

**Distr.
GENERAL**

**CES/AC.61/2001/32
28 August 2001**

ENGLISH ONLY

**STATISTICAL COMMISSION and
ECONOMIC COMMISSION FOR
EUROPE**

**CONFERENCE OF EUROPEAN
STATISTICIANS**

**Joint ECE/EUROSTAT/FAO/OECD Meeting
on Food and Agricultural Statistics in Europe
(Geneva, 17-19 October 2001)**

**COMMISSION OF THE EUROPEAN
COMMUNITIES (EUROSTAT)**

**FOOD AND AGRICULTURAL
ORGANISATION (FAO)**

**ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT
(OECD)**

FAO'S WORK ON ESTIMATES OF VALUE OF AGRICULTURAL PRODUCTION AND INVESTMENT

Invited paper submitted by Food and Agriculture Organisation (FAO)*

I. Introduction

1. Estimates of value of agricultural production and investment in agriculture are essential for monitoring the Organisation's mandate¹. As part of its functions, the Organisation is required to collect, analyze, interpret and disseminate information relating to nutrition, food and agriculture. These estimates are, therefore, required to monitor the level and growth of agricultural production, nutritional status, standards of living and productivity in member countries and also to make inter-country comparison. Progressing in this direction, the Organisation has been collecting data on agricultural² production, inputs, land use, prices paid & received by the farmers and items of agricultural machinery from member countries. These data-sets are further analyzed and processed to derive regional and global level estimates of crop and livestock production, index number of agricultural production and apparent consumption on regular basis.

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2. All along analysts and policy makers have felt need for the estimates of value of agricultural production and investment to determine efforts required to reach a given target and to quantify resources there for. The FAO has been working in this direction too for a long time. The present paper makes a review of the existing work by looking at (a) the concepts and definitions of related data-sets/estimates required by the analysts and (b) the existing estimates, and goes a step further to define current approach to the work to improve the availability of required data. The objective of preparing this paper is two fold: (i) to solicit comments on the proposed methodology, and (ii) to seek international co-operation in improving the database in future.

II. Value of agricultural production

3. Value of agricultural production is defined as output of agricultural activity (c.f. ISIC) expressed in monetary term. The obvious components of this aggregate are 'production (in quantity term)' and 'price per unit of production'. Regarding production, FAO has been collecting and compiling data on primary and derived agricultural products that are available from the year 1961. Two aggregates, value added (at current and constant prices in local currency and US \$) and index number of agricultural production are available to assess the level and trends of agricultural production. Respective countries generally prepare estimates of value added in local currency either independently or with the help of some other national or international agency. The country estimates (in local currency) are there-after converted in US \$ using exchange rates by the World Bank and by some other Organisation for presenting regional and global picture. This data set is not useful for analysing agriculture sector from the point of view of objective listed in first paragraph because of three reasons: (a) coverage of the estimates is different for different countries, (b) the estimates include forestry and fishery production, and (c) this data-set does not provide breakdown of the production by commodities. Index of agricultural production prepared by FAO uses 'international dollars'³ for compiling the aggregate. This aggregate is also of limited utility for studying productivity related issues and linking it with the resources that are required for achieving a level of nourishment and welfare of the population.

4. The SNA recommends use of producer prices or basic prices for compiling value of production. However, as the data on basic prices are not available for many countries, the obvious choice is to use the producer prices for compiling the estimates. A set of estimates of value of primary crop and livestock products at current and (1995) constant prices covering the period 1989 to 1998 have been prepared in local currency by the FAO to study the agriculture sector. Index numbers of agricultural production and (implicit) producer prices have also been derived using this data-set

5. A review of available data indicates that response rate in the period 1995 – 1998 is only about 60%. The price data supplied by member countries contain a number of gaps. Therefore, a complete price data series has been developed by estimating missing values in the series. Step by step details of the method of estimation are given below:

Step 1: The data received from member countries were incorporated in a database and a quick library search was made to collect additional data from other (non-official) sources.

Step 2: The missing values in the series for the period 1989-98 were estimated using a simple ratio estimation technique (e.g. wheat price relatives⁴ and "exchange rate in use"). In this case the 'exchange rate in use' was treated as a proxy indicator of the general rate of inflation in the absence of any other more appropriate data⁵ for many countries.

Step 3: A comprehensive check of the derived series was undertaken in order to detect any gross inconsistencies in the estimated missing values. This involved: a) the derivation of the value of production using the price series in Step 2 and the volume of production of the various products; b) the identification of the relatively important products (in value terms) for each country; and c) comparing the trend of the series of derived value of agricultural production with that of the series of value added (GDP) for agriculture at current prices as given in the World Bank CD ROM.

Step 4: For the countries which revealed large inconsistencies in the trend of the values of production versus the GDP, the prices for the important commodities were re-estimated using autoregressive models based on time series data on prices of agricultural commodities in the country as well as in the neighbouring countries.

6. The estimates are currently under examination, however, the study reveals that:

- the proportion of value of agricultural production at constant prices does not have uniform relation with agricultural value added at constant price over time and space;
- implicit price index numbers also do not indicate some what similar trend as indicated by implicit price index number derived from value added series or the index numbers of consumer prices;
- cross section inter-country analysis does not indicate some what consistent picture for some of the important commodities.

7. In this connection, it should be noted that the estimated values of agricultural production are expected to be different from the agricultural value added (at current prices in local currency). The reasons for the difference can be many. Firstly, the values of agricultural production do not include the by-products. Secondly, the value added estimates cover not only crop and livestock products but also fishery and forestry products. Thirdly, the imputation method used either for prices or the volume of production in estimating the value added could be different from the one adopted by FAO. Fourthly, data on agricultural value added in US \$ available in WDI uses official exchange rate for converting local currency data in the US \$ which may not represent true picture of inflation in the country.

Therefore, going into details of individual country data, some time the FAO series looks more realistic than the other aggregates. However, there are cases where reverse is true.

III. Investment in agriculture

(a) Concepts

8. Investment is a share of income which is kept aside (i.e. not consumed) or an expenditure on purchase of goods of durable nature required for future production process or to purchase something of intrinsic value. In economic sense this can be taken to acquire assets which can be physical or financial. UN System of National Accounts does not define the term "investment" as such, but directs to the term "fixed assets". The UN SNA has recommended following classification (in reference to agricultural activity) of fixed assets:

- (1) Acquisitions, less disposals, of new or existing tangible fixed assets, subdivided by type of assets into:

- (a) farm buildings and other structure;
- (b) machinery and equipment;
- (c) cultivated assets-plantations, trees and livestock - that are used repeatedly or continuously to produce products such as fruit, rubber or milk.

- (2) Major improvements to tangible non-produced assets, including land;
- (3) Costs associated with the transfer of ownership of non-produced assets.

9. These assets are used in a flow (total value of assets acquired in a given period of time, i. e. gross capital formation) as well as stock (value of total stock of capital held on a given date) concept. The SNA has provided guidelines for compiling these estimates according to use of assets for undertaking various economic (ISIC) activities.

(b) Sources of existing data-sets

10. Database for capital formation in agriculture is quite weak. Comprehensive and regular data on gross capital formation are being collected from all counties only by the United Nations Statistics Division (UNSD) along with OECD through an annual questionnaire on national accounts. These data are being published in an UN publication entitled "National Accounts Statistics: Main Aggregates and Detailed Tables". The latest issue contains data for 56 countries. Among these, depending on the complexity of data required for answering different questions, between 20 to 40 countries provide data of a nature that could support the analysis. Main limitations of this data-sets are given below:

- (i) The data are expressed in national currencies. Thus it is not possible to present any aggregate picture;
- (ii) The estimates for many countries are related to the group total 'Agriculture, forestry and fishery';
- (iii) The available data neither covers all the developed countries nor all major developing countries. The coverage of data in terms of period is also not same. In some cases data are available only for a few points of time;
- (iv) The base year for different countries for constant price series are different and for some of the countries constant price series is not available.

11. The OECD and EUROSTAT are also publishing similar data for their group of countries including some data on capital stocks. The time series data on capital formation by kind of economic activity are available only for 59 countries from the World Bank Project on "A New Database on Investment in Agriculture" for the period 1950 to 1992.

12. The estimates of capital stock in agriculture including forestry and fishing are available for 14 OECD countries in the publication: 'Flows and Stocks of Fixed Capital', 1970 to 1995 (OECD, 1997). In addition for Iceland the estimates are available in UN publication: 'National Account Statistics, 1995'. For India the estimates of capital stock are available in their annual publication: 'National Accounts Statistics'. In all OECD countries, capital stock estimates are derived by the Perpetual Inventory Method (PIM) which involves adding fixed capital formation to an initial estimate of the capital stock and subtracting capital assets that are withdrawn. Capital consumption, and hence net capital stock are derived by assuming a depreciation function such that an asset declines in value from its initial cost to zero at the end of the its economic life. The valuation of the capital stock is done at constant/current replacement cost. The estimates of gross and net fixed capital stock are available from

Norway	75	75	45	33	75	8			
Sweden	80			60	25				
U. K.							30	50	50
USA	38			38	31	31			

13. Realising this fact World Bank Development Research Group made a major attempt in developing a cross-country database on investment in agriculture to study the determinants of agricultural production. The Group has released a number of papers in the "Policy Research Working Paper" series on the subject. The estimates of fixed Capital stock in the World Bank Project on "A New Database on Investment Agriculture have been prepared for 57 countries for the period 1967-92 using the perpetual inventory method (PIM) and 20 years as average life. The exercise uses the official estimates of fixed capital formation in agriculture including forestry and fishing available in UN NAS or in the publications of respective countries. The World Bank Research Group has in addition prepared the estimates of capital stock in the orchards and trees as well as livestock for 57 countries on the basis of FAO country data on land area under orchards and trees and number of livestock. Estimates for the orchard component have been prepared using the 'Capitalization of Income Method'. In the absence of required data, estimates for the livestock are based on number of livestock and export prices (to get the value of the herd). The World Bank Research Group assumed that the fixed capital in livestock and development of orchards and trees was not adequately captured by the respective countries in their official estimates. Accordingly estimated value of the capital stock of these components was added to the estimates of fixed capital stock⁶. The estimates of fixed capital stock, capital stock of livestock herds including young, breeding/draught from the World Bank Research Group are available for the period 1967-1992.

14. In order to test the assumptions made by the World Bank Research Group that the 'Breeding stock, dairy cattle etc.' and 'orchards etc' are not taken into account by the countries, the available methodological notes of OECD countries have been examined (see Statement 2). Except Australia, who do not account for any of the livestock in their estimates of capital formation or capital stock and the countries like Austria, Canada who account for the livestock under changes in inventories, the other countries do account for these items under fixed capital formation/fixed capital stock. Thus livestock for some countries may not be accounted in the fixed capital stock but the stock of inventories do include the livestock.

Statement 2: Inclusion or exclusion of 'breeding stock etc' and 'orchards etc' in fixed capital formation and availability of capital stock in agriculture in OECD group of countries

Country	Fixed Capital Formation includes		Capital Stock
	Breeding stock etc	Orchards, etc.	
1. Australia	no	yes	1970-94
2. Austria	no, includes under changes in inventories	yes	not available. GFCF available for 1984-94
3. Belgium	yes	yes	1970-95
4. Canada	no, includes under changes in inventories	no information	1970-95,
5. Czech Rep.	estimates not available		
6. Denmark	yes	no information	1970-92
7. Finland	no information	yes	1970-95

Country	Fixed Capital Formation includes		Capital Stock
	Breeding stock etc	Orchards, etc.	
8. France	no information	no information	1970-95
9. Germany	no, includes under changes in inventories	yes	1970-94
10. Greece	no, includes under changes in inventories	yes	1970-89 only net stock
11. Hungary	estimates not available		
12. Iceland	yes	yes	1984-95 UN NAS 1995
13. Ireland	yes	yes	not available. GFCF available, 1986-96
14. Italy	no information	yes	1980-95
15. Japan	yes	no information	1970-94
16. Korea	yes	yes	not available. GFCF available, 1984-96
17. Luxembourg	no information	yes	not available. GFCF available, 1984-91
18. Mexico	yes	no information	not available. GFCF available, 1988-96
19. Netherlands	yes	yes	not available. GFCF available, 1984-95
20. New Zealand	yes	no information	not available. GFCF available, 1984-89
21. Norway	yes	yes	1970-90 only net stock
22. Poland	estimates not available		
23. Portugal	yes	yes	not available. GFCF available, 1986-93
24. Spain	yes	yes	not available. GFCF also not available.
25. Switzerland	estimates not available		
26. Sweden	yes	yes	1980-94
27. Turkey	estimates not available		
28. United Kingdom	yes	yes	1970-92, but up to 1994 UN NAS , 1995
29. United States	no, includes under changes in inventories	no information	1970-93

15. Impact of making adjustment for livestock and orchards and of taking different service life for assets on the estimates for OECD countries can be seen in statement 3. The statement presents data for the OECD countries adjusted for 'breeding stock, dairy cattle etc' along with the estimates from the World Bank and FAO estimates prepared using the data from the World Bank study.

Statement 3 : Estimates of gross capital stock in agriculture for OECD countries
for the year 1992

(million 1990 US \$)

Country	OECD Estimates of Capital Stock		World Bank Estimates of Total Capital Stock	FAO Estimates using country estimates of fixed capital formation	
	Unadjusted	Adjusted for Livestock (if necessary)	(including Livestock and Orchards)	Using 25 years as average of assets	Using 30 years as average of assets
1. Australia	42,079	62,777	64,037	44,658	52,898
2. Belgium	10,680	10,680	14,077	17,378	20,443
3. Canada	48,872	55,948	62,563	107,548	126,449
4. Denmark	41,893	41,893	22,369	34,215	40,068
5. Finland	42,741	42,741	22,878	49,304	57,570

6. France	158,758	158,758	140,207	189,507	216,499
7. Germany	220,693	220,693	116,568	182,527	18,050
8. Greece	20,402	21,608	11,864	14,716	355,655
9. Italy	334,988	334,988	205,860	301,802	355,655
10. Japan	650,645	650,645	465,139	682,587	748,690
11. Norway	18,589	18,589	18,690	31,363	35,784
12. Sweden	28,448	28,448	22,349	22,349	0
13. United Kingdom	60,680	60,680	54,200	82,289	96,994
14. United States	400,877	458,326	336,924	336,924	646,030

Notes:

1. For Belgium the World Bank estimates are for Belgium and Luxembourg.
2. OECD estimates for Greece and Norway relate to Net Stock.
3. Blanks under World Bank estimates indicate that no estimates have been prepared.
4. Since OECD fixed capital stock estimates for Australia, Canada, Greece and USA, do not account for livestock, these have been adjusted for total capital stock of livestock estimated by the World Bank adjustment for breeding stock etc. alone could not be made for want of details.

(c) FAO's needs and status of work

16. Investment in agriculture is a major determinant of the future growth and sustainable development of the sector. It is also an important factor for a comprehensive analysis of the Sector involving use of private and public -- domestic and external resources diverted from short term consumption, improvement and from other forms of productive and non-productive public and private expenditures, including investment in other sectors. Therefore, estimates of investment in agriculture are required for:

- (a) Monitoring trends in investment at the international level (between countries and groups of countries, among sub-sectors and among investment categories);
- (b) Assessing the causes of variations in absolute or relative terms over time;
- (c) Evaluating the productivity of investment in agriculture (sectoral ICOR approach) ;
- (d) Research on the synergy of agricultural investment with investment in related sectors (rural infrastructure, marketing and processing, human resources development...);
- (e) Investigation into the net investment concept, with particular reference to natural resources conservation/degradation.

17. These analysis are required in the context of prevailing policies and economic conditions for formulating investment-related recommendations for development policies and for assessing investment requirements under specified development strategies. These topics are to be addressed through a combination of country case studies, or cross-country comparative analyses. This raises a few auxiliary questions about the data needs and definition of investment :

- Assessment of impact of investment on agricultural production - how to define agricultural production? global (or net of intra-consumption), at which stage of processing and for which (main) subsector?
- Whether to consider data on other factors of production (land and labor)? and if the total productivity should be studied?

- Can one analyse investment in relation to food production as distinct from other agricultural outputs? To what extent it is conceivable, feasible, useful/meaningful?

18. Investment in agriculture can be defined in broad as well as narrow sense. The narrow sense considers only on farm investment, i.e. investment required for undertaking agricultural activities as defined in International Standard Industrial Classification of all economic activities (ISIC). In the broader sense investment in agriculture is defined to take into account infrastructural development which indirectly effect agricultural development. The narrow concept is used in national account while the broad concept is considered when undertaking sectoral analysis. However, what ever be the concept of investment in agriculture, analysis of data has its own problems. For example, when one considers on-farm investment, one is not sure if the total investment is being used for agricultural development. Thus, to illustrate small tractors are heavily used for transportation of goods and people. Similarly when taking the broad concept one does not know what to include, e.g. support services (mechanisation, storage, processing, markets?), infrastructures and their heavy maintenance (irrigation, flood control, rural roads, other means of communications, energy?), terracing, land improvement, afforestation? Apart from these cases there are some areas which are more uncertain and difficult to value. This may include fixed and recurrent costs in research, extension, investment in human capital, etc.?

19. In FAO the ES Department has (since the late 1960s) been involved in analysing investment requirements for the agricultural sector (narrowly / broadly defined). Investment analysis at the project (sub-sector) level has been attempted in the Organisation. A series of Country Perspective Studies carried out during the late 1960s / early 1970s, attempted to estimate at the country level investments (both in physical and monetary terms) needed to achieve a certain target for agricultural production over a projection period. In another attempt, to undertake a comprehensive analysis of investment requirements covering most of the developing countries, estimates of apparent investment⁷ in agriculture (which were based on a normative approach) were also compiled for use in the first global perspective analysis (The Indicative World Plan of 1969), and later on (after the CPS were discontinued in 1975) in the 1979 Agriculture: Towards 2000 study. These attempts were repeated at several occasions, for example, in the 1987 AT2000 study (See Alexandratos, 1988 for results and a description of the methodology) for undertaking global analysis. In early nineties the exercise was repeated once again and the estimates of investment in agriculture excluding forestry and fishing were prepared for Africa, Asia, and Latin America & Caribbean and presented in the Technical Background Document for the WFS (No. 10). These estimates have been compiled by enumerating net additions in capital stocks (about 26 items) needed to sustain a certain production level over a projection period (physical investment). By multiplying each capital item by an assumed unit cost⁸ (\$/unit collected from different sources) one arrived at investment in monetary terms. By adding an estimate for investment in replacement (depreciation) an estimate for total (gross) investment was obtained. The price data were compiled from a number of sources including sources like country investment project reports received/prepared in the FAO, implicit prices from foreign trade data, etc. To meet FAO needs this analysis was extended to cover agriculture in broad sense. For a number of reasons the 1993 AT2010 study does not include such an analysis (doubts over the methodology; impossibility to generate standard investment unit costs, lack of resources to do more serious work; etc.).

20. Recently, demand for data on investment in agriculture has been re-emphasised. It is under investigation if the food security is heavily dependent on investment in agriculture, and if so, what are the areas that need more attention. Thus a restart is being made to create country level estimates of investment in agriculture that are logically linked to the estimates of number of undernourished. Such an

exercise needed unit prices for various items of investment at country level. A brief description of the approach adopted for price data that represent a true inter-regional variation is presented below.

- (a) Land: The data on price are required for estimating improvement in arable land (i.e. cost of constructing wind and water barriers, bunding, terracing, etc.) and cost of plantation crops. The unit cost for the first items has been worked out using wage income for two months (wage income has been derived using per worker income from agricultural activity) for number of workers cultivating one hectare of land. The unit cost for plantation crops has been worked out similarly by using capitalization of income method with average life of permanent tree crops as 20 years.
- (b) Unit cost for irrigation works: This cost does not include large dams. Large dams, which are multi-purpose in nature, are considered as part of infrastructure development. Cost of small and medium irrigation projects and connected irrigation channels for 85 countries are based on information supplied by member countries (see FAO, 1995 -1999). For other countries the estimates have been imputed by keeping in view similarity of terrain and labor cost.
- (c) Livestock: Time series data on prices derived from foreign trade statistics for live animals by category of livestock i.e. cattle, buffaloes, sheep, goats, pigs, camels, horses, mules, etc. has been used to derive price per unit for livestock for better category of animal (used for breeding, work, milk, etc.). Independent estimates of price per unit of livestock have worked out using price of meat and body-weight. The two series have been used to derive a weighted average price for each type of livestock. Weights differ from country to country and from type of livestock.
- (d) Agricultural Machinery: This data set has been obtained by a combination of different data-sets: (a) time series data on price of agricultural machinery i.e. tractors, harvesters and milking machines derived from foreign trade statistics (Import prices of each item of assets has been adjusted for trade and transport margins and import duties. A uniform mark-up factor of 50 % has been used. This mark up factor is based on the mark ups for imported tractors for 15 countries for 1985 given in the World Bank Study, "Agricultural Mechanisation- Issues and Options", 1987.); (b) data on prices of various items of assets (prices of tractors, combines, harvesters, milking machines, draught animals like cattle, buffaloes, oxen, horses etc. in local currency converted in US \$) collected from the member countries (for the publication "Statistics on Prices paid by Farmers for Means of Production") and (c) Data on average horse power for agricultural tractors in use in different countries.

21. A detailed publication giving estimates and methodology would be released as soon as prepared.

NOTES

¹ The Nations accepting this Constitution, being determined to promote the common welfare by furthering separate and collective action on their part for the purpose of: raising levels of nutrition and standards of living of the peoples under their respective jurisdictions; securing improvements in the efficiency of production and distribution of all food and agricultural products; bettering the condition of

rural populations; and thus contributing towards an expanding world economy and ensuring humanity's freedom from hunger; hereby establish the Food and Agriculture Organization of the United Nations, ... (Basic Texts of the FAO).

² For the present purpose agriculture has been defined in narrow sense by referring to crop and animal husbandry.

³ The international dollars, are derived using a Geary-Khamis formula for the agricultural sector. This method assigns a single "price" to each commodity regardless of the country where it was produced. The "international dollar prices" are used in order to avoid the use of exchange rates for obtaining continental and world aggregates.

⁴ Over the years, the FAO has developed ratio of wheat prices to the prices of other commodities. These ratios are known as wheat relatives. Thus in the present exercise estimate of prices of wheat were prepared first. If no data on wheat prices was available, prices were estimated either from any other official/non-official publication or by using any other important crop for the country as base and the wheat relative. The last benchmark data was moved to other years using 'exchange rate in use' as a proxy variable to indicate rate of inflation. This series of wheat prices and wheat relatives were further used to complete first approximation of the price series.

⁵ In many countries with social disturbances or war conditions, due to very high rate of inflation, people vary often loose faith in local currency and the official exchange rate (In most of these countries, the official exchange rate are almost of no significant value and there is a parallel exchange rate in use - sometime known as black market rate, indicating marked increases in the level of prices) and US \$ is taken more as a 'commodity' then as a monetry instrument. Thus the black market exchange rate is taken as a proxi to the rate of inflation.

⁶ It may be clarified that generally the official estimates of fixed capital formation of various countries, as per 1993/1968 SNA, are inclusive of increment in 'breeding stock, draught animals etc' and the increment in 'young stock, livestock raised for slaughter etc' is included in increase in stocks. Capital expenditure in respect of development of orchards and trees etc. also forms part of the fixed capital formation.

⁷ The term apperent investment has been used as the estimates are an indirect estimate of investment and could differ significantly from country estimates, if available, for known reasons.

⁸ Land Development (Arable land, Permanent crops, Irrigation); Implements (Tractors, Hand tools, Housing of animals) and Livestock (Cattle and buffaloes, Sheep, Goats, Pigs, Poultry)

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