimized subject to the other linear constraints described in chapter 3.7.5.1.. The limits (bounds) for the non marketable feed inputs (equation 89b, chapter 3.7.5.1) are 0.5 and 1.5. The dry matter requirements of the animal production activities are described in chapter 3.7.5.3..

PART 3

Short-term Forecast and Simulation System

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1. INTRODUCTION

The methodological and technical structures of the SPEL/EU-Model as described in the documentation on the EU Model [98] also form the basis of the Short-term Forecast and Simulation System (SPEL/EU-SFSS). A knowledge of that documentation will therefore make it easier to understand the details given below.

The SFSS is designed as a system for carrying out an annual extrapolation of the Activity Based Table of Accounts (ABTA) and Matrix of Activity Coefficients (MAC) for the European Union (EU) agriculture which are compiled for ex-post representation.

When the SFSS is employed as a forecasting system, the exogenous variables are specified by using available statistics or the assessments of experts. The SFSS then produces a consistent forecast of the production of and demand for agricultural products by using these exogenous proposals based on the already started production processes.

When the SFSS is used for simulation purposes, the Common Agricultural Policies (CAP) changes to be simulated have to be applied to the exogenous variables so that their effects can be analysed by comparison with reference results (e.g. exogenous variables by trend extrapolation). The SFSS is used within the Commission for both forecasts and simulations.

[98] SeeSPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS and SPEL System, Technical Documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS.

2. AIMS AND GENERAL GUIDELINES

The aim of the SPEL/EU-SFSS is to carry out sectoral forecasts or simulations of the evolution of gross agricultural production in the European Union (EU) for a period of up to two or three years. It can be depicted also as

- the supply of and demand for agricultural products and
- the agricultural income generated

for the Member States of the EU and the EU as a whole. Agricultural income is represented by gross value added at market prices.

As far as possible, the SFSS forecasts and simulations take into account annual fluctuations in output generation. Apart from changes in production and production structure, the immediate effects of fluctuations (e.g. those caused by meteorological factors) on supply of and demand for agricultural products and the resulting agricultural income are also depicted.

Alternative sets of administered agricultural prices or other policy instruments of the CAP (direct payments, subsidies, quotas, changes in tax rates, etc.) can also be included in the forecasts and simulations in order to show the direct effects on production and income in agriculture and demand for agricultural products.

The design of the SFSS reflects the general characteristics of the SPEL/EU-Model [99], especially the

"*flexible user interface*"

general feature in order to facilitate the dialogue between the policy-makers and the model.

[99] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

3. PRINCIPLES

3.1. Background and limitations

The central hypothesis on which the SPEL/EU-SFSS hinges is that the major decisions on the initiation of production processes and allocation of production factors have already been met. The production process can then be viewed as being "in the pipeline", so that some specific Output Generation variables (e.g. yield coefficients of main products, production activity levels) can be forecast exogenously.

With these exogenously forecast Output Generation variables, most Input Use variables can be calculated endogenously; the uses, sales and purchase of agricultural products are thus determined endogenously by the output of agricultural production activities.

The principle limitations of the short-term model result from the fact that only the immediate effects on agricultural production and income are considered, but not the allocational responses of primary factors or the feedback on investment and labour mobility which determine the long-term sectoral developments. Only those (limited) substitutions of products and factors which are feasible for the short term (e.g. between different feed categories) are explained endogenously by the model mechanism.

3.2. Accounting system

SFSS forecasts and simulations are performed within the framework of the accounting system on which the Activity-Based Table of Account (ABTA) and the Matrix of Activity Coefficients (MAC) [100] are based.

Gross agricultural production is the background for this accounting system and is approached from the following viewpoints:

- Output Generation,
- Output Use,
- Input Generation and
- Input Use.

These four ways of viewing gross production are linked consistently by a system of equations which in turn determines the structure of the ABTA and MAC [101].

The separate elements of this ABTA and MAC equation system are projected with the SFSS. For the projection years in question, the SFSS produces the **components of the ABTA** (physical and valued):

- Output Generation,
- Output Use,
- Input Generation and

[100] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, chapters 3., 4. and 5..

[101] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapters 3., 4. and 5. and see SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, figure 5 and 7.

- Input Use

and the **components of the MAC** (physical and valued):

- Output Generation coefficients and
- Input Use coefficients.

For the basic accounting system a complete set of data is prepared for the projection period so that the data of the ex-post and ex-ante representation can be linked with each other in time and/or compared with each other.

The additional "**Demand component**" of the ABTA[102] is also forecast fully in all elements of the underlying equation system and can also be linked and/or compared with data of the ex-post representation.

As is already done for the Base Model, the ABTAs and MACs are normally forecast for the specific projection years consecutively in ascending order for each region (Member State). The calculations for the projection years are linked with the results of the previous year.

The aggregation to the EU as a whole is done by the same algorithms as for the Base Model[103] by annual aggregation of the Member State data.

3.3. Basic Data

For SFSS forecasts and simulations it is essential that the projections for each region should always be based on an available consistent annual set of ABTA data for ex-post representation (SPEL/EU-Data). Normally, SFSS projections are based on the data from the latest available year of ex-post representation (the projection's "base year").

The SPEL/EU-Data incorporate ABTA and MAC data from 1973 up to the latest calendar year data for ex-post representation. If the current year is "t", the latest available year is normally "t-2". This time lag of approximately 1-2 years in the SPEL/EU-Data depends on the delay in obtaining the original statistical data required to actualise the ex-post representation.

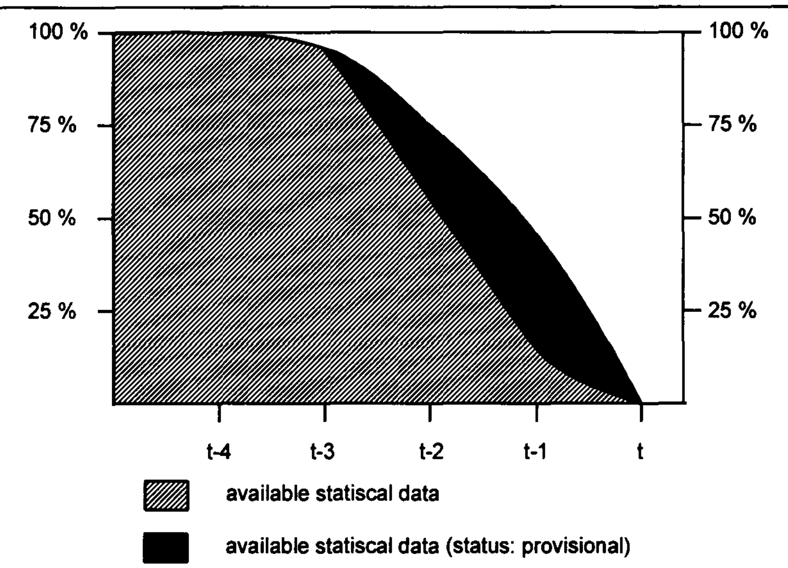
Figure 1 indicates the availability of the original statistical material needed for an ex-post representation (SPEL/EU-Data).

It should, however, be stressed that the most important data on crop and animal production statistics and Economic Accounts for Agriculture are always available for the last available year of the SPEL/EU-Data (e.g. for cereal and cattle production).

From Figure 1 it is clear that, starting in the middle of year "t", some statistical data cannot be included in the calculations of SPEL/EU-Data until after a delay of up to four years. As a rule, SPEL/EU-Data are extended a year when actualising is carried out if at least 2/3 of the required data material is available, and therefore at the middle of year "t", the latest available year of SPEL/EU-Data is year "t-2" (see chapter 3.4).

[102] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, chapter 6., and Part 2: Base System, chapter 3..
[103] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapter 3.10..

Figure 1: Availability of statistical data to update the SPEL/EU-Data



Missing data are filled in as far as possible in the Data completion work steps [104] using subject-related estimates or trend extrapolation.

One further point with regard to Figure 1 is that about 1/5 of available data material still have the "provisional" status when SPEL/EU-Data are actualised; it is highly probable therefore that such data will be altered one or more times in subsequent years.

Figure 1 does not include the definitional changes to individual original statistical series which are sometimes necessary and also result in changes to SPEL/EU-Data for the whole ex-post representation.

Since SFSS projections are based on SPEL/EU-Data, already existing exogenously determined extrapolations of variables like system proposals and/or assessments of experts (see chapters 5.2 and 5.3) for the projections have to be rechecked after each actualisation of the ex-post representation.

3.4. Time scale

The SFSS provides for projections for up to three years. Since, as mentioned in the previous chapter, the last available year of SPEL/EU-Data is one to two years previously, the projection results generally indicate a different projection scope depending on the projection time scale.

If projections cover periods extending into the future, they are designated ex-ante projections in the text below. For such projections no observed statistical data material or experience-based findings are available.

If the projection periods already lie in the past at the time of preparation of the projection, they are described below as ex-post projections. It is highly probable that compiled statistical data material will

[104] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapter 2.

be available for such periods. Experience-based findings referring to these periods will most probably be available for at least some production branches.

Obviously, projection results will differ in their level of accuracy, if they show the scope of an ex-ante or ex-post projection at the time of their preparation.

The time scale of projection for the SFSS is normally from the middle of year "t" as follows:

(t-2) projection base year (last available year of SPEL/EU-Data),

(t-1) actualisation (first projection year),

(t) diagnosis (second projection year) and

(t+1) forecast (third projection year).

The projection results for the first projection year therefore have to be interpreted as a provisional "actualisation" of the ex-post representation (reference period) and come within the ex-post projection scope.

The results for the second projection year, depending on the timing of the projection in the current year, may be of either an ex-ante or an ex-post projection scope, like a "diagnosis" of the current situation .

The results of the third projection year will in most cases be an ex-ante projection ("forecast").

These different scopes of projection will influence the quality of the projection results because the degree of ex-post information used for projection will be different. Therefore the timing of the application in the current year "t" has to be decided carefully to ensure the quality of the projection, especially for the "diagnosis" of the current situation.

Usually, the SFSS will be applied in the spring and autumn of a year ("routine" application) and, if requested, at other times of the year for CAP simulations.

The "routine" application in autumn focuses the projection on year "t" (diagnosis), because it can normally be based on the actualised SPEL/EU-Data of "t-1". The spring application will normally be used to incorporate the latest statistical information for year "t-1" (ex-post scope of projection) to improve the previous autumn's results. This projection application is like an "actualisation" as described above.

4. SFSS STRUCTURE

The projection work with the SFSS is based on an accounting system (described above) like the other components of the EU-Model. The structure of this accounting system is specified with an equation system [105]. Each element of this equation system is calculated for the projection years in question.

To carry out the calculations the elements of the equation system have to be grouped into exogenously and endogenously specified variables (elements of the equation system). The specification of these grouped exogenous and endogenous variables for the projection years are done in well-defined work steps. The dependencies and the sequences of these work steps are schematically described in the following chapters.

4.1. System

The Short-term Forecast and Simulation System (SFSS), like the other components of the SPEL/EU-Model, is a computer-based system of separated and correlated work steps [106]. The standardisation of both the technical and methodological structures within the SPEL/EU-Model makes it possible to use multiply the individual algorithms and programs for similar problems in the different work sectors (e.g. Base System and SFSS) of the SPEL/EU-Model.

The SFSS comprises:

- preparatory work (proposals exogenous variables) and
- projection work (forecasts or simulations),

which have to be completed in the sequence shown in Figure 2 in order to produce the projection results.

4.2. Preparatory work

The ex-ante or ex-post development of the exogenous variables, depending on the projection scope of the forecast year (see chapter 3.4) is specified in the preparatory work.

The work steps indicated in Figure 3 are generally performed in the sequence shown. Depending on the type of problem, the four work steps can be carried out independently of each other, but as a result of this work, the work sector "projection" must be provided with a full set of specified developments of exogenous variables.

As a rule, use is made of three sources of information for deciding on the exogenous developments:

- original statistical material (for calculation of the so called indicators [107]),
- SPEL/EU-Data (for calculation of trend based system proposals [108]) and
- experts judgement [109].

[105] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, Figure 5.
[106] See SPEL System, Technical Documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS.
[107] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 3: SFSS, chapter 5.2..
[108] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 3: SFSS, chapter 5.2..
[109] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 3: SFSS, chapter 5.3..

Figure 2: Structure of the work sector SFSS

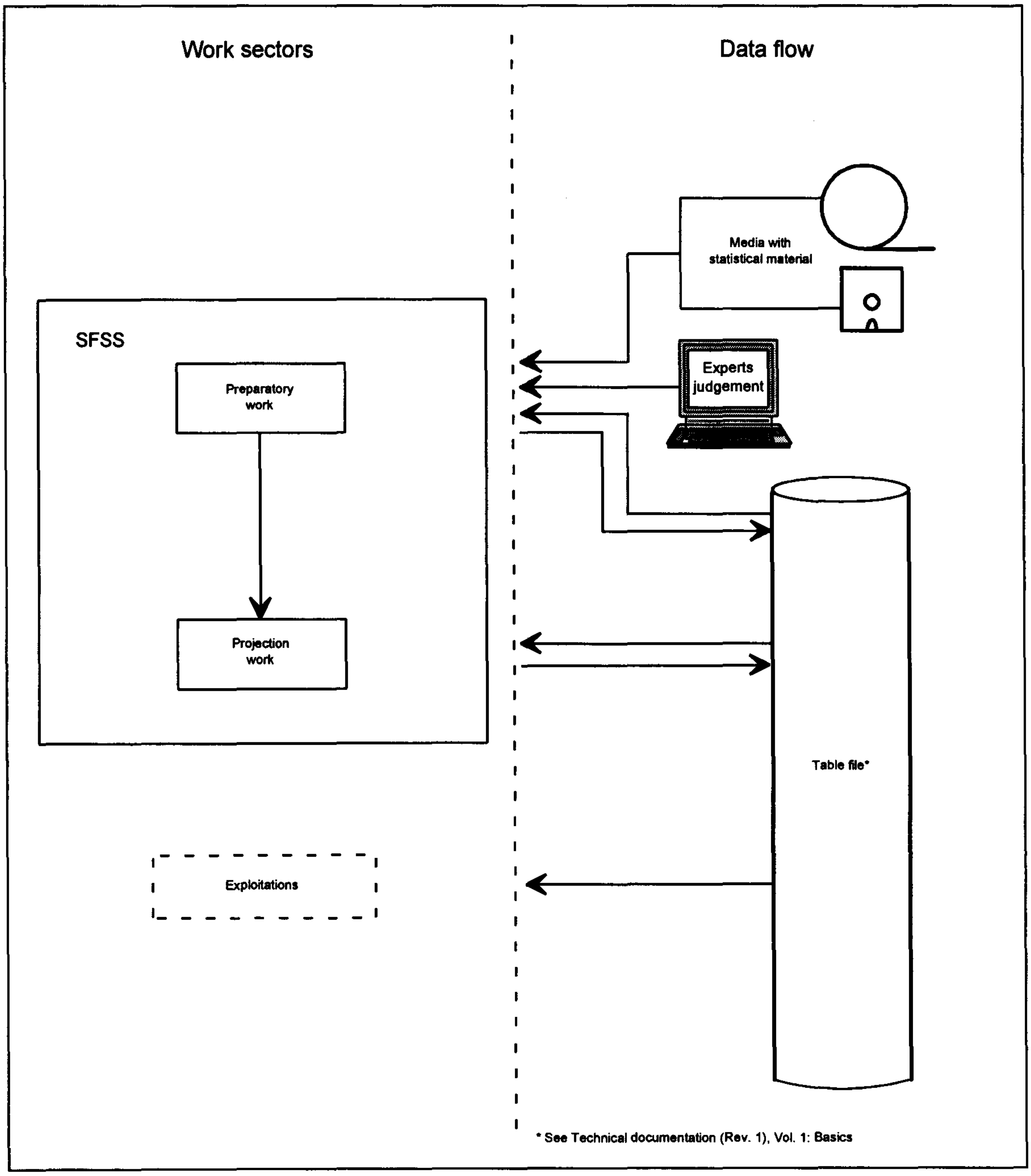
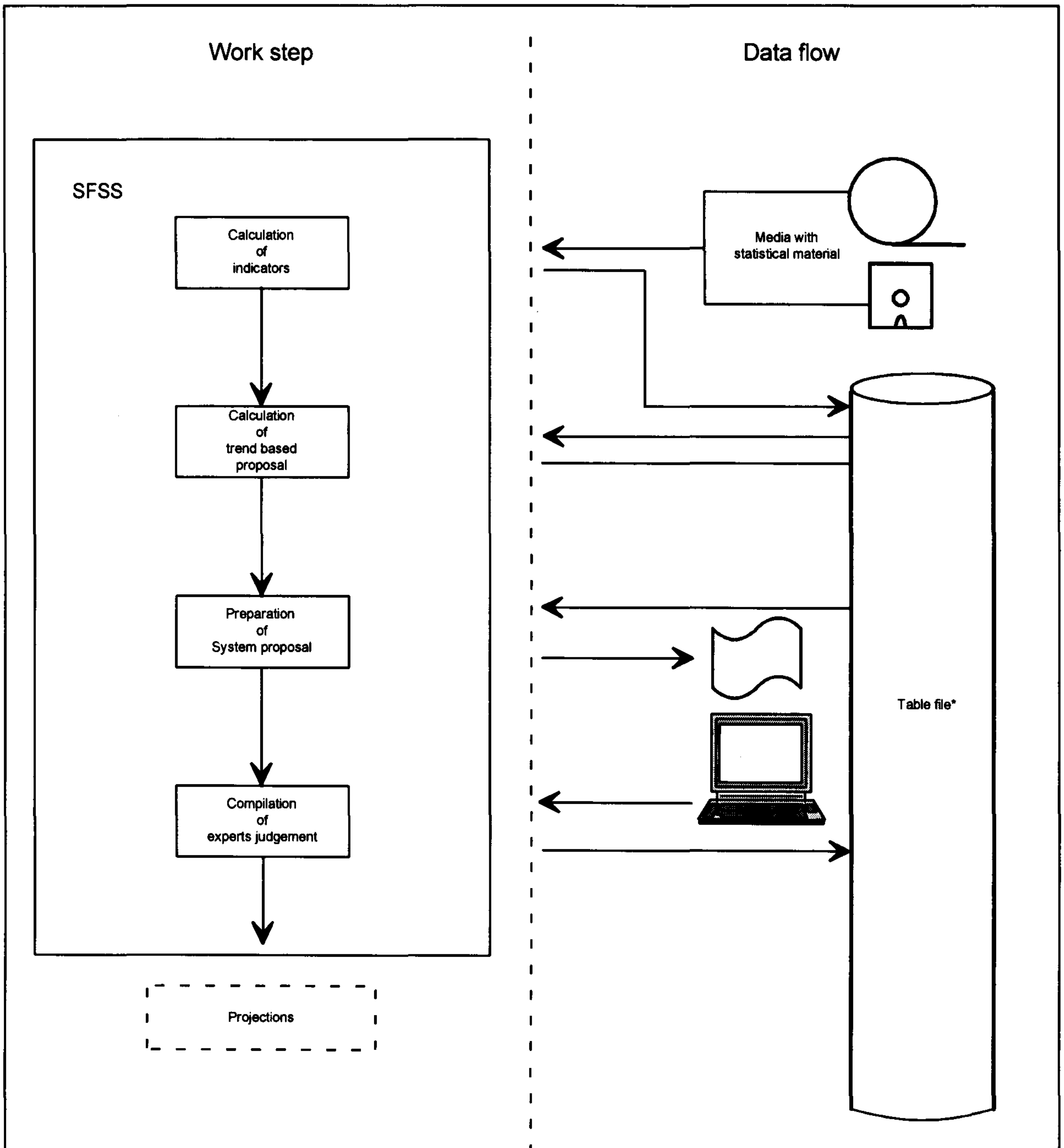


Figure 3: Structure of the "Preparatory" work step



* See Technical documentation (Rev. 1), Vol. 1: Basics

The results of the first two sources (statistics and SPEL/EU-Data) are prepared and presented to a group of experts for approval and possible changes. Any differences in assessment by the experts will be made available to the next work step.

4.3. Projection work

The structure of the work step "projection" and the preceding and subsequent ones are shown in Figure 4.

The preparation of the projection results is based on the set changes to the exogenous variables compared with the base year and therefore these set figures should be available for each projection year. If such figures are not available for individual exogenous variables or the whole set, the no-change hypothesis is assumed for the variable(s) in question, i.e. the base year data are inserted in the projection unchanged.

The endogenous variables are calculated recursively for the ABTA and MAC components (see chapter 6) and in ascending recursive sequence for the projection period, beginning with the first projection year after the base year. These calculations are performed successively for each region (Member State) independently of the other regions.

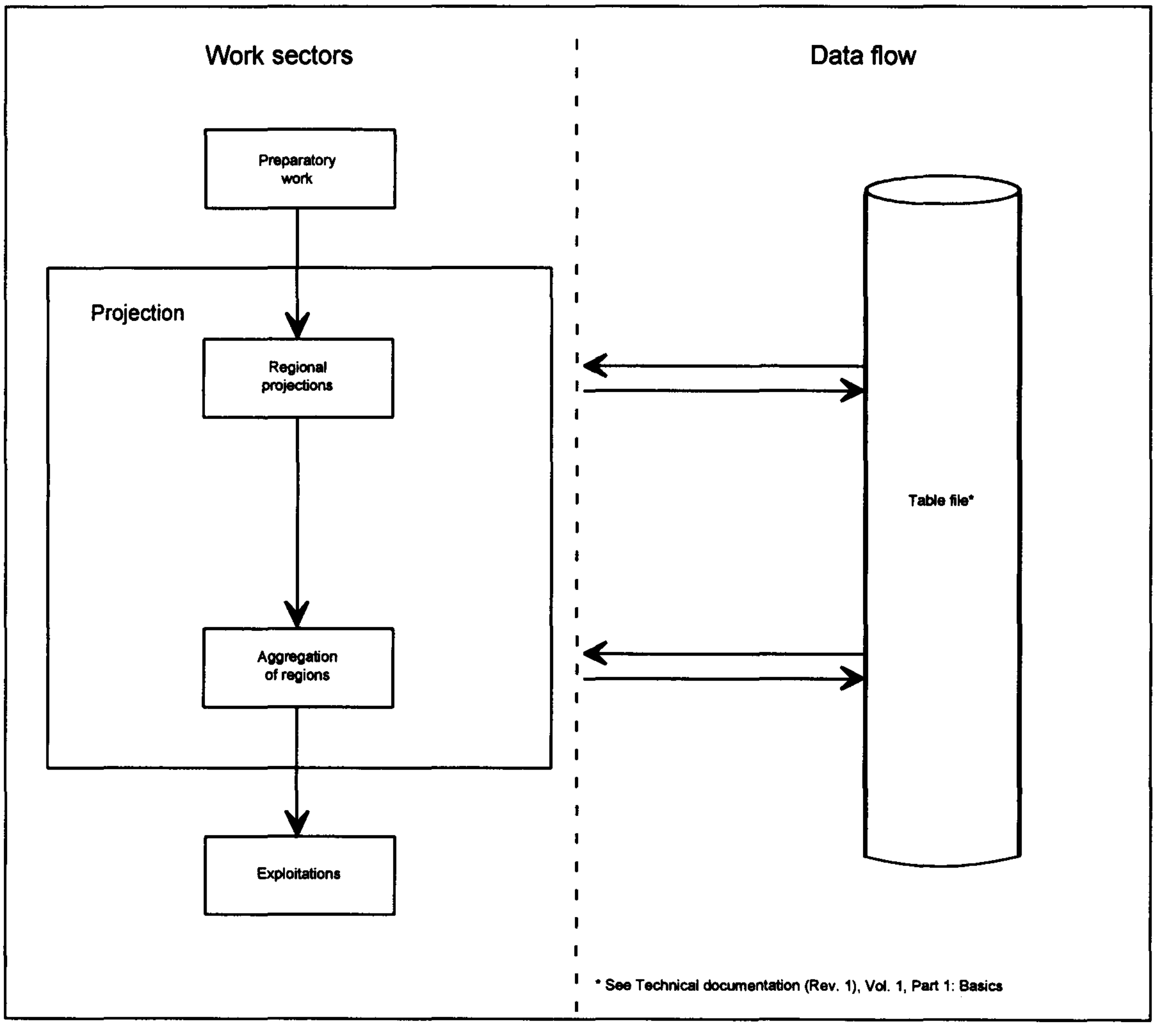
This is then followed, as shown in Figure 4, by the regional aggregation for the EU as a whole . This regional aggregation is performed according to the method already described in the Base Model documentation [110].

All the results of the work step "projection" are stored in the same structure as the data for ex-post representation [111], so that the evaluations of the work sector "exploitation" can be performed in the same way as for the SPEL/EU-Data (results of the Base Model).

[110] See 'SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System.

[111] The accounting system (ABTA and MAC) of SPEL/EU-Model is the base for a supply oriented table and a demand oriented table. The SPEL/EU-Data are stored in the line and the column structure of these annual tables for each region. See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, annex 1.

Figure 4: Structure of the "Projection" work step



5. PREPARATORY WORK

5.1. Exogenous variables

5.1.1. Definitional remarks

As mentioned above, projections are obtained within the framework of the ABTA and MAC. The results being compiled from the following grouped exogenous variables:

- **Output generation (physical component of MAC),**
- **Levels of production activities,**
- **Farm gate prices (producer and purchase prices),**
- **Market resource / use activities and**
- **Other variables.**

The various elements (variables) of these groups are determined exogenously on the basis of their changes in relation to the base year, before the actual projection work starts. The changes of these variables are regarded as constants when the projection results are drawn up.

- **Output Generation (physical component of MAC) and Levels of production activities,**

In this respect, the division of the Output Generation components into production activities is useful since the output generation coefficients and the corresponding levels of production activity can be specified independently of each other in order to take account of technical and structural production aspects individually.

<u>Technical progress and substitution processes</u> for the Output Generation component must be generally taken into account by specification of the changes of the specific exogenous variables (output generation coefficients and production activity levels). The consideration of these aspects is provided by establishing the projection results. However, the importance of these determined factors is under the short-term perspective not so high, because mostly they are dominated and effaced by the random annual fluctuations.

In most cases, however, it is easier to make provision for <u>random influences</u> (e.g. climatic conditions) or administrative influences of the CAP (e.g. quotas) to the physical Output Generation via the yield coefficients and the production activity levels, rather than through overall sector variables (e.g. total physical production, etc.).

- **Farm gate prices (producer and purchase prices),**

For the exogenous price variables, the market-related and administratively-influenced price-forming processes for agriculture have to be taken into account at the outset when the changes in relation to the base year are being specified, since these exogenous variables, too, are treated as constants in the projections.

- **Market use activities,**

The evolution of the gross physical product flows outside the agricultural sector (market use and resource activities) are determined by the total domestic use. These use activities are exogenously specified for the product groups under consideration.

- **Other variables:**

Apart from these groups of exogenous variables, there is a group of "Other variables" which needs to be determined exogenously and which includes overall economic variables. Some of these variables affect agricultural production only very slightly but have to be available for calculations for the projection period as well (e.g. ECU/national currency exchange rate, inflation rate, etc.).

The grouped exogenous variables are listed in annex 2 of this documentation and also some definitional remarks for specific variables or variable groups are given in this annex.

5.1.2. Specification

The development of exogenous variables is specified for each year of the projection period on the basis of their change with regard to the base year (as a rule the last available year of the ex-post representation period). The percentage rates of change can be calculated either from projected data of the exogenous variables such as:

(1a) $$p_{i,j,tb+s} = \left(\frac{XP_{i,j,tb+s}}{X_{i,j,tb}} - 1 \right) 100$$

or from annual percentage growth rates such as:

(1b) $$p_{i,j,tb+s} = \left(\prod_{a=tb+1}^{tb+s} \left(1 + \frac{p^*_{i,j,a}}{100} \right) - 1 \right) 100$$

The percentage changes are entered as factors in the projection algorithms (work step "projection") as follows:

(2) $$FAC_{i,j,tb+s} = 1 + \frac{p_{i,j,tb+s}}{100}$$

where:
p : Growth rate in percent,
p^* : Growth rate (annual) in percent,
FAC : Factor,
XP : Exogenous variable data, projected,
X : Exogenous variable data, ex post,
tb : Subscript, base year (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year (s = (1, 2, 3)),
i : Subscript, table column of exogenous variable,
j : Subscript, table line of exogenous variable.

Since the trend of exogenous variables is specified by their relative change, the rate of change of variables based on different definitions but which are subject-related can be used. The rate of change principle ensures that there is no break in the definitional basis when ex-post and ex-ante data are linked. Relative changes are also a clear means of depicting developments.

For each projection year, the rate of change of the exogenous variables compared with the base year is specified. As a result, the projections of individual years are independent of each other and the exogenous variable specifications are entered in the projection results without amendment.

As already mentioned in chapter 3.3, whenever data for ex-post representation are actualised it must be assumed that there will be changes to the base year data. Consequently, exogenous variables are either not specified until the actualisation has taken place or, if already specified, they are given a further check.

5.2. System proposals

Three sources may be used for the numerical specification of exogenous variables in the SFSS:

- original statistical data,
- SPEL/EU-Data for ex-post representation, and
- the judgement of experts.

System proposals are calculated using the rate of change of indicator times series and those of trend calculations of the respective exogenous variables. These system proposals are submitted to experts for checking (see next chapter).

5.2.1. Indicators

Each exogenous variable can be allocated one or more statistical time series[112]. These statistical time series, termed "indicators", have a definitional link with the exogenous variables. Where possible, statistical series extracted from the CRONOS data bank for producing the SPEL/EU-Data (ex-post representation) are used as indicators. If calculations have been made with these time series for ex-post representation, they are checked where possible. For example, the output coefficients are calculated if both the production activity level and physical production data are available.

With the aid of these indicators, a proposal is made for changing the exogenous variables for the projection period. If several indicator proposals are available, an indicator is selected on the basis of the statistical fit (Theil coefficient or coefficient of determination)[113] for the ex-post period. In order to calculate the statistical fit, for a given ex-post period[114] the data of the exogenous variables and those of the indicators are scaled by calculating factors. For the exogenous variables of the SPEL/EU-Data:

$$\text{(3a)} \qquad SFAC_{i,j,t+s} = \frac{X_{i,j,t+s}}{X_{i,j,t}}$$

and for the indicators,

[112]A full list of used indicators can be obtained as a working paper from the Eurostat SPEL team.

[113]The definition of these coefficients are given in SPEL System, Technical Documentation (Rev. 1), Vol. 2: BS, SFSS, MFSS.

[114]The given ex-post period for the statistical fit calculation is changed to the shortest common ex-post period if ex-post data are not available for all the specified years

(3b) $$SFAC_{l,i,j,t+s} = \frac{XC_{l,i,j,t+s}}{XC_{l,i,j,t}}$$

The growth rate is calculated with the selected indicator as shown in equation (1a) as follows:

(3c) $$p_{i,j,tb+s} = \left(\frac{SFAC_{l',i,j,tb+s}}{SFAC_{l',i,j,tb}} - 1 \right) 100$$

The proposal for the development of the exogenous variable is then calculated with this growth rate as shown in equation 2:

where:
- $SFAC$: Scaling factor,
- X : SPEL/EU-Data, ex-post,
- XC : CRONOS data, ex-post,
- p : Growth rate in percent,
- t : Subscript, year$\left(t \in (73,...,T)\right)$,
- tb : Subscript, base year $\left(tb \in (73,...,T)\right)$,
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year (s = (1, 2, 3)),
- i : Subscript, table column of exogenous variable,
- j : Subscript, table line of exogenous variable,
- l : Subscript, indicator ($l \in (1, ..., 20)$),
- l' : Subscript, chosen indicator ($l' \in (1, ..., 20)$).

The importance of these indicators for the projections increases the more the ex-post projection scope can be allocated to the individual projection year. The proposals based on a selected indicator are available for the "projection" work step, in accordance with equations 1a and 2.

However, before they are entered in the system proposals, they are compared with the proposals based on ex-post extrapolation using the statistical fit method (Theil coefficient or coefficient of determination).

5.2.2. Extrapolation by trend

The ex-post trend development for each exogenous variable is calculated independently of the indicator time series and applied to the projection years by extrapolation. This trend development should generally be interpreted as the result of a large number of economic, production technology and other factors which have influenced the development of the exogenous variables in the past. This influence by a group of factors is referred to below simply as the "shift factor".

A time series is available for each exogenous variable in the SPEL/EU-Data for ex-post representation starting with the year 1973. A simple function of a time trend is estimated from a given ex-post representation period by OLS [115] regression. The trend data for the exogenous variable for the ex-post and projection period can be estimated as follows:

[115] Ordinary Least Squares method (OLS).

(4a) $X^{*}_{l,i,j,t} = f(t) = a_0 + a_1 t$

The dependent data and the independent data by OLS regression can be transformed to obtain a best fit as follows,

LIN	Linear (no transformation)	$x' = x$
LN	Natural logarithm	$x' = \mathrm{LOG_e}(x)$
LOG	Logarithm base 10	$x' = \mathrm{LOG_{10}}(x)$
SQR	Square root	$x' = \sqrt{x}$
REZ	Inverse	$x' = \frac{1}{x}$
EXP	Exponential	$x' = e^x$
POW	Power	$x' = 10^x$
QUA	Square	$x' = x^2$

The combination that fits best according to the Theil coefficient or the coefficient of determination is then automatically selected unless the operator wants to force a particular combination, determined on the basis of plausibility.

Using the selected trend function, the trend data needed for establishing the growth rates are calculated as shown in equation (1a), as follows:

(4b) $$p_{i,j,tb+s} = \left(\frac{X^{*}_{l',i,j,tb+s}}{X_{i,j,tb}} - 1\right)100$$

where:
- X^* : Trend data based on SPEL/EU-Data,
- X : SPEL/EU-Data, ex-post,
- p : Growth rate in percent,
- t : Subscript, year $\left(t \in (73,\ldots,T)\right)$,
- tb : Subscript, base year $\left(tb \in (73,\ldots,T)\right)$,
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year (s = (1, 2, 3)),
- i : Subscript, table column of exogenous variable,
- j : Subscript, table line of exogenous variable,
- l : Subscript, indicator ($l \in (1, \ldots, 8)$),
- l' : Subscript, chosen trend function ($l' \in (1, \ldots, 20)$).

The proposal for the development of the exogenous variable is then calculated with this growth rate as shown in equation 2.

The importance, for the projections, of these proposals based on trend extrapolation increases the more the ex-ante projection scope has to be allocated to the individual projection year.

Before these proposals assume the importance of a system proposal, a comparison based on statistical fit (Theil coefficient or the coefficient of determination) is made of the proposals based on the selected indicator (equation 3b). For this comparison, the ex-post trend data estimated by equation (4a), are scaled as follows:

(5) $$SFAC_{i,j,t+s} = \frac{X^{*}_{l',i,j,t+s}}{X_{i,j,t}}$$

where:
- $SFAC$: Scaling factor,
- X : SPEL/EU-Data, ex post representation,
- X^{*} : Trend data,
- t : Subscript, year ($t \in (73, \dots, T)$),
- tb : Subscript, base year ($tb \in (73, \dots, T)$),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year ($s = (1,2,3)$),
- i : Subscript, table column of exogenous variable,
- j : Subscript, table line of exogenous variable,
- l' : Subscript, chosen trend function($l' \in (1,\dots,8)$).

The system proposal is carried out according to the statistical fit (Theil coefficient or coefficient of determination) based on equations 3b and 5. The system proposals (growth rate calculated according to equation 1a) for the exogenous variables are presented to the experts for information and checking together with some additional ex-post information.

5.3. Judgement of experts

A major stage in the preparatory work is given over to experts. As a rule, the system proposals (see previous chapter) for specifying exogenous variables for each projection year and each region (Member State) are submitted to experts for approval. The system proposals are assigned according to their origin (indicator, trend extrapolation) and treatment (e.g. trend function).

The function of the experts mainly consists in processing the available information and subjective estimates of possible development trends and/or random influences, in accordance with the definitional requirements of the exogenous variables. Anticipated technological advances, substitutive processes, structural changes, etc. are some of the aspects which help to form the judgement of the experts. Aid in this opinion-forming and conversion process is provided by the supplementary ex-post information supplied with the system proposals for each exogenous variable.

When applying the assessments, the expert either confirms or rejects the system proposals. The experts' assessments must be specified with the same base year-related rates of change. The judgement of the experts as a rule is included in the subsequent projections. Only in cases where the expert has confirmed the system proposals or not provided any assessment are the system proposals resorted to for the projections.

6. PROJECTION METHODS

6.1. General remarks

The components of the EU-Model are based on an accounting system which in turn is structured, in its details, by the ABTA and MAC. As a result, as already mentioned, the numerical specification of the ABTA and MAC for the projection years constitutes the basis and guideline for the methodological procedure applied in the SFSS.

As already mentioned, one aim of the SFSS (see chapter 2) is to identify the direct effect of random or administrative factors influencing production and income. The influence of these factors (see chapter 5.1) is supplemented by a whole range of other interdependent results of economic and production technology decision-making processes. In the Output Generation, which is described below, it is assumed that these factors of influence have been taken into account as far as possible in the specification of the exogenous variables. This also applies to the effects of the allocation of the primary factors (labour and capital) to the Output Generation. For a period of one to three years, however, it can be assumed that the influence of the primary factors on production remains unchanged.

As with the methodological procedure for the Base Model, in the SFSS, the equation system on which the ABTA and MAC are based is numerically specified recursively each year and recursively in the table components:

- Output Generation
- Input Use
- Output Use including the additional Demand component and
- Input Generation

for each region (Member State) of the EU followed by a regional aggregation for the EU as a whole . Figure 5 provides a synopsis view of the sequence and the recursive links in the methodological procedure for specifying the annual accounting tables.

The design of the Base Model is based on the availability of original statistics for the ex-post periods. These statistical data are generally the aggregated result of economic, production technology and other individual decision-making processes completed in the past. On the basis of these data, in the Base Model the respective agricultural production and consumption aspects considered to be important are determined in such a way that they remain consistent with each other.

In the SFSS, on the other hand, the methodological procedure is based on the extrapolation, for the projection years, of the consistent agricultural production and consumption aspects available for a base year, in order to calculate the overall sectoral gross production data for agriculture.

Figure 5: Scheme of the recursive solution of ABTA and MAC

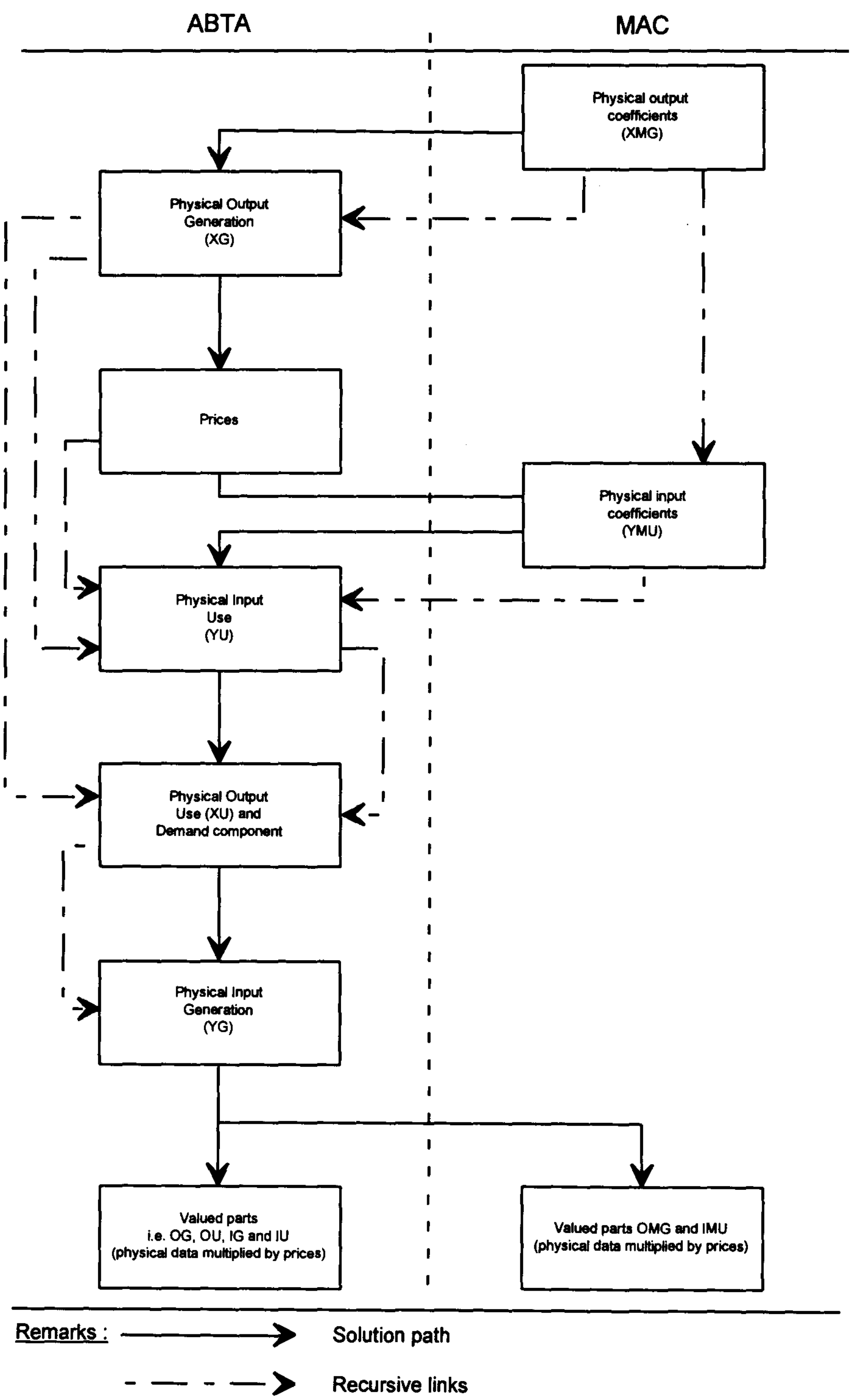


Figure 6: Solution scheme for the time and regional dimensions of the "Projection" work step of SFSS

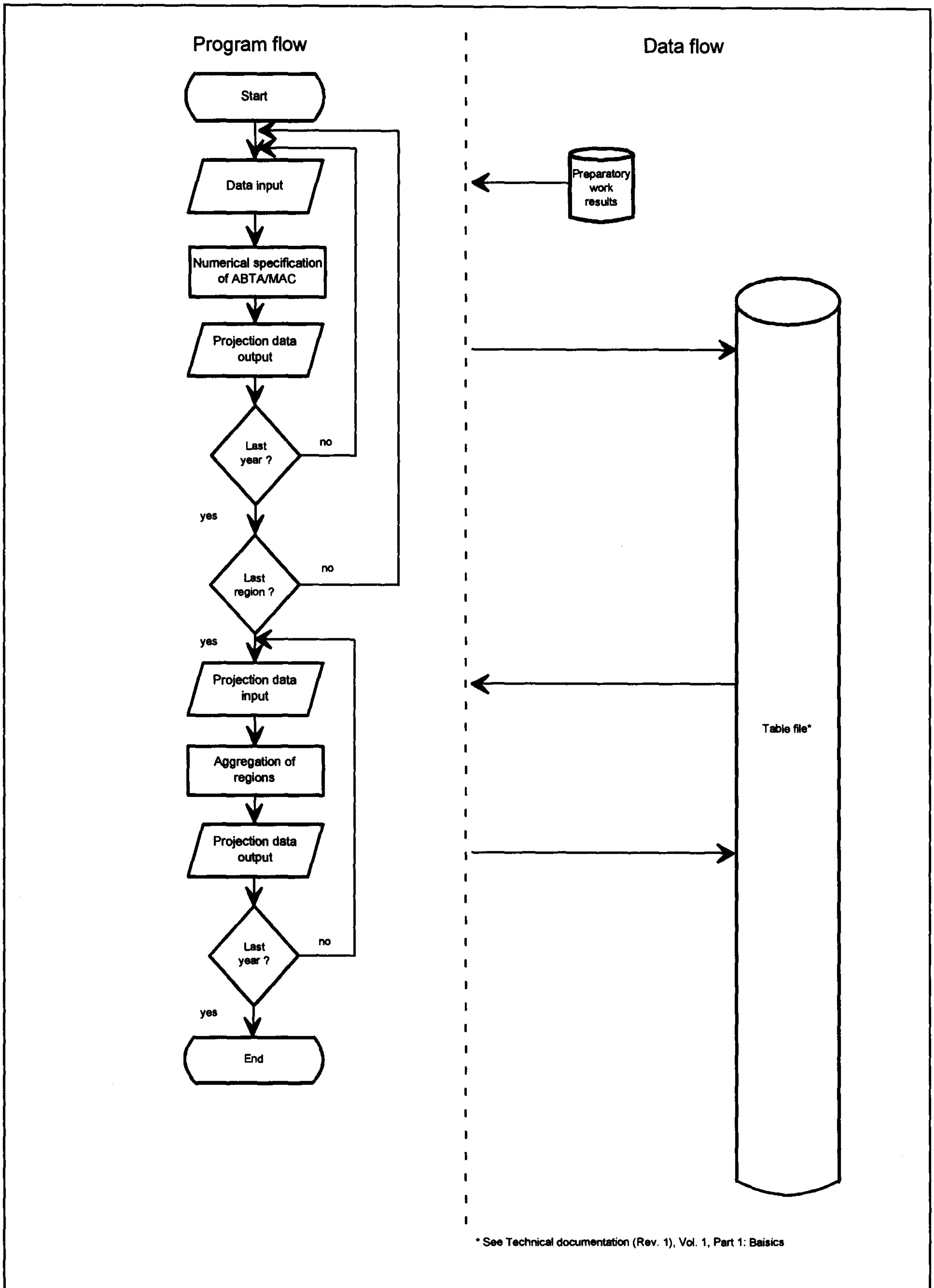
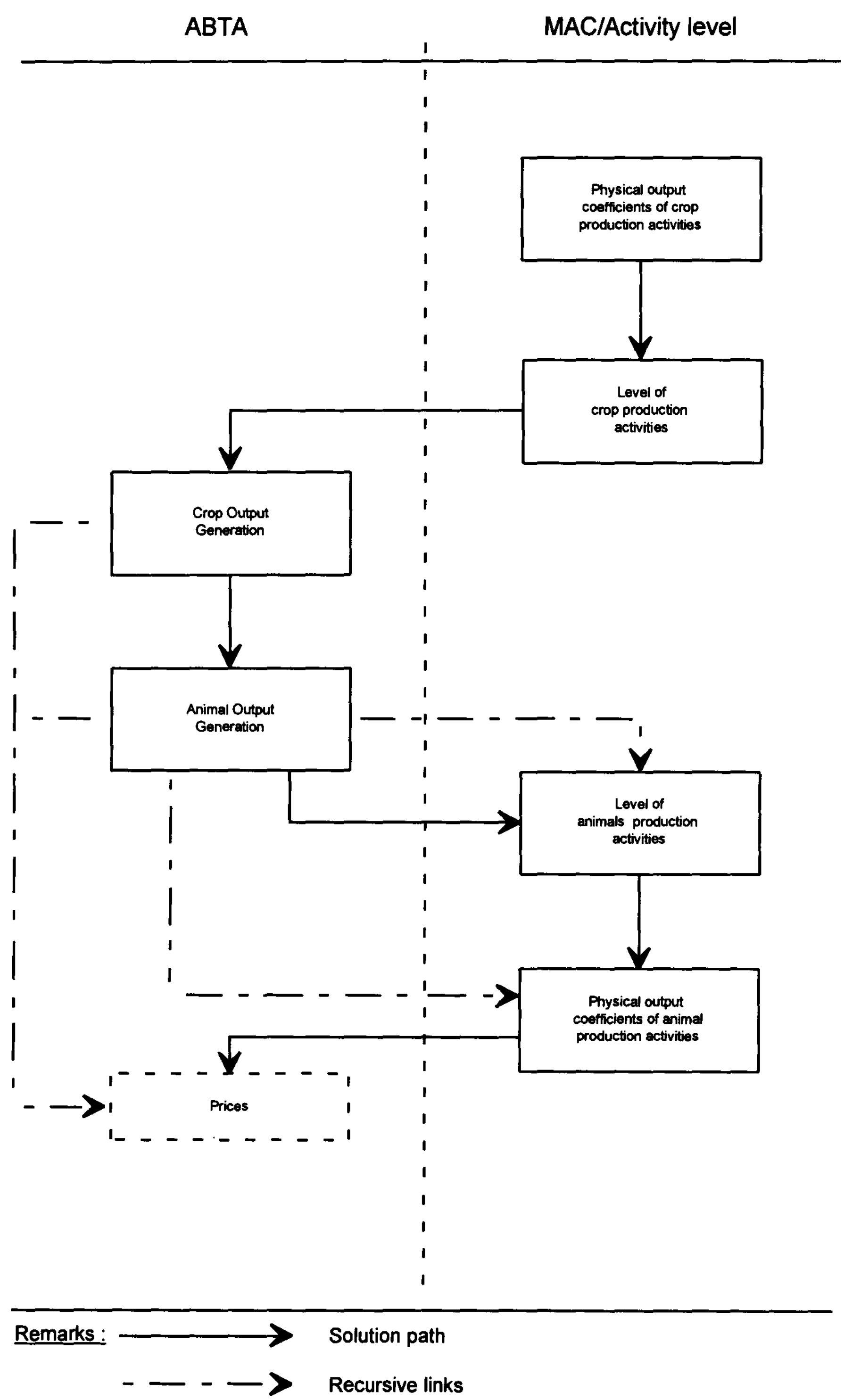


Figure 7: Scheme of the solution of Output Generation



The numerical specification algorithms are commented on in the following chapters in the sequence indicated in Figure 5. Figure 5 does not contain a time reference because this schematic structure has to be followed in the given order of succession for any period under consideration (calendar year). However, the equations in the following notes contain mostly a subscript for time references. A regional subscript is not added in the following equation because the given equations are used unchanged for each region (Member State) under consideration. Such a subscript is added only if the comments focus on these subscripts. For the line and column subscripts, the abbreviations used are as defined in Part 1 of the EU-Model documentation[116]. The ABTAs (MACs) for separate EU Member States are also numerically specified sequentially as shown in Figure 6.

Once all the projection data for the Member States have been produced, they are put through a further work step (see figure 6) to obtain the aggregates for the EU as a whole . Details of the algorithms are given in the Base Model documentation[117]

Some equations depend on exogenously specified proposals. If these proposals (factors) are not specified, the "no change assumption" is used principally. If a different assumption is made, this difference is mentioned in the text.

e.g. IF $(s+1>3)$ then $FAC_{tb+(s+1)} = 1.0$

where: FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

6.2. Physical Output Generation of MAC and ABTA

The physical output coefficients, based on a unit of the production activity levels constitute the main sector for the projection of the ABTA and MAC elements (variables). Again, the exogenous proposals of the production activity levels form a central area for projections. Figure 7 shows the schematic path followed for the specification of the physical Output Generation component of both the MAC and the ABTA.

6.2.1. Crop production

The Output Generation of crop products is generally specified by the exogenous data of the output coefficients of the main crop products[118] and the production activity levels, according to equations 1a and 2, as follows:

for physical output coefficients of MAC:

(6a) $$XMG_{i',j',tb+s} = XMG_{i',j',tb} FAC_{i',j',tb+s}$$

and *for production activity levels*:

(6b) $$LEVL_{i,tb+s} = LEVL_{i,tb} FAC_{i,tb+s}$$

[116] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, annex 1.
[117] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapter 3.10..
[118] The agricultural products under consideration are divided into main and joint products, see SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, annex 1, Supply table structure.

To calculate the joint crop products of the main crop production activites, the available ratio of the physical output coefficients of the base year is used (e.g. silage from sugar beet production and straw from cereal production), as follows:

(6c) $$XMG_{i',j'',tb+s} = XMG_{i',j,tb+s} \frac{XMG_{i',j'',tb}}{XMG_{i',j,tb}}$$

where:
- XMG : Output Generation, MAC, physical component,
- $LEVL$: Production activity levels,
- FAC : Factor (exogenously specified),
- i : Subscript, crop production activities,(i = (SWHE, .., SILA)),
- i' : Subscript, main crop production activities,(i = (SWHE, .., OCRO)),
- j : Subscript, crop products, (j = (SWHE, .., SILA)),
- j' : Subscript, main crop products, (j = i),
- j'' : Subscript, joint crop products, (j" = (SILA, STRA),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1, 2, 3)).

All output coefficients of the production activites for final crop products are specified.

The elements of the physical Output Generation of the ABTA are expressed, as equations 6a and 6b, as follows:

(7) $$XG_{i',j,tb+s} = XMG_{i',j,tb+s} LEVL_{i',tb+s}$$

where:
- XMG : Output Generation, MAC, physical component,
- XG : Output Generation, ABTA, physical component,
- $LEVL$: Production activity levels,
- i' : Subscript, crop production activities,(i = (SWHE, .., OCRO)),
- j : Subscript, crop products, (j = (SWHE, .., STRA)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1, 2, 3)).

The physical output coefficients of the intermediate production activities[119] are endogenously calculated, depending on the resource needs for "fresh and ensilaged fodder" and for "dried fodder" to feed the animals. After the calculation of feed use (see chapter 6.4.2) the physical output coefficient calculation is performed as follows:

For the Input Generation of ABTA:

(8a) $$YG_{FEEP,FFSI,tb+s} = \sum_{i''} YMU_{i'',FFSI,tb+s} LEVL_{i'',tb+s}$$

For the Output Use of ABTA:

[119] The production activities for intermediate crop products under consideration only produce root crops, silage, green fodder and hay, see SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics, annex 1, Supply table structure.

(8b) $$XU_{\mathrm{FEEP},j',\mathrm{tb+s}} = YG_{\mathrm{FEEP,FFSI,tb+s}} \frac{XU_{\mathrm{FEEP},j',\mathrm{tb}}}{\sum_{j'} XU_{\mathrm{FEEP},j',\mathrm{tb}}}$$

For the Output Generation of ABTA:

(8c) $$XG_{i',j',\mathrm{tb+s}} = \left(XU_{\mathrm{FEEP},j',\mathrm{tb+s}} - \sum_{i} XG_{i,j',tb+s} \right) \frac{XG_{i',j',\mathrm{tb}}}{\sum_{i'} XG_{i',j',\mathrm{tb}}}$$

so that the physical output coefficients are obtained as follows:

(8d) $$XMG_{i',j',\mathrm{tb+s}} = \frac{XG_{i',j',tb+s}}{LEVL_{i',tb+s}}$$

where:
YG : Input Generation, ABTA, physical component,
XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
YMU : Input Use, MAC, physical component,
$LEVL$: Production activity levels,
h' : Subscript, input items, unmarketed feedingstuffs,(i' = (FDRY, FFSI)),
i : Subscript, crop production activities,(i = (SWHE, ... , SILA), excluding i'),
i' : Subscript, crop production activities,(i' = (OROO, GRAS, SILA)),
i'' : Subscript, animal production activities, (i" = (MILK, ..., PIGL)),
j' : Subscript, intermediate crop products, (j' = (OROO, ... , STRA)),
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1, 2, 3)).

Exceptions to this general rule are made for those final crop products for whose physical production administratively fixed limits (quotas) are to be considered (e.g. sugar beet production). For these products, instead of the production activity levels, the total physical production or the agricultural sales are exogenously specified, in order to take account of changes in CAP administrative prescriptions. For these products, the production activity levels are calculated residually as follows:

for exogenous agricultural sales:

(9a) $$TXG_{\mathrm{j,tb+s}} = \sum_{k'} XU_{\mathrm{k',j,tb}} + \sum_{k''} XU_{\mathrm{k'',j,tb+s}} FAC_{\mathrm{k'',j,tb+s}}$$

for exogenous gross production:

(9b) $$TXG_{\mathrm{j,tb+s}} = \sum_{i} XG_{\mathrm{i,j,tb}} FAC_{\mathrm{TXG,j,tb+s}}$$

and the endogenously calculated activity level:

(10) $$LEVL_{i,tb+s} = \frac{TXG_{j,tb+s}}{XMG_{i,j,tb+s}}$$

with:

$$FAC_{TXG,j,tb+s} = \frac{TXG_{j,tb+s}}{\sum_{k} XU_{k,j,tb}}$$

where:
- XMG : Output Generation, MAC, physical component,
- XU : Output Use, ABTA, physical component,
- TXG : Total output generation, (physical gross production),
- $LEVL$: Production activity levels,
- FAC : Factor (exogenously specified),
- i : Subscript, crop production activities with quotas, (i ∈ (SWHE,..., SILA)),
- j : Subscript, crop products with quotas, (j ∈ (SWHE, ...,SILA)),
- k : Subscript, use activities, (k = (PLOF, ..., TRAP)),
- k' : Subscript, use activities, (k'= k, excluding k"),
- k'' : Subscript, use activities, (k" = (PCOF, TRAP)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

This residual calculation of activity levels via quota production allows the sectoral production to be stipulated whilst taking into account economic and production technology factors (e.g. advances in biotechnology) by stipulating the output coefficients.

6.2.2. Animal production

In order to solve the following equations for the animal Output Generation physical component of the ABTA, the production activity has to be calculated in advance for some equations. For simplification purposes, the corresponding equation is referred to with the note "with equation".

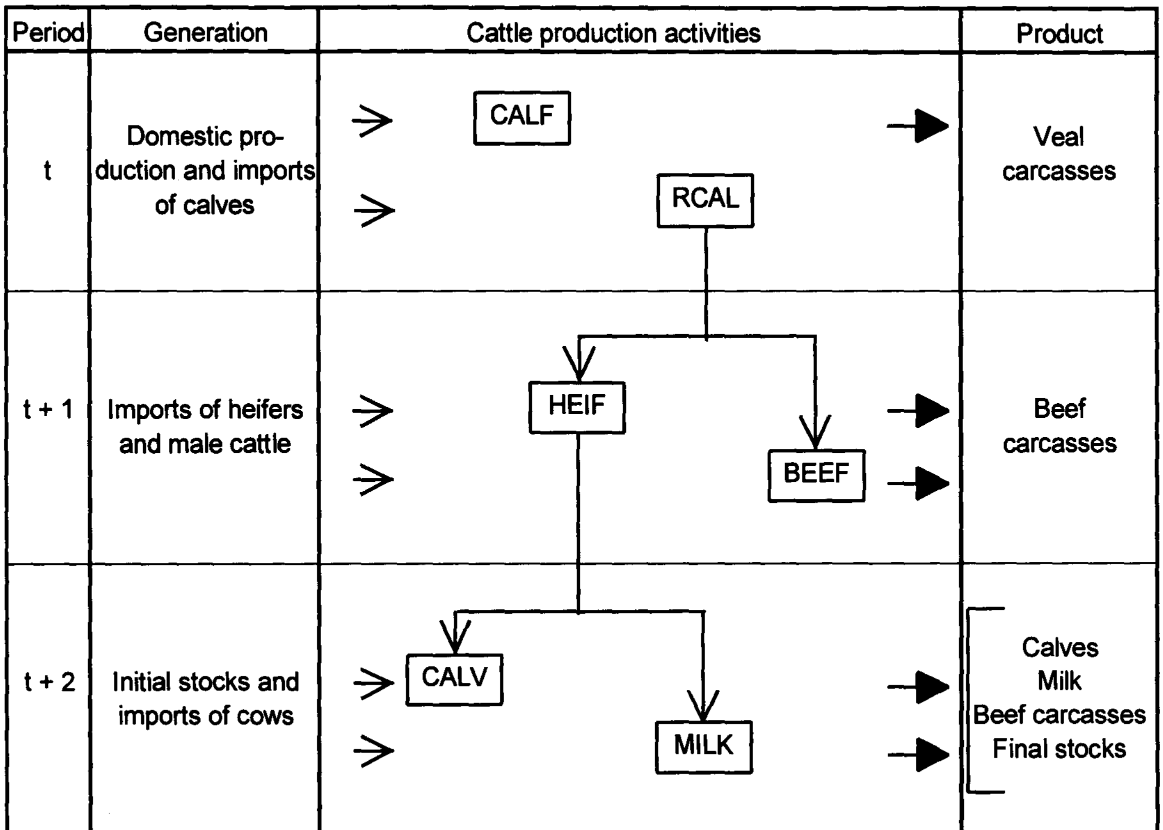
In order to cover the live animal interactions (e.g. Figure 8) between the activities, first of all the gross flows of the Output Generation component of the ABTA are calculated. In some cases the output coefficient of the MAC of the base year has to be used.

At the next stage, the production activity levels and the Output Generation are calculated, which are largely interdependent. The calculations are preceded with references to the equation on which they are based.

Some cattle products are produced over a period of more than one year as shown in Figure 8 which is explained in the Base System documentation[120]. Therefore the cattle gross production calculation for Output Generation and also the activity level calculation are separated from the other production activities.

[120] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, Chapter 3.3.3..

Figure 8: Cattle production activities interaction



Remark :

The meat products include live animal exports for slaughter.

The calves produced at the end of period t + 2 are inputs into the cattle younger than 12 months production activities at the beginning of the period t + 3.

6.2.2.1. Cattle production activities

6.2.2.1.1. Production activity levels

According to the type of activity and the age of the cattle, the calculations are done,

- for ***Dairy cows*** (MILK):

  The livestock changes for dairy cows are exogenously given and the replacement of dairy cows is influencend by the exogenously given slaughtered cows.The calculations are done as follows:

(11a) $$FS_{DCOW,tb+s} = FS_{DCOW,tb} FAC_{FS,DCOW,tb+s}$$

(11b) $$\Delta FS_{DCOW,tb+s} = FS_{DCOW,tb+s} - FS_{DCOW,tb+(s-1)}$$

(11c) $$GIP_{DCOW,tb+s} = GIP_{DCOW,tb}\, FAC_{GIP,cows,tb+s}$$

(11d) $$LEVL_{MILK,tb+s} = FS_{DCOW,tb+s}$$

where: $LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
FS : Final stock,
ΔFS : Final stock changes,
FAC : Factor (exogenously specified),
$DCOW$: Subscript, product, dairy cows,
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Other cows*** (CALV):

The livestock changes for "other" cows are endogenously calculated and the replacement of dairy cows are influencend by the exogenously given slaughtered cows. All imported cows are assumed to be cows for slaughter.The calculations are done as follows:

(12a) $$GIP_{SCOW,tb+s} = GIP_{SCOW,tb}\, FAC_{GIP,cows,tb+s}$$

(12b) $$\Delta FS_{SCOW,tb+s} = GIP_{SCOW,tb+(s+1)} - GIP_{SCOW,tb+s}$$

If the cows for slaughter for the next period is not specified, then the following assumptions will be made:

$$IF\,(s+1 \le 3) \quad \text{then} \quad FAC_{GIP,cows,tb+(s+1)} = FAC_{GIP,cows,tb+s}$$

(12c) $$FS_{SCOW,tb+s} = FS_{SCOW,tb+(s-1)} + FS_{SCOW,tb+s}$$

(12d) $$LEVL_{CALV,tb+s} = FS_{SCOW,tb+s} + IMP_{SCOW,tb+s}$$

with: $$IMP_{SCOW,tb+s} = IMP_{SCOW,tb} FAC_{IMP,cows,tb+s}$$

- and for ***all cows***:

The livestock changes for cows are exogenously given. The same change rates are used as for dairy and "other" cows and the calculations are done as follows:

(13a) $$GIP_{cows,tb+s} = GIP_{DCOW,tb+s} + GIP_{SCOW,tb+s}$$

(13b) $$\Delta FS_{cows,tb+s} = \Delta FS_{DCOW,tb+s} + \Delta FS_{SCOW,tb+s}$$

where: $LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
FS : Final stock,
ΔFS : Final stock changes,
IMP : Imports, live animals for slaughtering,
FAC : Factor (exogenously specified),
$SCOW$: Subscript, product, other cows,
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Calves fattening*** (CALF):

The gross indigenous production of slaughtered calves and the imports of calves for slaughter are exogenously given.The calculations are done as follows:

(14a) $$GIP_{calves,tb+s} = GIP_{calves,tb} FAC_{GIP,calves,tb+s}$$

(14b) $$LEVL_{CALF,tb+s} = GIP_{calves,tb+s} + IMP_{calves,tb+s}$$

with: $$IMP_{calves,tb+s} = IMP_{calves,tb} FAC_{IMP,calves,tb+s}$$

where: $LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
IMP : Imports, live animals,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Calves rearing*** (RCAL):

The rearing calves dependon the heifers and bulls (male adult cattle) used in the next period.,The calculation are done as follows (with equations 16b and 17b):

(15) $$LEVL_{RCAL,tb+s} = FS_{heifers,tb+s} + FS_{bulls,tb+s}$$

where: LEVL : Production activity levels,
FS : Final stock,
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Heifers, breeding and fattening*** (HEIF):

The gross indigenous production of slaughtered heifers (next period) and the imports of heifers for slaughter are exogenously given. The calculations are done as follows (with equation 13b):

(16a) $GIP_{heifers,tb+(s+1)} = GIP_{heifers,tb} \; FAC_{GIP,heifers,tb+(s+1)}$

(16b) $FS_{heifers,tb+s} = GIP_{heifers,tb+(s+1)} - GIP_{cows,tb+(s+2)} - \Delta FS_{cows,tb+(s+2)}$

(16c) $GIP_{heifers,tb+s} = FS_{heifers,tb+(s-1)} - GIP_{cows,tb+(s+1)} - \Delta FS_{cows,tb+(s+1)}$

(16d) $LEVL_{HEIF,tb+s} = GIP_{cows,tb+(s+1)} + \Delta FS_{cows,tb+(s+1)} + GIP_{heifers,tb+s} + IMP_{heifers,tb+s}$

If the heifers becoming dairy cows and other cows are greater than the available indigenously produced heifers ($FS_{HEIF,tb+s-1}$), then the following assumption is made:

with: $IMP_{heifers,tb+s} = IMP_{heifers,tb} \; FAC_{IMP,heifers,tb+s}$

where:
- $LEVL$: Production activity levels,
- GIP : Gross indigenous production, slaughtered animals,
- FS : Final stock,
- ΔFS : Final stock changes,
- IMP : Imports, live animals for slaughtering,
- FAC : Factor (exogenously specified),
- tb : Subscript, base year, ($tb \in (73, ..., T)$),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, ($s = (1,2,3)$).

- for ***Male adult cattle fattening*** (BEEF):

The gross indigenous production of slaughtered male adult cattle (next period) and the imports of male adult cattle for slaughter are exogenously given.The calculations are done as follows:

(17a) $GIP_{bulls,tb+(s+1)} = GIP_{bulls,tb} \; FAC_{IMP,bulls,tb+(s+1)}$

(17b) $FS_{bulls,tb+s} = GIP_{bulls,tb+(s+1)}$

(17c) $GIP_{bulls,tb+s} = FS_{bulls,tb+(s-1)}$

(17d) $LEVL_{BEEF,tb+s} = GIP_{bulls,tb+s} + IMP_{bulls,tb+s}$

with: $IMP_{bulls,tb+s} = IMP_{bulls,tb} FAC_{IMP,bulls,tb+s}$

where:
- $LEVL$: Production activity levels,
- GIP : Gross indigenous production, slaughtered animals,
- FS : Final stock,
- IMP : Imports, live animals for slaughtering,
- FAC : Factor (exogenously specified),
- tb : Subscript, base year, ($tb \in (73, ..., T)$),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, ($s = (1,2,3)$).

6.2.2.1.2. *Output Generation of ABTA*

On the basis of the gross interactive flows of live animals (see chapter before: production activity levels) and some exogenous output coefficients of meat, the Output Generation (main and joint products) are numerically specified.

- for ***Calves fattening*** (CALF) with equation 14b.

The meat output coefficient is exogenously specified and the Output Generation of veal is calculated as follows:

(18) $$XG_{CALF,VEAL,tb+s} = XMG_{CALF,VEAL,tb}\, FAC_{CALF,VEAL,tb+s}\, LEVL_{CALF,tb+s}$$

where:
XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
$LEVL$: Production activity levels,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Calves rearing*** (RCAL).

The Output Generation of *Calves rearing* considers the live animals for

- male adult cattle, older than 12 months and
- heifers, older than 12 months

of the next period. These cattle products are exogenously determined. The product calculations are made for

- male adult cattle product, older than 12 months with equation 17b,

(19a) $$XG_{RCAL,BULL,tb+s} = FS_{bulls,tb+s}$$

- heifers product, older than 12 months with equation 16b,

(19b) $$XG_{RCAL,HEIF,tb+s} = FS_{heifers,tb+s}$$

where:
XG : Output Generation, ABTA, physical component,
FS : Final stock,
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Male adult cattle fattening*** (BEEF) with equation 17d.

The meat output coefficient is exogenously specified and the production of beef of male adult cattle is calculated as follows:

(20) $$XG_{BEEF,BEEF,tb+s} = XMG_{BEFF,BEEF,tb}\, FAC_{BEEF,BEEF,tb+s}\, LEVL_{BEEF,tb+s}$$

where: XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
$LEVL$: Production activity levels,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Heifers, breeding and fattening*** (HEIF):

The calculation to specify the different cow products (dairy and other cows), the slaughtered cows and the stock changes of cows (next period) are considered as follows:

- heifers breeding with equations 11b and 11c:

(21a) $$XG_{HEIF,DCOW,tb+s} = GIP_{DCOW,tb+(s+1)} + \Delta FS_{DCOW,tb+(s+1)}$$

and with equations 12a and 12b

(21b) $$XG_{HEIF,SCOW,tb+s} = GIP_{SCOW,tb+(s+1)} + \Delta FS_{SCOW,tb+(s+1)}$$

- heifers fattening (meat production) with equation 16c

The meat output coefficient is exogenously specified and the production is calculated, having taken into account the products "dairy cows" and "other cows" are calculated as follows :

(21c) $$XG_{HEIF,cows,tb} = XG_{HEIF,DCOW,tb} + XG_{HEIF,SCOW,tb}$$

(21d)
$$XG_{HEIF,BEEF,tb+s} = \frac{XG_{HEIF,BEEF,tb}}{LEVL_{HEIF,tb} - XG_{HEIF,cows,tb}} FAC_{HEIF,BEEF,tb+s}\left(GIP_{heifers,tb+s} + IMP_{heifers,tb+s}\right)$$

where: XG : Output Generation, ABTA, physical component,
GIP : Gross indigenous production, slaughtered animals,
$LEVL$: Production activity levels,
IMP : Imports, live animals for slaughtering,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Dairy cows*** (MILK):

The milk output coefficient is exogenously specified and the production is calculated as follows:

- milk product with equation 11d.

(22a) $$XG_{MILK,MILK,tb+s} = XMG_{MILK,MILK,tb}\, FAC_{MILK,MILK,tb+s}\, LEVL_{MILK,tb+s}$$

The other products (joint products) are calculated with the exogenously given "final stock" and slaughtered dairy cows, as follows:

- dairy cow product with equation 11a:

(22b) $$XG_{MILK,DCOW,tb+s} = FS_{DCOW,tb+s} - GIP_{DCOW,tb+s}$$

- calf product with equations 14b and 15:

(22c) $$CALV_{born,tb+s} = LEVL_{RCAL,tb+s} + LEVL_{CALF,tb+s} - IMP_{calves,tb+s}$$

(22d) $$XG_{MILK,CALV,tb+s} = CALV_{born,tb+s} \frac{FS_{DCOW,tb+(s-1)}}{FS_{DCOW,tb+(s-1)} + FS_{SCOW,tb+(s-1)}}$$

- beef product with equation 11c:

The average carcass weight of a slaughtered dairy cow is assumed to be constant, so that

(22e) $$XG_{MILK,BEEF,tb+s} = \frac{XG_{MILK,BEEF,tb+(s-1)}}{GIP_{DCOW,tb+(s-1)}\; GIP_{DCOW,tb+s}}$$

where:

XG	:	Output Generation, ABTA, physical component,
XMG	:	Output Generation, MAC, physical component,
GIP	:	Gross indigenous production, slaughtered animals,
$LEVL$	:	Production activity levels,
$CALV$	:	Total calves, born,
IMP	:	Imports, live animals for slaughtering,
FS	:	Final stock,
FAC	:	Factor (exogenously specified),
tb	:	Subscript, base year, (tb $\in$ (73, ..., T)),
T	:	Subscript, last available year of SPEL/EU-Data,
s	:	Subscript, projection year, (s = (1,2,3)).

- for ***Other cows*** (CALV):

The calf output coefficient is taken as a residual from the total number of calves born and the calves of dairy cows and is calculated as follows

- calf product with equations 22c:

(23a) $$XG_{CALV,CALV,tb+s} = CALV_{born,tb+s} - XG_{MILK,CALV,tb+s}$$

The other products (joint products) are calculated with the exogenously given "gross indigenous production of cows" and a constant average carcass weight as follows:

- beef product with equation 12a:

(23b) $$XG_{CALV,BEEF,tb+s} = \frac{XG_{CALV,BEEF,tb+(s-1)}}{GIP_{SCOW,tb+(s-1)} + IMP_{SCOW,tb+(s-1)}} \left(GIP_{SCOW,tb+(s-1)} + IMP_{SCOW,tb+(s-1)}\right)$$

- other cow product with equations 12a and 12c:

(23c) $$XG_{CALV,SCOW,tb+s} = FS_{SCOW,tb+s} - GIP_{SCOW,tb+s}$$

- milk product with equations 12d

(23d) $$XG_{CALV,MILK,tb+s} = XMG_{CALV,MILK,tb+(s-1)}\ LEVL_{CALV,tb+s}$$

where:
XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
$LEVL$: Production activity levels,
$CALV$: Total calves born,
IMP : Imports, live animals for slaughtering,
GIP : Gross indigenous production, slaughtered animals,
FS : Final stock,
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

6.2.2.2. Production activities other than cattle

6.2.2.2.1. Output Generation of ABTA

The products of the other-than-cattle production activities are mainly produced annually. Meat output coefficients are generally exogenously specified. Breeding activities depend on livestock figures, which are also mostly determined exogenously.

The following calculations are carried out:

- for **Pig breeding** (PIGL) with equations 33, 34.
  - piglet product:

    The exogenously determined final stocks vary relative to the base year stocks

(24a) $$FS_{sows,tb+s} = FS_{sows,tb}\ FAC_{FS,sows,tb+s}$$

(24b) $$\Delta FS_{sows,tb+s} = FS_{sows,tb+s} - FS_{sows,tb+(s-1)}$$

are also used for the calculation of the maiden gilts as follows:

(24c) $$YSO_{tb+s} = YSO_{sows,tb}\ FAC_{FS,sows,tb+s}$$

so that the piglet production can be endogenously calculated as follows:

(24d) $$XG_{PIGL,PIGL,tb+s} = LEVL_{PORK,tb+s} + YSO_{tb+s} - IMP_{pigs,tb+s}$$

  - pork product:

    According to the final stock changes and the maiden gilt's, the slaughtered sows are calculated endogenously as follows:

(24e) $$SSO_{tb+s} = YSO_{tb+s} - \Delta FS_{sows,tb+s}$$

(24f) $$XG_{PIGL,PORK,tb+s} = \frac{SSO_{tb+s}\; XG_{PIGL,PORK,tb+(s-1)}}{SSO_{tb+(s-1)}}$$

where:
- XG : Output Generation, ABTA, physical component,
- $LEVL$: Production activity levels,
- IMP : Imports, live animals for slaughtering,
- FS : Final stocks,
- ΔFS : Final stock changes,
- YSO : Maiden gilts,
- SSO : Sows slaughtered,
- FAC : Factor (exogenously specified),
- tb : Subscript, base year, (tb $\in$(73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

- for **Pig fattening** (PORK) with equation 34

The number of slaughtered pigs is determined exogenously (equation 34), and the meat output coefficients are projected exogenously. The pork production can then be calculated as follows:

(25) $$XG_{PORK,PORK,tb+s} = XMG_{PORK,PORK,tb}\; FAC_{PORK,PORK,tb+s}\; LEVL_{PORK,tb+s}$$

where:
- XG : Output Generation, ABTA, physical component,
- XMG : Output Generation, MAC, physical component,
- $LEVL$: Production activity levels,
- FAC : Factor (exogenously specified),
- tb : Subscript, base year, (tb $\in$ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

- for **Laying hens** (EGGS) with equation 35

  - egg product:

  The final stock and the output coefficient are determined exogenously for the main product "eggs" as follows:

(26a) $$XG_{EGGS,EGGS,tb+s} = XMG_{EGGS,EGGS,tb}\; FAC_{EGGS,EGGS,tb+s}\; LEVL_{EGGS,tb+s}$$

The other joint products are mainly calculated endogenously:

  - chick product (constant replacement factor):

(26b) $$FS_{hens,tb+s} = FS_{hens,tb}\; FAC_{FS,hens,tb+s}$$

(26c) $$\Delta FS_{hens,tb+s} = FS_{hens,tb+s} - FS_{hens,tb+(s-1)}$$

(26d) $$CHI_{tb+s} = c_1\; FS_{hens,tb+(s-1)}$$

(26e) $SLH_{tb+s} = CHI_{tb+s} - \Delta FS_{hens,tb+s}$

(26f) $XG_{EGGS,CHIC,tb+s} = LEVL_{POUL,tb+s} + CHI_{tb+s} + \Delta FS_{hens,tb+s} - IMP_{poultry,tb+s}$

(26g) $IMP_{poultry,tb+s} = IMP_{poultry,tb}\ FAC_{poultry,tb+s}$

- poultry product (constant weight of hen carcass):

(26h) $XG_{EGGS,POUL,tb+s} = c_2\ SLH_{tb+s}$

where:
XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
$LEVL$: Production activity levels,
IMP : Imports, live animals for slaughtering,
FS : Final stocks,
FAC : Factor (exogenously specified),
ΔFS : Final stock changes,
CHI : Chicks for laying,
SLH : Hens slaughtered,
c_1 : Constant (assumed 0.8),
c_2 : Constant (average carcass weight, assumed 0.9 kg),
tb : Subscript, base year, (tb e (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Poultry fattening*** (POUL) with equation 36:

The number of slaughtered poultry is determined exogenously (equation 36), and the meat output coefficients are projected exogenously. The poultry production can then be calculated as follows:

(27) $XG_{POUL,POUL,tb+s} = XMG_{POUL,POUL,tb}\ FAC_{POUL,POUL,tb+s}\ LEVL_{POUL,tb+s}$

where:
XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
$LEVL$: Production activity levels,
FAC : Factor (exogenously specified),
tb : Subscript, base year, ($tb \in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Ewes and nanny goats*** (MUTM) with equation 37:

For this breeding activity the milk output coefficient and the final stocks are also given exogenously, so that:

- milk product:

(28) $$XG_{MUTM,MUTM,tb+s} = XMG_{MUTM,MUTM,tb}\, FAC_{MUTM,MUTM,tb+s}\, LEVL_{MUTM,tb+s}$$

where: XG : Output Generation, ABTA, physical component,
XMG : Output Generation, MAC, physical component,
$LEVL$: Production activity levels,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

For the other joint product the following calculations are carried out:

- lamb product (constant replacement of base year):

(29a) $$GIP_{MUTT,tb+s} = GIP_{MUTT,tb}\, FAC_{MUTT,tb+s}$$

(29b) $$IMP_{MUTT,tb+s} = IMP_{MUTT,tb}\, FAC_{MUTT,tb+s}$$

(29c) $$XG_{MUTM,LAMB,tb+s} = YMU_{MUTM,LAMB,tb}\, LEVL_{MUTM,tb+s} + GIP_{MUTT,tb+s}$$

where: XG : Output Generation, ABTA, physical component,
YMU : Input Use, MAC, physical component,
$LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
IMP : Imports, live animals for slaughtering,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- sheep and goat meat product:

Depending on changes in stock (exogenous figures) and the base year ratio of gross indigenous production to imports, the carcass weight of the base year is used to calculate the meat production as follows:

(30a) $$FS_{MUTM,tb+s} = FS_{MUTM,tb}\, FAC_{FS,MUTM,tb+s}$$

(30b) $$\Delta FS_{MUTM,tb+s} = FS_{MUTM,tb+s} - FS_{MUTM,tb+(s-1)}$$

(30c) $$GIP_{MUTM,tb+s} = YMU_{MUTM,LAMB,tb}\, LEVL_{MUTM,tb+s} - \Delta FS_{MUTM,tb+s}$$

(30d) $$XG_{MUTM,MUTT,tb+s} = \frac{XG_{MUTM,MUTT,tb+(s-1)}}{GIP_{MUTM,tb+(s-1)}\, GIP_{MUTM,tb+s}}$$

where: XG : Output Generation, ABTA, physical component,
YMU : Input Use, MAC, physical component,
$LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
FS : Final stock,
ΔFS : Final stock changes,
FAC : Factor (exogenously specified),

	tb	: Subscript, base year, (tb ∈ (73, ..., T)),
	T	: Subscript, last available year of SPEL/EU-Data,
	s	: Subscript, projection year, (s = (1,2,3)).

- for ***Sheep and goat fattening*** (MUTT) with equation 38:

  The total number of slaughtered sheep and goats is determined exogenously (equation 38), adjusted by the slaughtered ewes and nanny goats (equation 24e, 24f), and the meat output coefficients are projected exogenously . The sheep and goat meat production can then be calculated as follows:

(31) $$XG_{MUTT,MUTT,tb+s} = XMG_{MUTT,MUTT,tb}\ FAC_{MUTT,MUTT,tb+s}\ LEVL_{MUTT,tb+s}$$

where:	XG	: Output Generation, ABTA, physical component,
	XMG	: Output Generation, MAC, physical component,
	$LEVL$	: Production activity levels,
	FAC	: Factor (exogenously specified),
	tb	: Subscript, base year, (tb ∈ (73, ..., T)),
	T	: Subscript, last available year of SPEL/EU-Data,
	s	: Subscript, projection year, (s = (1,2,3)).

- for ***Other animals*** (OANI) with equation 39:

  The output coefficient and activity level are exogenous and calculated as follows:

(32) $$XG_{OANI,OANI,tb+s} = XMG_{OANI,OANI,tb}\ FAC_{OANI,OANI,tb+s}\ LEVL_{OANI,tb+s}$$

where:	XG	: Output Generation, ABTA, physical component,
	XMG	: Output Generation, MAC, physical component,
	$LEVL$	: Production activity levels,
	FAC	: Factor (exogenously specified),
	tb	: Subscript, base year, (tb ∈ (73, ..., T)),
	T	: Subscript, last available year of SPEL/EU-Data,
	s	: Subscript, projection year, (s = (1,2,3)).

6.2.2.2.2. Production activity levels

On the basis of the gross interactive flows of live animals (Output Generation of ABTA), the exogenous gross indigenous production of live animals for slaughter and the exogenously specified imports of live animals, the production activities are numerically specified.

The calculations are done as follows:

- for ***Pig breeding*** (PIGL) with equation 24a:

(33) $$LEVL_{PIGL,tb+s} = FS_{sows,tb+(s-1)}$$

where:	$LEVL$	: Production activity levels,
	FS	: Final stocks,
	tb	: Subscript, base year, (tb ∈ (73, ..., T)),
	T	: Subscript, last available year of SPEL/EU-Data,
	s	: Subscript, projection year, (s = (1,2,3)).

- for ***Pig fattening*** (PORK):

(34) $$LEVL_{PORK,tb+s} = GIP_{pigs,tb}\ FAC_{GIP,pigs,tb+s} + IMP_{pigs,tb}\ FAC_{IMP,pigs,tb+s}$$

where: $LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
IMP : Imports, live animals for slaughtering,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb e (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Laying hens*** (EGGS) with equation 26b:

(35) $$LEVL_{EGGS,tb+s} = FS_{hens,tb+(s-1)}$$

where: $LEVL$: Production activity levels,
FS : Final stocks,
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Poultry fattening*** (POUL) with equation 26g:

(36) $$LEVL_{POUL,tb+s} = GIP_{poultry,tb}\ FAC_{GIP,poultry,tb+s} + IMP_{poultry,tb+s}$$

where: $LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
IMP : Imports, live animals for slaughtering,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Ewes and nanny goats*** (MUTM) with equations 30a and 30c:

(37) $$LEVL_{MUTM,tb+s} = FS_{MUTM,tb+(s-1)} + GIP_{MUTM,tb+s}$$

where: $LEVL$: Production activity levels,
FS : Final stocks,
GIP : Gross indigenous production, slaughtered animals,
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Sheep and goat fattening*** (MUTT) with equations 29a and 29b:

(38) $$LEVL_{MUTT,tb+s} = GIP_{MUTT,tb+s} + IMP_{MUTT,tb+s}$$

where: $LEVL$: Production activity levels,
GIP : Gross indigenous production, slaughtered animals,
IMP : Imports, live animals for slaughtering,
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for ***Other animals*** (OANI):

(39) $$LEVL_{OANI,tb+s} = LEVL_{OANI,tb} \; FAC_{OANI,tb+s}$$

where: $LEVL$: Production activity levels,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

6.2.2.3. Physical output coefficients of MAC

Both the Output Generation of ABTA and the production activity levels are numerically specified for the projection year and therefore the normal calculation for the output coefficients can be performed as follows:

(40) $$XMG_{i,j,tb+s} = XG_{i,j,tb+s} \;/\; LEVL_{i,j,tb+s}$$

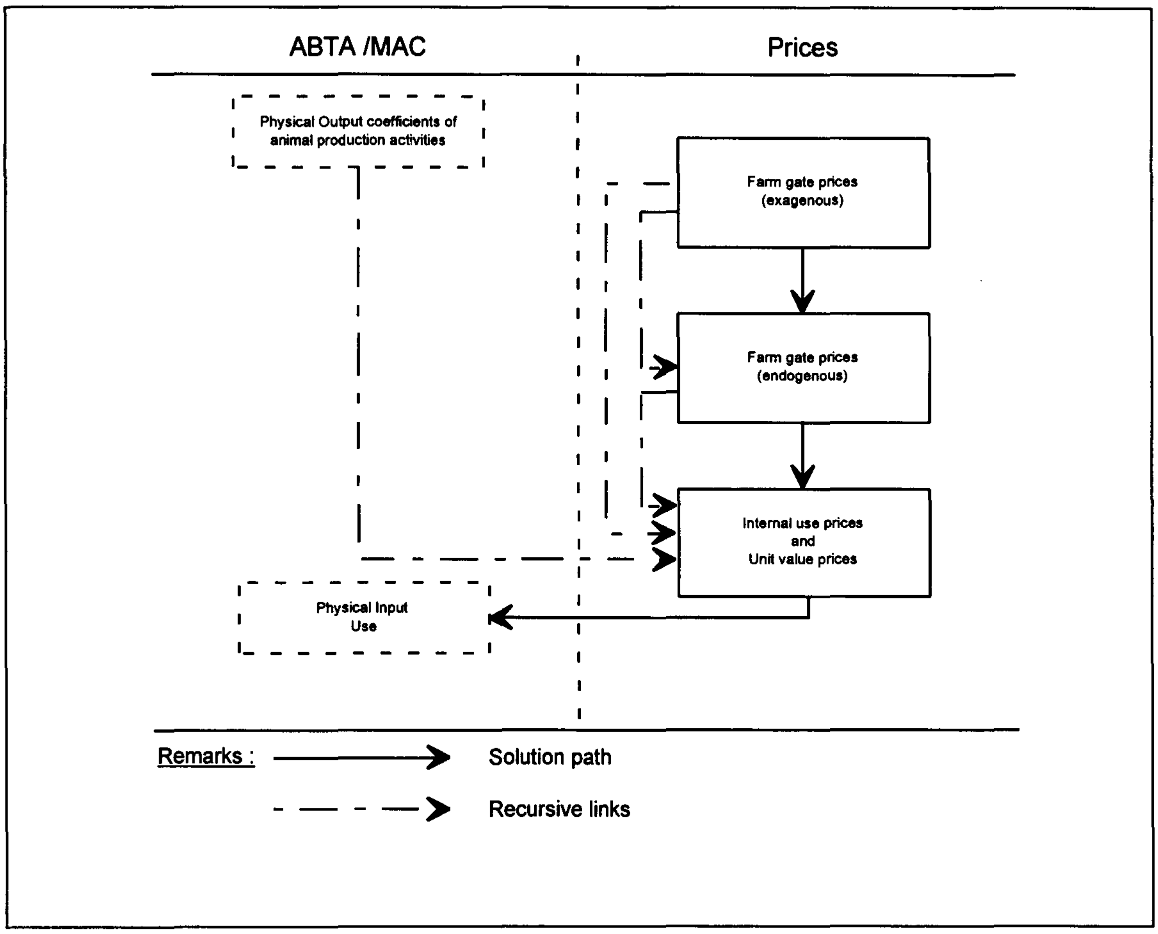
where: XMG : Output Generation, MAC, physical component,
XG : Output Generation, ABTA, physical component,
$LEVL$: Production activity levels,
FAC : Factor (exogenously specified),
i : Subscript, animal production activities, (i = (MILK ,..., PIGL)),
j : Subscript, animal products (j = (MILK, ..., SCOW)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

6.3. Prices

The farm gate prices for assessing the intersectoral product flows are mainly specified exogenously and the other prices (internal use and unit value prices) are dependent on the farm gate prices calculated endogenously. Figure 9 provides an overview of the sequence and recursive aspects of the calculation stages.

As indicated in Figure 9, farm gate prices are calculated as far as possible independently of prior calculations. Internal use prices and unit value prices are dependent on farm gate prices and the physical Output Generation.

Figure 9: Scheme of the solution of prices



6.3.1. Farm gate prices

Exogenous price specification is optional for the determination of real or nominal price developments. The farm gate producer prices are used to evaluate

- intersectoral sales,
- human consumption on farm and
- stock changes on farm,

whereas farm gate purchase prices are used for evaluating

- intersectoral input purchases.

As a rule prices are defined in physical units of product weight. Notice that the production of some products (e.g. flowers) are measured at constant prices of a specific year. The price development of those products are given by price indices.

Principally the SFSS algorithms are based on nominal price developments. If exogenously the real price development is chosen the nominal price development will be calculated by using an exogenously specified inflation rate (e.g. price index of gross domestic product). The inflation rate is calculated as follows:

(41a) $$INF_{tb+s} = INF_{tb}\, FAC_{INF,tb+s}$$

therefore the exogenous real price factors are inflated, because the projections are carried out principally with nominal prices, therefore (only in the case of chosen real price development):

(41b) $$FAC_{PRIC,j,tb+s} = FAC_{PRIC,j,tb+s}\, INF_{tb+s}$$

where:
- INF : Inflation index (1990 = 1),
- FAC : Factor (exogenously specified),
- j : Subscript, final products, (j = (SWHE, ..., OCRO, MILK, ..., WOOL)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

For specification purposes the following calculations are performed:

- for ***final products***, producer prices:

(42a) $$PU_{PRIC,j,tb+s} = PU_{PRIC,j,tb}\, FAC_{PRIC,j,tb+s}$$

- for ***input products***, purchase prices:

(42b) $$QG_{PRIC,h',tb+s} = QG_{PRIC,h',tb}\, FAC_{PRIC,h',tb+s}$$

where:
- PU : Producer prices for Output Use,
- QG : Purchase prices for Input Generation,
- FAC : Factor (exogenously specified),
- j : Subscript, final products, (j = (SWHE, ..., OCRO, MILK, ..., WOOL)),
- h' : Subscript, input item, h' = (NITF,PHOF,POTF,SEEP,PLAP,IAIM,IPHA, FCER, ..., FMIL, FOTH, REPV, ..., INPV)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

6.3.2. Internal use prices and unit value prices

For evaluating of the intrasectoral product flows of Output Use and Input Generation of the ABTA the EU-Model generally uses the so called "Internal use prices". A weighted average of these "internal use prices" and the above mentioned farm gate prices is calculated and called "Unit value price" to evaluate the physical elements of Output Generation and Input Use components of ABTA and MAC.

The following calculations are carried out for **internal use prices**:

- for the products ***calves and piglets*** (if real prices, like equation 41b above):

The prices for Output Use are calculated as follows

(43a) $$PU_{PRIN,j',tb+s} = PU_{PRIN,j',tb}\, FAC_{PRIN,j',tb+s}$$

and for Input Generation

(43b) $QG_{PRIN,h',tb+s} = PU_{PRIN,j',tb+S}$

where:
PU : Production use price,
QG : Purchase prices for Input Generation,
FAC : Factor (exogenously specified),
j' : Subscript, products (j' = (CALV, PIGL)),
h' : Subscript, input item (h' = (ICAL, IPIG) and h' = j'),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for the products ***other live animals***:

The other live animal price trends are related to the respective meat prices (e.g. heifer price related to beef price, etc.).The prices for Output Use are calculated as follows

(44a) $PU_{PRIN,j'',tb+s} = PU_{PRIN,j'',tb}\ FAC_{PRIC.meat,tb+s}$

and for Input Generation

(44b) $QG_{PRIN,h'',tb+s} = PU_{PRIN,j'',tb}$

where:
PU : Production use price,
QG : Purchase prices for Input Generation,
FAC : Factor (exogenously specified),
j'' : Subscript, products (j'' = (HEIF, DCOW, LAMB, ..., SCOW) excluding: (CALV; PIGL),
h'' : Subscript, input item (h'' = (IHEI, ICOW, IBUL, ..., ICHI) excluding: (ICAL, IPIG)) and h'' ≡ j'',
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for the products of ***manure***:

The prices of nitrogen, phosphate and potassium derived from manure are related to the nutrient content prices of mineral fertilizer. The calculations are as for equation 44a therefore the Input Generation internal use price is equal to the production use price (equation 44b).

- for the ***other products***:

The changes in final product producer prices are also considered for internal use prices:

if: $PU_{PRIC,j,tb+s} > 0.0$

(45a) $PU_{PRIN,j,tb+s} = PU_{PRIN,j,tb}\ FAC_{PRIC.j,tb+s}$

if: $PU_{PRIC,j,tb+s} = 0.0,\ (a\ \cos t\text{-}based\, price\ is\ calculated)$

(45b) $$PU_{PRIN,j',tb+s} = \frac{\sum_{h} YMU_{i',h,tb+s}\, QU_{UVAL,h,tb+s}}{XMG_{i',j',tb+s}}$$

where: PU : Production use price,
QU : Input Use price,
YMU : Input Use, MAC, physical component,
XMG : Output Generation, MAC, physical component,
FAC : Factor (exogenously specified),
h : Subscript, input item, (h = (NITF, ... , INPO)),
i : Subscrilpt, production activity (i = (SWHE, ... , PIGL)),
i' : Subscript, production activity (i' = j'),
j' : Subscript, products (j ∈ (SWHE, ..., OANI)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

The cost-based internal use price is calculated when the physical Input Use elements (other than feed products) are calculated (see chapter 6.4.1).

On the basis of the assumptions indicated above for farm gate prices and internal use prices, the unit value prices are correlated mainly with the exogenously determined price evolution. The calculation can be performed for the **unit value prices** as follows

- ***Output Generation*** products:

if: $FAC_{PRIC,j,tb+s} > 0.0$

(46a) $$PG_{j,tb+s} = PG_{j,tb}\, FAC_{PRIC.j,tb+s}$$

if: $FAC_{PRIC,j,tb+s} = 0.0$

(46b) $$PG_{j,tb+s} = PU_{PRIN,j,tb+s}$$

where: PG : Production Generation price (unit value),
PU : Production use price,
FAC : Factor (exogenously specified),
j : Subscript, products (j = (SWHE, ..., MANK)),
tb : Subscript, base year, (tb e (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

The calculations with equation 46b are carried out when the cost-based internal use price has been calculated.

- ***Input Use*** products:

For <u>seed input</u> the intrasectoral flows (Output Use and Input Generation) have to be specified before prices are calculated:

(47a) $$XU_{SEEP,j,tb+s} = \frac{XU_{SEEP,j,tb}}{\sum_i XG_{i,j,tb}} \sum_i XG_{i,j,tb+s}$$

(47b) $$YG_{SEEP,SEEP,tb+s} = \sum_j XU_{SEEP,j,tb+s}\, PU_{PRIN,j,by}$$

therefore the price calculation is as follows:

(47c) $$QG_{PRIN,tb+s} = \frac{\sum_j XU_{SEEP,j,tb+s}\, PU_{PRIN,j,tb+s}}{YG_{SEEP,SEEP,tb+s}}$$

where:
- XU : Output Use, ABTA, physical component,
- XG : Output Generation, ABTA, physical component,
- YG : Input Generation, ABTA, physical component,
- PU : Output Use price,
- QG : Input Generation price,
- FAC : Factor (exogenously specified),
- i : Subscript, crop production activity (i = (SWHE,...,OCRO)),
- j : Subscript, crop products (j = (SWHE,...,OCRO)),
- by : Subscript, EAA base year for constant prices, (by ∈ (90, ..., T)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

The Input Use prices are calculated in connection with the physical Input Use specification (see chapter 6.4.).

For the _other input items_ (excluding fodder) the following calculations are performed:

if: $FAC_{PRIC,h,tb+s} > 0.0$

(48a) $$QU_{h,tb+s} = QU_{h,tb}\, FAC_{PRIC.h,tb+s}$$

if: $FAC_{PRIC,h,tb+s} = 0.0$

(48b) $$QU_{h,tb+s} = QG_{PRIN,h,tb+s}$$

where:
- QU : Input Use price,
- QG : Input Generation price,
- FAC : Factor (exogenously specified),
- h : Subscript, input items (h = (NITF, ..., POTM, PLAP, ICAL,..., INPV)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

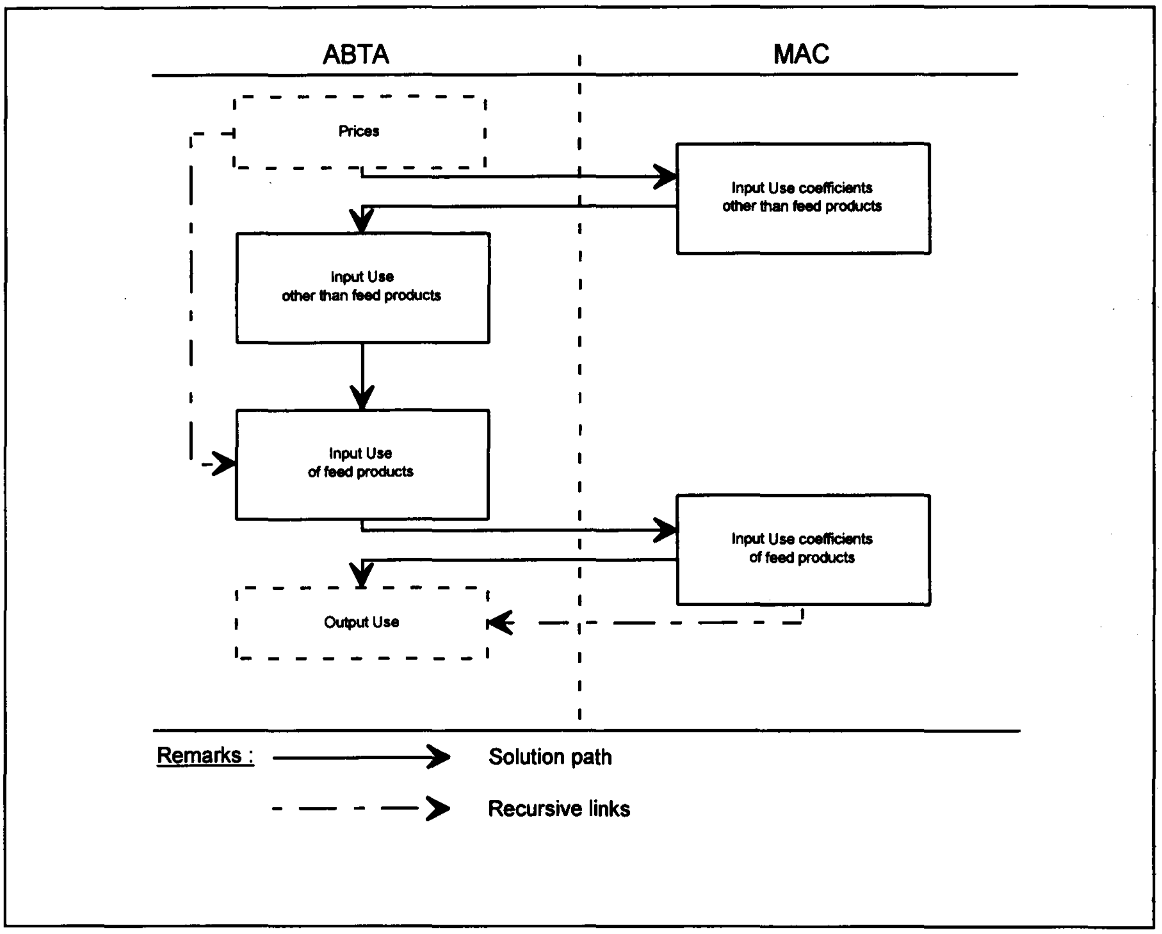
The prices (price indices) for the overheads (REPO, ENEO, INPO) for the Input Generation as well as for the Input Use are equal to the related prices for variable input items (REPV, ENEV, INPV).

The internal use prices for all grouped fodder prices are specified in connection with the calculation of the feed Input Use (see next chapter).

6.4. Physical Input Use

The physical Input Use component of ABTA and MAC is generally calculated endogenously. Figure 10 provides an overview of the sequence and recursive aspects of the calculation.

Figure 10: Scheme of the solution of Input Use



6.4.1. Input Use other than fodder

The input coefficients of the MAC are principally taken over from the reference period-based trend extrapolation by OLS.In the following the Input Use of live animals is separated, because the calculations are dependent on the domestic production of the previous year and also on the exogenously specified imports of live animals for slaughter.

- **Other than live animals:**

  - <u>Input coefficients of MAC, trend based</u>:

(49a) $$YMU^{*}_{i,h,tb+s} = YMU_{i,h,tb} FAC^{*}_{i,h,tb+s}$$

- *Input Use of ABTA, trend based:*

(49b) $$YU^{*}_{i,h,tb+s} = YMU^{*}_{i,h,tb+s} LEVL_{i,tb+s}$$

- *Input Use of ABTA:*

According to the Input Generation calculation (chapter 6.6):

(49c) $$YU_{i,h,tb+s} = YU^{*}_{i,h,tb+s} \frac{\sum_{k} YG_{k,h,tb+s}}{\sum_{i} YU^{*}_{i,h,tb+s}}$$

- *Input coefficients of MAC:*

(49d) $$YMU_{i,h,tb+s} = \frac{YU_{i,h,tb+s}}{LEVL_{i,tb+s}}$$

where:
YMU : Input Use, MAC, physical component,
YU : Input Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
YMU^{*} : Input Use, MAC, physical component, trend based,
YU^{*} : Input Use, ABTA, physical component, trend based,
$LEVL$: Production activity level,
FAC^{*} : Factor trend (specified SFSS preparatory work),
k : Subscript, use activity (k = (PLOF, ... , TRAP),
h : Subscript, input items (h = (NITF, ..., PLAP, IPHA, ..., INPO)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

For the costs of imported animals, the per unit costs of imported animals have to be calculated. With these costs, the Input Generation and Input Use variables are calculated using the values of animals imported in the projection year as follows:

(50a) $$CAVU_{by} = \frac{YG_{TRAP,IAIM,tb}}{\sum_{h'} YG_{TRAP,h',tb} QG_{PRIN,h',by}}$$

and equation 74a combined with equation 50 a:

(50b) $$YU_{i',IAIM,tb+s} = YG_{TRAP,h',tb+s} QG_{PRIN,h',by} CAVU_{by} c$$

where:
$CAVU$: Costs per animal value unit,
YU : Input Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
QG : Purchase price for Input Generation,
c : Constant (technical progress factor, assumed to be 0.985),
i' : Subscript, animal production activity
(i' = (HEIF,CALV,PORK,BEEF,MUTT,POUL,) and i' = h'),
h' : Subscript, input items (h' = (ICAL, ..., ICHI)
by : Subscript, EAA base year for constant prices, (by ∈ (90, ..., T)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),

T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- **Input Use of live animals:**

Under consideration of Output use (chapter 6.5.2) and Input Generation (chapter 6.6) of live animals which are determined by Output Generation of this and the previous year the following calculation are be done:

- *Input Use of ABTA*:

- for cows:

(51a) $$YU_{MILK,ICOW,tb+s} = XU_{COWP,DCOW,tb+s}$$

(51b) $$YU_{CALV,ICOW,tb+s} = YG_{COWP,ICOW,tb+s} + YG_{TRAP,ICOW,tb+s} - YU_{MILK,ICOW,tb+s}$$

- for other live animals:

(51c) $$YU_{i,h',tb+s} = YG_{k',h',tb+s} + YG_{TRAP,h',tb+s}$$

where:
YU : Input Use, ABTA, physical component,
XU : Output Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
i : Subscript, animal production activity (i = (MILK, ..., PIGL)),
h' : Subscript, input items (h' = (ICAL, ..., ICHI) exclusive ICOW),
k' : Subscript, resource activity (k' = (CALP, ..., CHIP) exclusive COWP and k' = h'),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- *Input coefficients of MAC:*

(52) $$YMU_{i,h'',tb+s} = \frac{YU_{i,h'',tb+s}}{LEVL_{i,tb+s}}$$

where:
YMU : Input Use, MAC, physical component,
YU : Input Use, ABTA, physical component,
$LEVL$: Production activity level,
i : Subscript, animal production activity (i = (MILK, ..., PIGL)),
h'' : Subscript, input items (h'' = (ICAL, ..., ICHI)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

In the Base Model, available quantities of feedingstuffs are allocated to the animals required for production. The use of feedingstuffs availability in the production process is the result of the calculations.

6.4.2. Feed products

To specify the feed input uses in the SFSS, the same equation structure and similar constraints are used as in the Base Model[121] of the EU-Model. Compared with the Base Model, the SFSS is confronted with some different problems, which result in some changes to the constraints.

In the SFSS, on the other hand, the sectoral feedingstuffs data are not available and the animals used for production are provided with feed according to the production and price conditions which have changed, compared with the projection base year. As a result, the availability of feedingstuffs and their use are the subject of calculations in the SFSS. The number of animals to be fed, the production result (Output Generation) and feedingstuff prices are already available as in the Base Model and provide the basis for the feed calculations.

6.4.2.1. · Solution method

To avoid any aprupt changes in the use of feedingstuffs when preparing projections, the feed data for the year before the "projection year" (tb+(s-1)) are used. This optimal solution for the year tb+(s-1) is used in the application of non- linear (quadratic) programming approach, along with data on animal production and feedingstuffs prices for the "projection year".

With the application of a non-linear (quadratic) programming approach, the deviation of total sectoral feed costs from the figures of year tb+(s-1) is minimized. Depending on the optimal solution of fed fodder to animals (animal menus) of the year tb+(s-1), the animal menus and the feedingstuffs resources used for the gross animal production for the "pojection year" (tb+s) are specified according to nutrient and production constraints.

The solution method reflects farmers' behaviour during the reference period, when determining the feed menus for production activities given the levels concerning activity levels (herd sizes), output coefficients, internal prices and the purchase prices of feedingstuffs.

The following objective function (equation 53) is minimized under constraints (equation 54 - 66d). The feed prices are used (equation 53), to reflect the relative price changes of feed resources determined for the projected year. The dry matter requirement weights of the production activity insures that the influence of each activity will be considered independently from the activity level (herd size) and the kind of activity (e.g. cows, ewes, etc.).

$$(53) \qquad Min!_{(\Delta YU)}\ \Delta TSC_t = \sum_i \sum_h \left(\Delta YU_{i,h,tb+s}\right)^2 QU_{i,h,tb+s} \frac{\sum_i RDM_{i,t,b+s}}{RDM_{i,tb+s}}$$

$$\Delta YU_{i,h,tb+s} = YU_{i,h,tb+s} - YU^*_{i,h,tb+s}$$

with:

$$YU^*_{i,h,tb+s} = YMU_{i,h,tb+s-1} FA_{i,tb+s}$$

$$RDM_{i,tb+s} = FA_{i,tb+s} REQ_{i,drymatter,tb+s}$$

where:
- ΔTSC : Hypothetical total sectoral cost deviation for feedingstuff,
- ΔYU : Input Use deviation, ABTA, physical component,
- YU : Input Use, ABTA, physical component,
- YU^* : Hypothetical Input Use, ABTA, physical component,
- YMU : Input Use, MAC, physical component,

[121] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapter 3.7.5. feedingstuffs.

QU	:	Input Use price,
RDM	:	Dry matter requirements per activity,
REQ	:	Total nutrient requirements per animal (see chapter 6.4.2.2),
FA	:	Fed animals,
i	:	Subscript, production activities, (i = (MILK,...,PIGL)),
h	:	Subscript, input items, feedingstuffs, (h = (FCER,...,FOTH)).
tb	:	Subscript, base year, (tb ∈ (73, ..., T)),
T	:	Subscript, last available year of SPEL/EU-Data,
s	:	Subscript, projection year, (s = (1,2,3)).

The total sectoral feed cost deviations (equation 53) are minimized, subject to the following constraints:

- All animals used for production in the projected year are fed :

(54) $$FA_{i,tb+s} = LEVL_{i,tb+s}$$

- The distribution of all feed inputs is limited (bounded):

(55) $$0.5\sum_k YG_{k,h,tb+s} \leq \sum_i YU_{i,h,tb+s} \leq 1.1\sum_k YG_{k,h,tb+s}$$

- The energy, protein and dry matter contents required for animal production are met in full,

(56a) $$\sum_h RQP_{i,h,f,tb+s} \leq REQ_{i,f,tb+s}$$

- and the minimum (maximum) requirement restrictions for feed products are adhered to in each animal production activity:

(56b) $$\sum_i YU_{i,h,tb+s}c_{h,tb+s} \geq REQ_{i,drymatter,tb+s}\,factor_{i,\min}\,LEVL_{i,tb+s}$$

and

(56c) $$\sum_i YU_{i,h,tb+s}c_{h,tb+s} \leq REQ_{i,drymatter,tb+s}\,factor_{i,\max}\,LEVL_{i,tb+s}$$

and

(56d) $$YMU_{i,h,tb+s}c_{h,tb+s} \leq RFP_{i,h,\max,tb+s}$$

where:

$LEVL$	:	Production activity levels,
FA	:	Fed animals,
YU	:	Input Use, ABTA, physical component,
YMU	:	Input Use, MAC, physical component,
YG	:	Input Generation, ABTA, physical component,
RQP	:	Nutrient content per feed product,
REQ	:	Total nutrient requirements per animal, (chapter 6.2.2.2.),
RFP	:	Dry matter requirement per animal (exogenously set),
c	:	Dry matter content coefficient,
$factor$	:	Constant factor (see figure 11),
i	:	Subscript, production activities, (i = (MILK,...,PIGL)),
h	:	Subscript, input items, feedingstuffs, (h = (FCER, ... ,FOTH)),
k	:	Subscript, resource activity (k = (n+1,...,N)),
f	:	Subscript, content of energy, protein, dry matter.

According to the dry matter requirements of the animal production activities (see chapter 6.2.2.2.), the requirement restrictions (equations 56b and 56c) are formulated by using a constant factor shown in figure 11.

Figure 11: Restriction factors for dry matter requirements

Production activities		Factor	
		min.	max.
Dairy Cows	(MILK)	0.8	1.3
Male adult Cattle for Fattening	(BEEF)	0.7	1.4
Calves for Fattening	(CALF)	0.9	1.5
Pigs for Fattening	(PORK)	0.8	1.2
Ewes and Goats	(MUTM)	0.8	1.5
Sheep and Goats for Fattening	(MUTT)	0.8	1.2
Poultry for Fattening	(POUL)	0.8	1.2
Laying Hens	(EGGS)	0.8	1.2
Heifers	(HEIF)	0.7	1.3
Calves, Rearing	(RCAL)	0.9	1.4
Pigs Breeding	(PIGL)	0.8	1.2
Suckler Cows	(CALV)	0.8	1.4

The requirement restrictions (equation 56d) are expressed in feed product weight per animal in order to allow any information available on the use of individual feed quantities for specific animal categories to be considered. Upper and lower diet limits for animal feeding, obtained from farm management data, are generally used for specifying these restrictions.

Changes in the domestic animal production structure enter the distribution account via the hypothetical Input Use of ABTA (equation 53) and the nutrient feed requirements per animal. The percentage of feed resources needed by imported animals up until to their slaughter is regarded as negligible, for the ex-post period as well.

The feed input coefficients of MAC are calculated as usual from the Input Use data of the ABTA as follows:

(57) $$YMU_{i,h,tb+s} = \frac{YU_{i,h,tb+s}}{LEVL_{i,tb+s}}$$

where:
- YMU : Input Use, MAC, physical component,
- YU : Input Use, ABTA, physical component,
- $LEVL$: Production activity level,
- i : Subscript, animal production activity (i = (MILK, ..., PIGL)),
- h : Subscript, input items (h = (FCER, ..., FOTH)),
- tb : Subscript, base year, (tb $\in$ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

6.4.2.2. Nutrient content and requirements

The nutrient content of feed products and the nutrient requirements per animal unit are still calculated as for the ex-post representation period [122].

The nutrient content of feedingstuffs for the different animal categories is calculated from the following ingredients of the individual feed products:

- the energy content, measured in metabolizable energy and for lactating animals, in net energy (in megajoules (MJ)),
- the protein content, measured in crude protein (in kg) and
- the dry matter (in kg).

The nutrient content coefficients are currently assumed to be constant for the projection period. The weighted coefficients are taken from the projection base year.

The nutrient requirements per animal unit (energy, protein and dry matter requirements) are calculated by using requirement functions, in order to take into account animal requirements for:

- survival (basic requirements),
- work and
- replacement

insofar as this is required by the animal category.

The same requirement functions and parameters are used for the calculation as are used for establishing the ex-post representation (SPEL/EU-Data).

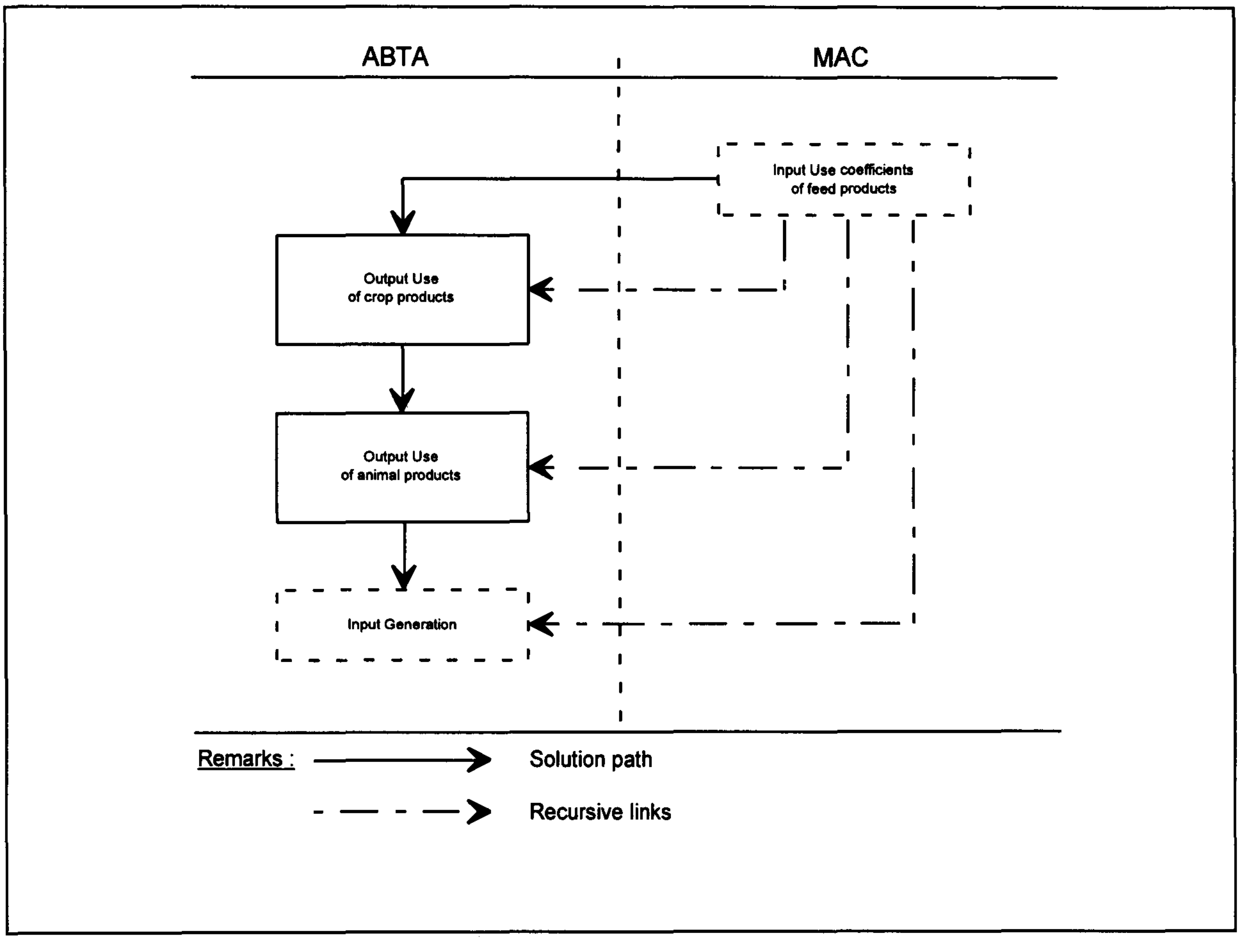
6.5. Physical Output Use

The calculation of the physical Output Uses of agricultural products depends on the specification of the physical Output Generation component of the ABTA. For the use of the products "live animals", the parallel pattern between it and the Input Use and Input Generation of the ABTA should be noted.

To deal with the particularities of using animal and crop products, the two product categories are considered separately from each other. The differentiated use activities are specified one after the other for each of these product categories. Figure 12 provides a schematic view of the sequence of the work steps.

[122] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, feedingstuffs chapters 3.7.5.2 and 3.7.5.3..

Figure 12: Scheme of the solution of Output Use



6.5.1. Crop products

The following calculations are performed to specify the use activities of crop products:

- for seed use:

(60) $$XU_{SEEP,j,tb+s} = c\ \frac{XU_{SEEP,j,tb+s-1}}{LEVL_{i,tb+s-1}}\ LEVL_{i,tb+s}$$

where:
XU : Output Use, ABTA, physical component,
$LEVL$: Production activity level,
c : Constant (technical progress factor, assumed to be 0.985),
i : Subscript, production activity, (i = (SWHE, ..., SILA)),
j : Subscript, main crop products (j = (SWHE, ..., SILA) and (j = i)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for feed use with equations 77b and 77c of Input Generation:

(61a) $$XU_{FEEP,j',tb+s} = YG_{FEEP,h',tb+s}\ \frac{XU_{FEEP,j',tb}}{YG_{FEEP,h',tb}}$$

where: XU : Output Use, ABTA, physical component,
YG : Input Generation, ABTA, physical component,
j' : Subscript, crop products of feed group h', (j' ∈ (SWHE, ..., STRA)), and (j' ≡ h')
h' : Subscript, input items, feed groups, (h' ∈ (FCER, ..., FOTH)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for on-farm losses and on-farm human consumption:

(61b) $$XU_{k',j,tb+s} = \frac{XU_{k',j,tb}}{\sum_i XG_{i,j,tb}} \sum_i XG_{i,j,tb+s}$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity, (i = (SWHE, ..., SILA)),
j : Subscript, crop products, (j' = (SWHE, ..., STRA)),
k' : Subscript, use activity, (k' = (PLOF, PCOF)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for intersectoral sales with equation 87a:

(62) $$XU_{TRAP,j',tb+s} = DR_{MAPR,j',tb+s}$$

where: XU : Output Use, ABTA, physical component,
DR : Resources Demand, ABTA, physical component,
j' : Subscript, crop products, (j' = (SWHE, ..., OCRO)),
k' : Subscript, use activity, (k' = (PLOF, PCOF, TRAP)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for stock changes on farm:

(63) $$XU_{PCSF,j,tb+s} = \sum_i XG_{i,j,tb+s} - \sum_{k'} XU_{k',j,tb+s}$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity, (i = (SWHE, ..., SILA)),
j : Subscript, main crop products, (j = (SWHE, ..., SILA)),
k' : Subscript, use activity, (k' = (PLOF, ... , TRAP), excluding PCSF),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for final stock on farm:

(64) $$FS_{j,tb+s} = FS_{j,tb+(s-1)} + XU_{PCSF,j,tb+s}$$

where: XU : Output Use, ABTA, physical component,
FS : Final stocks,
i : Subscript, crop products, (j = (SWHE, ..., SILA)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

The on-farm use activities on farm of crop products are specified. The differences of Output Generation and Output Use are enclosed in the on-farm stock changes.

6.5.2. Animal products

The following calculations are performed to specify the use activities of animal products:

- milk for feed use:

Cows milk:

if human consumption and deliveries to dairy are specified exogenously (quota, equations 67b, 71b):

(65a) $$XU_{FEEP,MILK,tb+s} = XG_{CALV,MILK,tb+s} + XG_{MILK,MILK,tb+s} - XU_{PCOF,MILK,tb}\, FAC_{PCOF,MILK,tb+s} - XU_{TRAP,MILK,tb}\, FAC_{TRAP,MILK,tb+s}$$

if human consumption and deliveries to dairy are calculated endogenously:

(65b) $$XU_{FEEP,MILK,tb+s} = XG_{CALV,MILK,tb+s} + XG_{MILK,MILK,tb+s} \left(1 - \frac{XU_{PCOF,MILK,tb} + XU_{TRAP,MILK,tb}}{XG_{MILK,MILK,tb}}\right)$$

where: XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
FAC : Factor (exogenously specified),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

ewes and nanny goat milk:

(66) $$XU_{FEEP,MUTM,tb+s} = XG_{MUTM,MUTM,tb+s} \left(1 - \frac{XU_{PCOF,MUTM,tb} + XU_{TRAP,MUTM,tb}}{XG_{MUTM,MUTM,tb}}\right)$$

where: XU : Output Use, ABTA, physical ,component
XG : Output Generation, ABTA, physical component,
tb : Subscript, base year, (tb ∈ (73, ..., T)),

T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for human consumption and losses on farm:

(67a) $$XU_{k',j,tb+s} = \frac{XU_{k',j,tb}}{\sum_i XG_{i,j,tb}} \sum_i XG_{i,j,tb+s}$$

if cows milk, human consumption and deliveries to dairy are specified exogenously (quota, equation 71b):

(67b) $$XU_{PCOF,MILK,tb+s} = XU_{PCOF,MILK,tb}\ FAC_{TRAP,MILK,tb+s}$$

then

(67c) $$XU_{PLOF,MILK,tb+s} = 0$$

where:
XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
FAC : Factor (exogenously specified),
i : Subscript, production activity (i = (MILK, ..., OANI)),
j : Subscript, main animal products, (j = (MILK, ..., OANI)),
k' : Subscript, use activity, (k' = (PLOF, PCOF)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- intrasectoral use manure:

(68) $$XU_{k',j',tb+s} = \sum_i XG_{i,j',tb+s}$$

where:
XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity (i = (MILK, ..., PIGL)),
j' : Subscript, manure products, (j' = (MANN, ..., MANK)),
k' : Subscript, use activity, (k' = (MANN, ..., MANK) and k' = j'),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- intrasectoral use of live animals:

(69) $$XU_{k',j',tb+s} = \sum_i XG_{i,j',tb+(s-1)}$$

where:
XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity (i = (MILK, ..., PIGL)),
j' : Subscript, live animal products, (j' = (CALV, ..., SCOW)),
k' : Subscript, use activity, (k' = (CALP, ..., COWP) and k' = j'),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- stock changes on farm only calculated for live animals:

(70) $$XU_{PCSF,j',tb+s} = \sum_{i} XG_{i,j',tb+s} - \sum_{k'} XU_{k',j',tb+s}$$

where:
XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
i : Subscript, production activity (i = (MILK, ..., PIGL)),
j' : Subscript, animal products, (j' = (CALV, ..., SCOW)),
k' : Subscript, use activity, (k' = (CALP, ..., COWP)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

-intersectoral sales:

(71a) $$XU_{TRAP,j,tb+s} = \sum_{i} XG_{i,j,tb+s} - \sum_{k'} XU_{k',j,tb+s}$$

if cows milk deliveries to dairy are specified exogenously (quota):

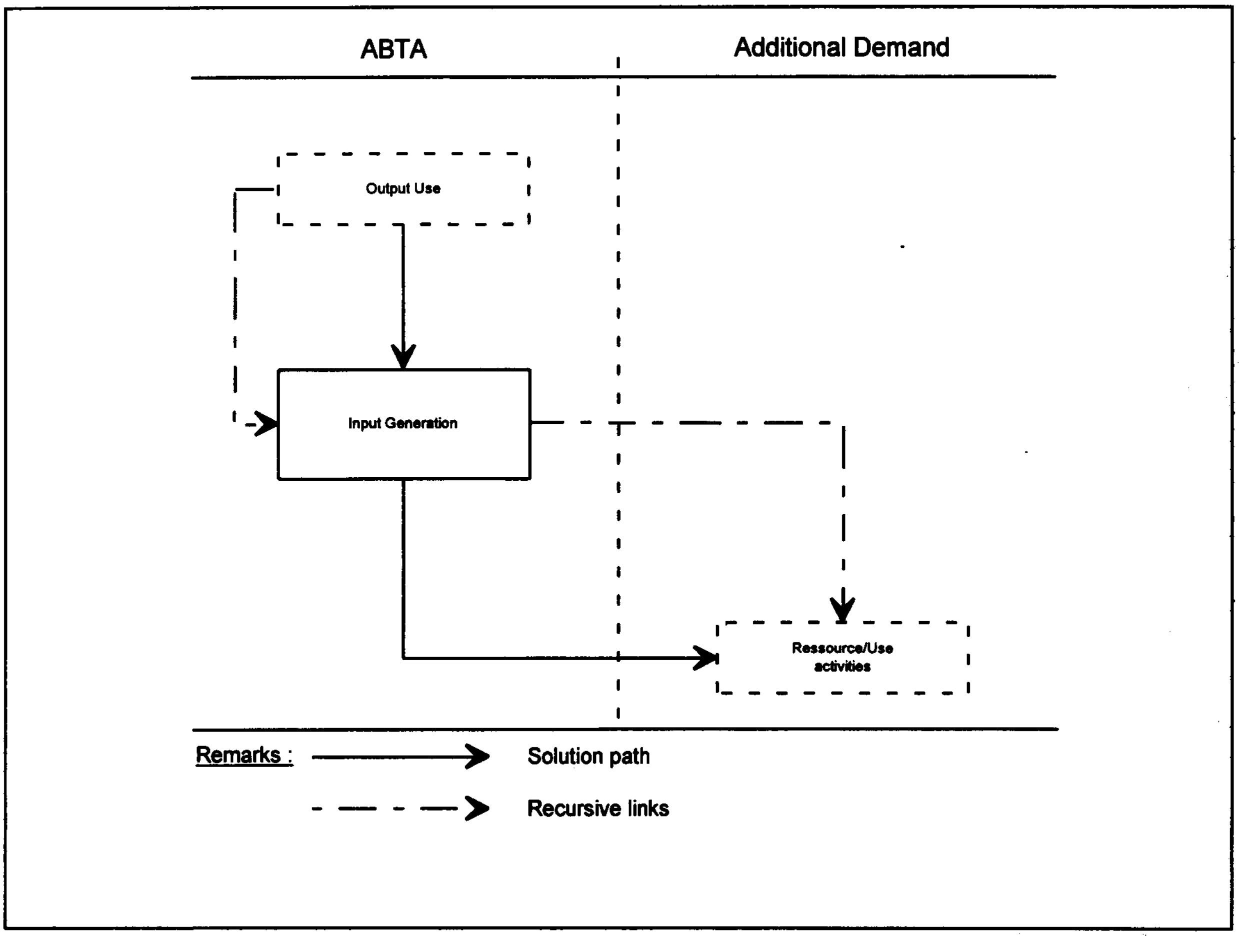
(71b) $$XU_{TRAP,MILK,tb+s} = XU_{TRAP,MILK,tb} \, FAC_{TRAP,MILK,tb+s}$$

where:
XU : Output Use, ABTA, physical component,
XG : Output Generation, ABTA, physical component,
FAC : Factor (specified exogenously),
i : Subscript, production activity (i = (MILK, ..., PIGL)),
j : Subscript, animal products, (j = (MILK, ..., WOOL)),
k' : Subscript, use activity, (k' = (PLOF,..., PCOF)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

6.6. Physical Input Generation

The physical Input Generation of the ABTA is calculated according to the results of the Input Use and Output Use of the ABTA. Figure 13 provides an overview of the links between prior and subsequent work steps.

Figure 13: Scheme of the solution of Input Generation



The physical Input Generation of the **ABTA** is calculated as follows:

- for intrasectorally produced and used products:

  - manure and live animals:

(72) $$YG_{k',h',tb+s} = XU_{k',j',tb+s}$$

- losses on farm:

(73) $$YG_{PLOF,PLOF,tb+s} = \sum_j XU_{PLOF,j,tb+s}\, PU_{PRIN,j,by}$$

where:

YG	:	Input Generation, ABTA, physical component,
XU	:	Output Use, ABTA, physical component,
PU	:	Production use price,
j	:	Subscript, main products, (j = (SWHE, ..., OANI)),
j'	:	Subscript, products, (j' = (MANN, ..., CHIP)) and j' = k'),
h'	:	Subscript, input items, (h' = (NITM, PHOM, POTM, ICAL, ..., ICHI)),
k'	:	Subscript, use activity, (k' ∈ (MANN,..., CHIP)) and (k' = h'),
by	:	Subscript, EAA base year for constant prices, (by ∈ (90, ..., T)),
tb	:	Subscript, base year, (tb ∈ (73, ..., T)),
T	:	Subscript, last available year of SPEL/EU-Data,
s	:	Subscript, projection year, (s = (1,2,3)).

- for intersectorally purchased input items:
- input animals imports (EAA) with equation 50a:

(74a) $$YG_{TRAP,IAIM,tb+s} = \sum_{h'} YG_{TRAP,h',tb+s}\ QG_{PRIN,h',by}\ CAVU_{by}\ c$$

- other purchased input items (e.g. plant protection):

(74b) $$YG_{TRAP,h'',tb+s} = YG_{TRAP,h'',tb}\ FAC^{*}_{TRAP,h'',tb+s}$$

where:
- YG : Input Generation, ABTA, physical component,
- $CAVU$: Costs per animal value unit (see equation 50a),
- QG : Purchase price for Input Generation,
- FAC^{*} : Factor trend (specified SFSS preparatory work),
- c : Constant (technical progress factor, assumed to be 0.985),
- h' : Subscript, input items (h' = (ICAL, ..., ICHI),
- h'' : Subscript, input items, (h'' = (NITF, ..., CAOF, PLAP, IPHA, REPV, ..., VATU)
- by : Subscript, EAA base year for constant prices, (by ∈ (90, ..., T)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

- for intrasectorally and intersectorally purchased input items (e.g. seed):
- seed input:

(75) $$YG_{SEEP,SEEP,tb+s} = \sum_{j} XU_{SEEP,j,tb+s}\ PU_{PRIN,j,by}$$

and

(76) $$YG_{TRAP,SEEP,tb+s} = \sum_{i} YU_{i,SEEP,tb+s} - YG_{SEEP,SEEP,tb+s}$$

where:
- YG : Input Generation, ABTA, physical component,
- YU : Input use, ABTA, physical component,
- XU : Output Use, ABTA, physical component,
- PU : Production use price,
- i : Subscript, production activity, (i = (SWHE, ..., FALL)),
- j : Subscript, main products, (j = (SWHE, ..., SILA)),
- by : Subscript, EAA base year for constant prices, (by ∈ (90, ..., T)),
- tb : Subscript, base year, (tb ∈ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

- feed input:

for the intrasectorally used feed:

- for fodder group (milk and milk products)

(77a) $$YG_{FEEP,FMIL,tb+s} = XU_{FEEP,MILK,tb+s} + XU_{FEEP,MUTM,tb+s}$$

- and for the other feed groups

(77b) $$YG_{FEEP,h',tb+s} = \frac{YG_{FEEP,h',tb}}{YG_{FEEP,h',tb} + YG_{TRAP,h',tb}} \sum_{i} YU_{i,h',tb+s}$$

for the intersectorally purchased feed for all feed groups:

(77c) $$YG_{TRAP,h'',tb+s} = \sum_{i} YU_{i,h''} - YG_{FEEP,h'',tb+s}$$

where:
- YG : Input Generation, ABTA, physical component,
- XU : Output Use, ABTA, physical component,
- YU : Input Use, ABTA, physical component,
- i : Subscript, animal production activity, (i = (MILK, ..., PIGL)),
- h' : Subscript, input items, feed groups, (h' = (FCER, ..., FOTH), exclusive FMIL),
- h'' : Subscript, input items, feed groups, (h" = (FCER, ..., FOTH)),
- tb : Subscript, base year, (tb $\in$ (73, ..., T)),
- T : Subscript, last available year of SPEL/EU-Data,
- s : Subscript, projection year, (s = (1,2,3)).

6.7. Additional Demand component

The projections of the physical components of the ABTA are used for specifying some "Additional Demand" elements (e.g. use activities of agricultural raw products). The agricultural market demand for agricultural and non-agricultural products for production purposes are used for specifying the corresponding resource and use activities (e.g. marketable feed resources).

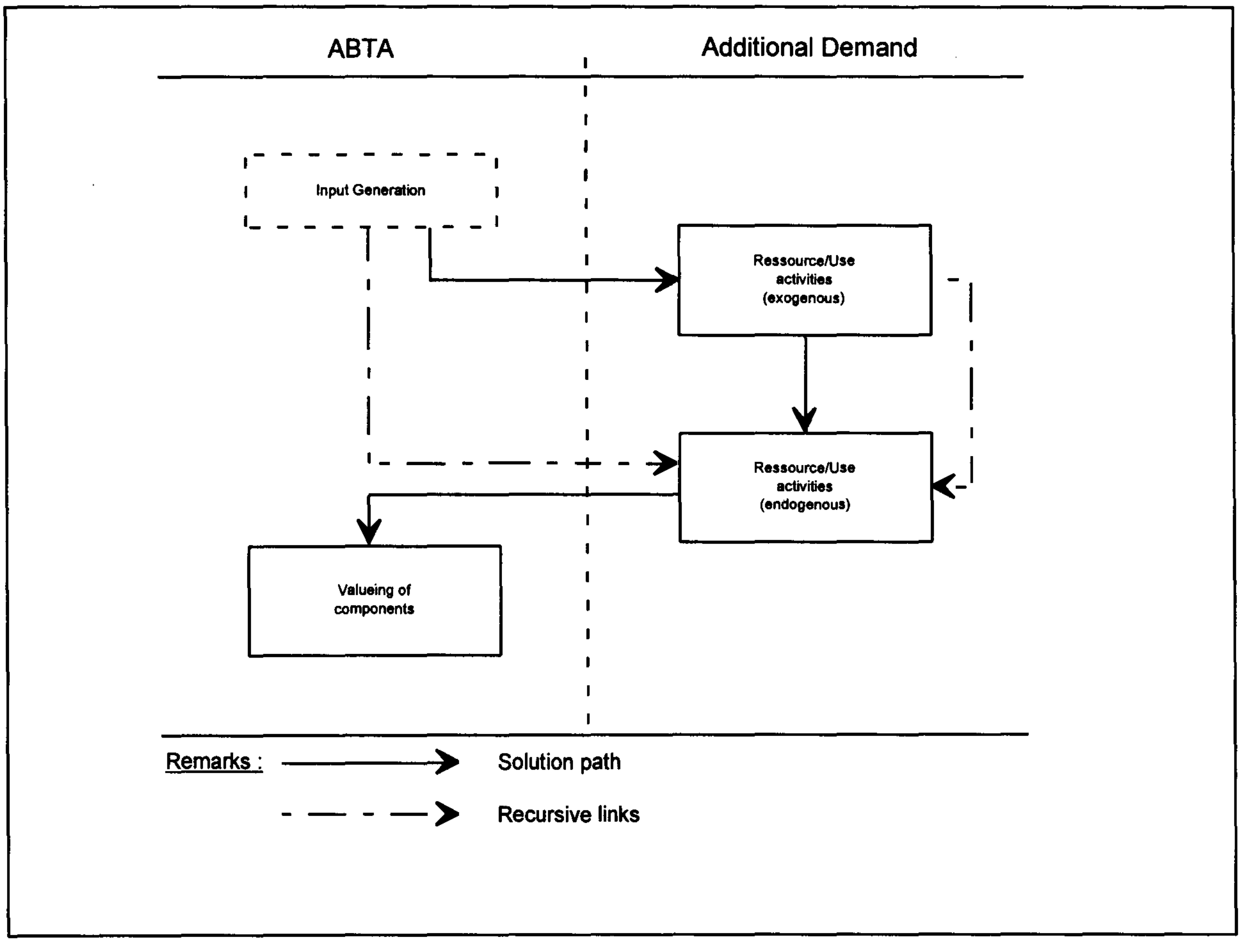
The respective domestic use activities of the products concerned are specified exogenously.

External trade in agricultural products is determined by the constant share of the previous year (base year of projection).

Figure 14 provides an overview of the links with the ABTA and the sequence of the separate calculation stages.

Beginning with the exogenously specified equation elements (variables), the calculations for the individual resource/use activities are indicated.

Figure 14: Scheme of the solution of additional Demand component



The projections of the following variables are mainly based on exogenous specification:

- Total Domestic use, specified exogenously:

(78) $$DU_{PDOM,j,tb+s} = DU_{PDOM,j,tb}\ FAC_{PDOM,j,tb+s}$$

where: DU : Uses, Demand,
FAC : Factor (specified exogenously),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- Population, specified exogenously:

(79) $$POP_{tb+s} = POP_{tb}\ FAC_{POP,tb+s}$$

where: POP : Population,
FAC : Factor (specified exogenously),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- Imports (exports) calculated by constant share of domestic use:

(80a) $$DU_{PEXT,j,tb+s} = DU_{PDOM,j,tb+s}\left(\frac{DU_{PEXT,j,tb}}{DU_{PDOM,j,tb}}\right)$$

(80b) $$DR_{PIMT,j,tb+s} = DU_{PDOM,j,tb+s}\left(\frac{DR_{PIMT,j,tb}}{DU_{PDOM,j,tb}}\right)$$

where: DU : Uses, Demand,
DR : Resources, demand,
j : Subscript, products, (j = (SWHE, ..., OMPR)),
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

and for intra- (extra-) EU imports (exports) also the share of the base year is used as a constant.

- Human consumption, market, as follows: (assuming that human consumption dominates the total domestic use)

(81) $$DU_{PCOM,j,tb+s} = \left(\frac{DU_{PCOM,j,tb}}{POP_{tb}}\right) POP_{tb+s}\, FAC_{PDOM,j,tb+s}$$

where: DU : Uses, Demand,
POP : Population,
FAC : Factor (specified exogenously),
j : Subscript, products, (j = (SWHE, ..., OMPR)),
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

The following use activities are calculated endogenously for the projection period as follows:

- animal feed, market, as follows:

(82a) $$DR_{MAPR,h',tb+s} = YG_{TRAP,h',tb+s}$$

and

(82b) $$DU_{PFEE,h',tb+s} = YG_{TRAP,h',tb+s}$$

and with imports (equation 80b):

(82c) $$DU_{PCSM,h',tb+s} = DR_{MAPR,h',tb+s} + DR_{PIMT,h',tb+s} - DU_{PFEE,h',tb+s}$$

where: DR : Resources, Demand,
YG : Input Generation, ABTA, physical component,
DU : Uses, Demand,
h' : Subscript, feed input items products, (h' = (FCER, ..., FOTH)),
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

For the individual products of the grouped feed products under consideration:

(83) $$DU_{PFEE,j',tb+s} = \frac{DU_{PFEE,j',tb+s}}{\sum_{j'} DU_{PFEE,j',tb+s}} DU_{PFEE,h',tb+s}$$

where: DU : Uses, Demand,
h' : Subscript, feed input items products, (h' = (FCER, ..., FOTH)),
j' : Subscript, sub-products of feed groups h', (j' ∈ (SWHE, ..., OMPR) and (j' = h')),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- seed, market, in comparison with equation 60 of seed use on farm as follows

(84) $$DU_{PSEE,j,tb+s} = c\left(\frac{DU_{PSEE,j,tb+s\text{-}1}}{LEVL_{i,tb+s\text{-}1}}\right) LEVL_{i,tb+s}$$

where: DU : Uses, Demand,
$LEVL$: Production activity level,
c : Constant (technical progress factor, assumed to be 0.985),
i : Subscript, production activity, (i = j),
j : Subscript, main crop products, (j = (SWHE, ..., OCRO)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for losses, industrial use and processing, market, the following shares are assumed:

(85) $$DU_{u',j,tb+s} = \frac{DU_{u',j,tb}}{DU_{PDOM,j,tb}} DU_{PDOM,j,tb+s}$$

where: DU : Uses, Demand,
u' : Subscript, use activity (u' = (PLOS, PIND, PPRO),
j : Subscript, products, (j = (SWHE, ..., OMPR)),
tb : Subscript, base year, (tb ∈ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

- for changes final stock, market:

(86a) $$DU_{PCSM,j,tb+s} = \sum_{v} DR_{v,j,tb+s} - \sum_{u'} DU_{u',j,tb+s}$$

and for final stocks:

(86b) $$FS_{j,tb+s} = FS_{j,tb+(s\text{-}1)} + DU_{PCSM,j,tb+s}$$

where: DU : Uses, Demand,
DR : Resources, Demand,
FS : Final stocks,
v : Subscript, resource activity, (v = (MAPR, PIME, PIMW)),
u' : Subscript, use activity, (u' = (PEXE, ..., PADJ), excl. PCSM),
j : Subscript, products, (j = (SWHE, ..., OMPR)),

tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

The marketable production resource variable is specified as follows:

- for raw products (with agricultural sales):

(87a) $$DR_{MAPR,j,tb+s} = XU_{TRAP,j,tb+s}$$

- for raw products (without agricultural sales) and for processed products without related "processing" of a raw product:

(87b) $$DR_{MAPR,j',tb+s} = DU_{PDOM,j',tb+s} + DU_{PEXT,j',tb+s} - DR_{PIMT,j',tb+s}$$

- for processed products with related processing of raw product:

(87c) $$DR_{MAPR,j'',tb+s} = DU_{PPRO,j',tb+s}$$

where: DR : Resources, Demand,
DU : Uses, Demand,
XU : Output Use, ABTA, physical component,
j : Subscript, products, (j = (SWHE, ..., WOOL)),
j' : Subscript, products, (j' $\in$ (SWHE, ..., OMPR)),
j'' : Subscript, products, (j" $\in$ (RICE, ..., OMPR) and (j" = j)),
tb : Subscript, base year, (tb $\in$ (73, ..., T)),
T : Subscript, last available year of SPEL/EU-Data,
s : Subscript, projection year, (s = (1,2,3)).

6.8. Valued components of ABTA and MAC

Figure 15 illustrates the interrelationships and sequence of the other stages involved in producing the projections based on ABTA and MAC for EU Member States.

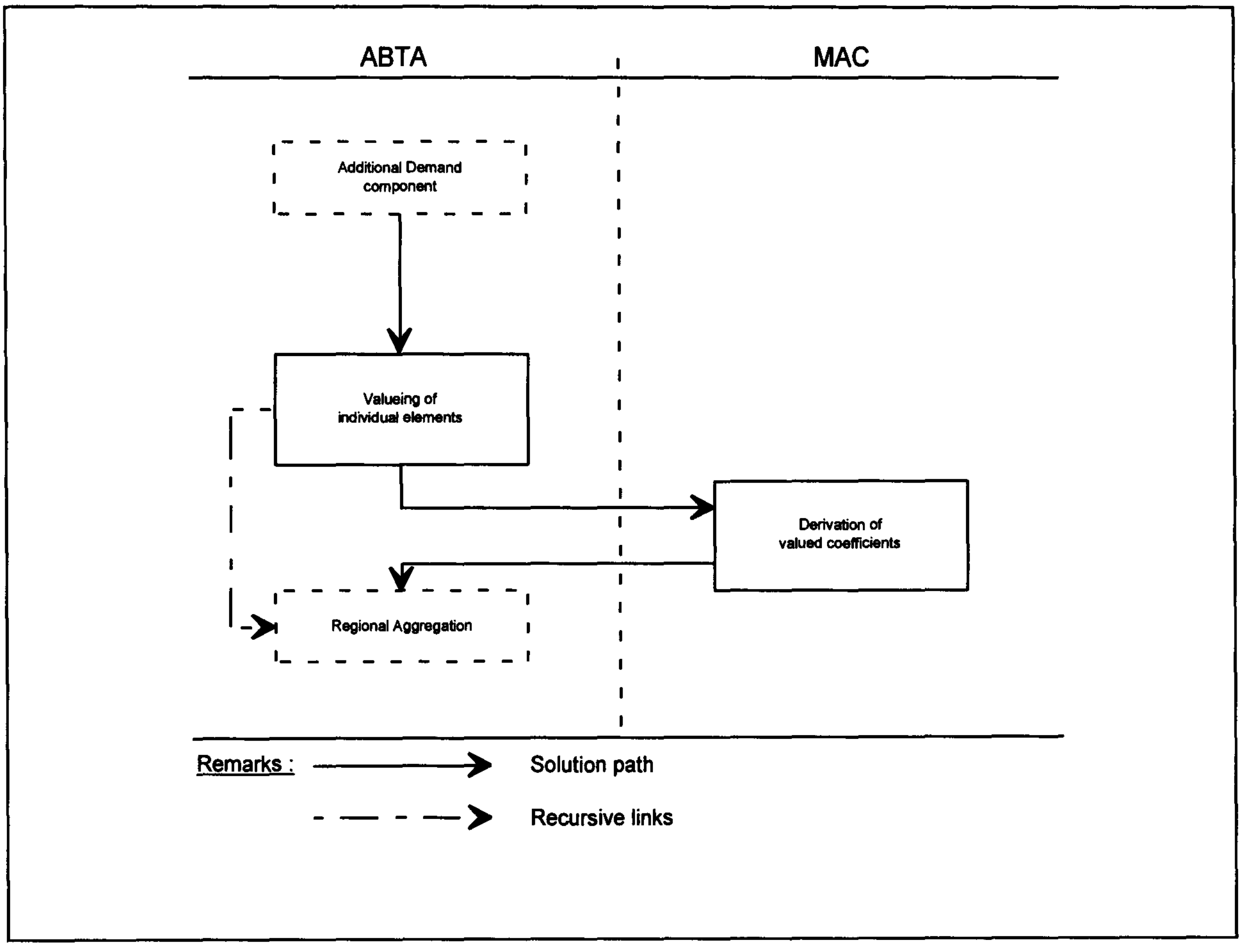
If all elements of the basic equation system measured in physical units:

- Output Generation for ABTA and MAC (XG, XMG),
- Output Use for ABTA (XU),
- Input Generation for ABTA and (YG),
- Input Use for ABTA and MAC (YU, YMU)

are available in a consistent numerically specified form together with the producer and purchase prices for the intrasectoral and intersectoral interactions, the filling-in of the ABTA and MAC component values can be carried out. The calculations are performed by multiplying the physical components by the related prices, as described and done for the Base Model[123].

[123] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapters 3.8..'

Figure 15: Scheme of the solution of valued components of ABTA/MAC



7. CONCLUSIONS

The Short-term Forecast and Simulation System (SFSS) is based, like the other components of the EU-Model, on an equation system used for establishing the consistent structures of the Activity Based Table of Account (ABTA) and the Matrix of Activity Coefficient (MAC). This equation system is basically the same for all components of the EU-Model. Using this equation system or the resulting structured ABTA (MAC) and a consistent ex-post data set (SPEL/EU-data), projections (forecasts or simulations) are made for the agricultural sectors of the EU for up to three years.

As in the case of ex-post depiction[124] the projection results are calculated recursively and separately for each region (Member State) on an annual basis. Figures for the EU as a whole are then obtained by adding together the annual regional data sets.

The projection results should be interpreted not as point-by-point estimates but as intervals, the limits to which are set by the random and/or methodological error rates. The fixing of these interval limits is based on experience in application, as well as on analyses to be carried out from time to time based on ex-post projections with the SFSS [125].

This monitoring work serves not only to establish forecast interval limits but also to highlight weak points in the specification of the exogenous variables (in the preparatory work) and/or methodology used and possibly to correct any errors (depending on their source). The results of this ex-post projection analytical work are available in the form of working papers.

[124] See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 2: Base System, chapters 3..

[125] Ex-post projection checks have already been carried out several times in the past. They were based, however, on the structure of the SFSS as established at the start of the 1980s. The SFSS with its current structure has already undergone test checks, the results of which have been set out in the form of working papers.

ANNEXES

ANNEX 1

LIST OF ABBREVIATIONS

8. ANNEX 1: LIST OF ABBREVIATIONS

ΔFS	=	Change in Final stock
ΔTSC	=	Hypothetical total sectoral costs deviation for feedingstuff
by	=	Subscript, EAA base year for constant prices, (by $\in$ (90, ..., T))
c	=	Constant
c_1	=	Constant (assumed 0.8)
c_2	=	Constant (average carcass weight, assumed 0.9 kg)
CAVU	=	Costs per animal value unit
CHI	=	Chicks for laying
EXP	=	Exports, live animals
f	=	Subscript, content of energy, protein, dry matter
FA	=	fed animals
FAC	=	Factor (exogenously specified)
factor	=	Constant factor
FS	=	Final stock
GIP	=	Gross indigenous production, slaughtered animals
h, h', h"	=	Subscript, input items
i, i', i"	=	Subscript, production activities
IMP	=	Imports, live animals
INF	=	Inflation index (1990 = 1)
j, j', j"	=	Subscript, products
k, k'	=	Subscript, resource and use activities
l, l'	=	Subscript, indicator
LEVL	=	Production activity levels
NIP	=	Net indigenous production, slaughtered animals
P	=	Growth rate in percent
P*	=	Growth rate (annual) in percent
PG	=	Production Generation price (unit value)
PU	=	Use price
QG	=	Input Generation price
QU	=	Input Use price
REQ	=	Total nutrient requirements per animal
RFP	=	Dry matter requirements per animal
RQP	=	Nutrient content per feed product
s	=	Subscript, projection year (s = (1,2,3))
SFAC	=	Scaling factor

SLH	=	Hens slaughtered
SSO	=	Sows slaughtered
T	=	Subscript, last available year of SPEL/EU-Data
t	=	Subscript, year ($t \in (73, ..., T, T+n)$)
tb	=	Subscript, base year ($tb \in (73, ..., T,)$)
TSS	=	Total sheep/goats for slaughtering
TXG	=	Total output generation (physical gross production)
X	=	SPEL/EU-Data, ex post
XC	=	CRONOS data, ex post
XG	=	Output Generation, ABTA, physical component
XMG	=	Output Generation, MAC, physical component
XP	=	Data exogenous variable, projected
XT	=	Trend-based data on SPEL/EU-Data
X^*	=	Trend-based data on SPEL/EU-Data
XU	=	Output use, ABTA, physical component
YG	=	Input Generation, ABTA, physical component
YMU	=	Input Use, MAC, physical component
YMU*	=	Input Use, MAC, physical component, trend based
YSO	=	Maiden gilts
YU	=	Input Use, ABTA, physical component
YU*	=	Input Use, ABTA, physical component, trend based

ANNEX 2

EXOGENOUS VARIABLES

9. ANNEX 2: EXOGENOUS VARIABLES

9.1. Definitional remarks

The definitions of the exogenous variables for the SFSS generally follow the definitions given in the Base Model methodological documentation. Detailed definitions, where needed, can be taken from the documentation on the

SPEL System, Methodological Documentation (Rev. 1), Vol. 1,
Part 1: Basics, specific chapters, and
Part 2: Base System, specific chapters and Annexes.

The following definitional remarks are only intended as a rough guide for the reader, dealing with the main features with brief descriptions.

Output Generation physical component of MAC

The output coefficients are defined as follows:

physical gross production / production activity level.

The following chapter contains some remarks on the expression "physical gross production" and "production activity level".

Crop output coefficients

The physical gross productions are defined as follows:

usable production definition (supply balance sheet) or

harvested production, if usable production is not available or

production value at constant prices (EAA) for

Other industrial crops,

Nursery plants,

Flowers and

Other crop products.

Animal output coefficients

The physical gross productions are defined as follows:

- for meat products:	net indigenous production plus exports of live animals for slaughtering;
- for milk:	resources on farm (including feed milk);
- for eggs:	eggs for breeding and consumption;
- for "other animals":	production value at constant prices (EAA).

Levels of production activities

The production activity levels consider for crop production the agricultural land use according to the definition of "main area" measured in (1000) hectares, which is given exogeneously.

If there is a product subject to quotas, like "sugar beet", then the activity level is calculated endogeneously, from the option of using

- the harvest production,

which is given exogeneously.

The animal production activities approximately consider the gross flow of live animals measured in head and used for gross Output Generation. The endogenous calculation of Output Generation and the activity levels is based on:

- gross indigenous production of slaughtered animals,
- imports of live animals for slaughtering and
- final stocks (December census).

If there is a product subject to quotas, like "milk", then the activity level is calculated endogeneously, from the option of using deliveries to dairies and

- human consumption on farm

which are given exogeneously.

Farm gate prices (producer and purchase prices)

The farm gate prices are measured in national currency per metric ton product weight. The specific group definitions, shown in annex 2 and 3 of Part 2 [126] offers additional information in grouping of the producer and purchase prices under consideration.

For some products and input groups the prices are defined as index (constant year of EAA = 1000).

Market use activities of marketable products

The original source definition of supply balance sheet resource / use activities and the processed product group is also used in the EU-Model.

The raw product definitions (final products) are listed in annex 2, Part 1 [127]

Other variables

The "Other" exogenous variables group are principally used in the definition of the original source (e.g. COSA for EAA variables and SEC1 for National Economic Account variables domains of CRONOS, Eurostat).

126 See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.
127 See SPEL System, Methodological Documentation (Rev. 1), Vol. 1: Basics, BS, SFSS, Part 1: Basics.

9.2. List of variables

SPEL code	Description	Unit
	Output generation physical component of MAC **Crop output coefficients**	
SWHE SWHE : : SILA SILA	Output coefficient: Soft wheat Output coefficient: Silage	kg / ha kg / ha
	Quota product	
PROP SUGB	Gross production: Sugar beet	1000 t
	Animal output coefficients	
MILK MILK : : HEIF BEEF	Output coefficient: Dairy cows milk Output coefficient: Beef of heifers	kg / hd kg / hd
	Quota product	
PCOF MILK TRAP MILK	Human consumption on farm, cows milk Deliveries dairy station, cows milk	1000 t 1000 t
	Levels of production activities **Crop production**	
SWHE LEVL : : FALL LEVL	Activity level: Soft wheat Activity level: Fallow land	1000 ha 1000 ha

SPEL code	Description	Unit
	Animal production **Gross indigenous production**	
PROP VEAL : : PROP MUTT	Gross indigenous production - calves Gross indigenous production - sheep, goats	1000 hds 1000 hds
	Import live animals	
TRAP ICAL : : TRAP ILAM	Total import of live animals - calves Total import of live animals - sheet, goats	1000 hds 1000 hds
	Live animal stocks	
CACL MILK : : LEVL OANI	Pop. cattle December, dairy cows > 2 years Pop. December, equids	1000 hds 1000 hds

SPEL code	Description	Unit
	Farm gate prices (producer and purchase prices)	
	Producer prices	
PRIC SWHE	Farm gate price: Soft wheat	NC / t
: :		
PRIC OCRO	Farm gate price: Other final crop products	index
	Purchase prices	
PRIC NITF	Farm gate price: Mineral nitrogenous fertilizer	NC / t
: :		
PRIC INPV	Farm gate price: Other inputs	index
	Market use activities of marketable products (only extrapolated by trend)	
NAGG NAGG	Population	Mio heads
PDOM SWHE	Domestic use total : Soft wheat	1000 t
: :		
PDOM OMPR	Domestic use total: Other milk products	1000 t
	Other variables	
PEAV SUBS	Subsidies (EAA)	Mio. NC
PEAV TAXE	Production taxes (EAA)	Mio. NC
PEAV LEVL	Depreciation (EAA)	Mio. NC
PEAV NAGG	Annual conversion rate (1 ECU = ... NC)	NC
WAGG NVAF	Price index of GDP	index
NAGG GVAF	Volume index of GDP	index

Remark:

- The complete list is available from the SPEL group, Eurostat
- Abbreviations:

  kg = kilogram

  t = metric tons

  ha = hectar

  NC = national currency

  cp = constant prices

  hd = head

  hds = heads

  Mio = million

  index = index (1990 = 1000)

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European Commission

SPEL system – Methodological documentation (Rev. 1) – Vol. 1: Basics, BS, SFSS

Luxembourg: Office for Official Publications of the European Communities

1995 – 311 pp. – 21.0 × 29.7 cm

Theme 5: Agriculture, forestry and fisheries (green)

Series E: Methods

ISBN 92-826-9773-8

Price (excluding VAT) in Luxembourg: ECU 26 (Volume 1)
ECU 35 (Volumes 1 + 2)

This publication contains a description of the methodology for the SPEL/EU base system and the SPEL/EU short-term forecast and simulation system. Part 1 (methodological background) explains the integrated approach to the agricultural sector, the structure of the activity-based table of accounts (ensuring full consistency) and the block-building approach of the model. The data flow, i.e. data extraction from the Cronos database, estimation of missing values, incorporation of expert knowledge, the sequential work steps along the solution path of the base system, etc. are described in Part 2. Part 3 explains the forecasting mechanism (trend extrapolation, algorithms used to find the solutions, etc.) of the short-term forecasts and simulation.