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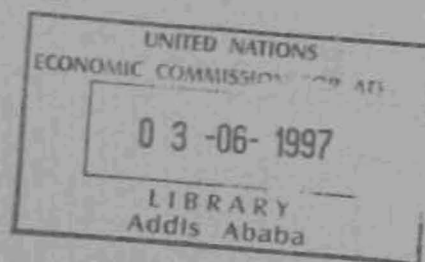
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**SURVEY ON POST-HARVEST FOOD
LOSSES IN THE EAST AFRICA SUBREGION**

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ABBREVIATIONS AND ACRONYMS

ADC	:	Agriculture Development Corporation in Somalia
ADLI	:	Agriculture-Development-Led-Industrialization in Ethiopia
AFMET	:	The Farmers' Training Centre in Somalia
ECA	:	Economic Commission for Africa
CEPGL	:	Economic Community of the Great Lakes Countries
DANIDA	:	Danish International Development Agency
ERRA	:	Eritrea Relief and Rehabilitation Agency
FAO	:	Food and Agriculture Organization of United Nations
GREMARWA	:	Grenier National du Rwanda
GSY	:	Gisenyi
JEFAD	:	Joint ECA/FAO Agriculture Division
MULPOC	:	Multinational Programming and Operational Centre
MUSALAC	:	Centre de Sante de Musange au Burundi
NCPB	:	National Cereals and Production Board of Kenya
OPROVIA	:	Office pour la Promotion et la Commercialisation des Produits Vivriers et Animaux au Rwanda
KBO	:	Kagera Basin Organization
OAU	:	Organization of African Unity
PISCA	:	Atelier de Planification du Programme d'infrastructures de stockage et de conservation des produits agricoles tenu au Zaïre en aout 1990
WFP	:	World Food Programme

II. INTRODUCTION

1. This survey was not conducted under the best of conditions. As a matter of fact, a mission to collect statistical data, and information was organized solely to a few countries of the subregion. Indeed, only Ethiopia and Eritrea were covered. Furthermore, a request for statistical data, and information sent to the member States was answered only by a very small number of countries.

1.1. Overview of the situation of post-harvest food losses in the East African subregion

2. Post-harvest food losses in East African countries which could often attain between two and five per cent, and storage conditions and location, can no longer remain unnoticed by the leaders of these countries which are daily confronted with problems of severe hunger and malnutrition. Global increased food production is, naturally, the objective of the food security strategy. However, it is important to preserve and protect food production, considering that a substantial part of it is lost along the various stages from production up to distribution. This loss is due to the absence of appropriate pre- and post-harvest storage and conservation systems.

3. Food losses, unstable climate and the development in the population's increasingly growing food requirements and the need for agro-industrial food processing, have aroused the necessity of not only using the traditional storage systems and means which consist, essentially, of storehouses, baskets, clay pots, casks, bags or underground holes, despite their proven performance in certain circumstances. To make up for this, efforts have been made to modernize the storage systems which very often consist of silos and stores in which food products are stored in bags placed on wooden boards. Other systems have also been used such as the piling of bags of foodstuffs in the open air covered with tarpaulin metallic frameworks covered with tarpaulin and light metal hangars.

4. However, most of these systems have turned out to be inefficient coupled with their high maintenance cost, the non-mastery of the corresponding technology, the lack of experts and the possibility to popularize them.

5. Losses in stored food products are very often caused by biological factors resulting from attacks by certain micro-organisms, insects and other vertebrate depredators such as rats, lizards and birds. Certain storage conditions such as hygiene and storage environment as well as handling, can also cause food losses and/or impel the action of the above-mentioned biological factors. Other technological factors such as traditional food processing methods, the lack of sufficient and appropriate marketing facilities and training also cause post-harvest food losses in the subregion. It is therefore within the framework of seeking lasting solutions to the problem of preventing and reducing pre- and post-harvest food losses and ensuring better food collection, that this survey was undertaken.

1.2. Survey content

6. Taking into account the factors cited above, this survey report comprises six chapters: The introduction gives an overview of the situation of food security and pre- and post-harvest food losses in the East African subregion. Chapter two analyzes the situation of food production and security in the course of these past years. It also identifies basic food productions and reviews country measures taken to increase food security through increased food production.

7. Chapter three lists out and diagnoses food storage and conservation means and systems at the level of family farms and centres for the purchasing distribution and processing of foodstuffs. Lastly, it analyzes the obstacles to food storage and conservation. Chapter four examines the main factors and the magnitude of food losses in the major foodstuffs stored. It also analyzes national programmes implemented in order to prevent and reduce post-harvest food losses. The chapter finally presents facts on the subregion in this area.

8. Chapter five identifies means likely to improve and strengthen the food storage and conservation systems as well as prevent and reduce food losses during pre-and post-harvests and collection of food products. The chapter ends with a time-table for the execution of identified projects. Finally, chapter six draws up the survey's general conclusions and recommendations.

II. FOOD PRODUCTION IN THE EAST AFRICAN SUBREGION

9. The survey covers ten member countries of the Common Market of Eastern and Southern African (COMESA) namely, Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Uganda, Somalia, Tanzania and Zaire. These countries are located in the East African subregion which extends to latitude 18° North with Eritrea furthest to the North, latitude 14° South with Zaire furthest to the South, longitude 12° East with Zaire furthest to the West and longitude 50° East with Somalia furthest to the East.

10. This subregion has the following main features:

(a) High mountainous plateaux propitious for the development of a certain number of micro-organisms such as mushrooms and bacteria. This situation does not provide good conditions for food storage and conservation;

(b) Fewer possibilities exist for the proper drying of food products, particularly, during the rainy seasons;

(c) Arid areas in Djibouti and Somalia which impede any expansion of food production in this region, except in the southern part of Somalia where, owing to irrigation, sugar cane, cotton and bananas are cultivated;

(d) Possibility for vertebrate predators to cause serious damage to stored foodstuffs even before harvest, in particular, tubers and root crops that are ready for harvest or still to be harvested; and

(e) Predominance of speculations on tubers and root crops, legumes and bananas whose storage and conservation conditions are more demanding and more liable to change.

11. The main food crops cultivated in this East African subregion are: cereals such as maize, wheat, sorghum, rice and millet; tubers and root crops such as cassava, sweet potatoes, potatoes and yams; legumes such as beans; vegetables; oil seeds such as soya beans, groundnuts, cotton seeds and palm nuts as well as fruits essentially bananas. Export food crops are also cultivated viz; coffee, tea and sugar cane. Stock farming is also practised mostly cattle, goats, sheep and pigs; and finally, poultry and bees. Table 1 below, shows the development of overall food production in the subregion during the period 1991-1995. 1995 production was however provisional. Tables 2, 3 and 4 respectively furnish detailed data on food production indexes, food production and the areas over which the main food crops were cultivated during the same period 1991-1995.

Table 1 : Food production development in the East African Subregion (1000 tonnes)

Table 1(a): Burundi and Djibouti

	Burundi					Djibouti				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Cereals (total)	299	309	299	213	...	...	...	...	...	...
Root crops & tubers (total)	1,449	1,487	1,449	1,124	...	...	...	...	...	...
Legumes (total)	377	386	376	287	346	...	...	...	...	...
Vegetables (total)	220	230	225	210	...	21	21	21	22	...
Fruits (total)	1,673	1,735	1,673	1,385	...	...	...	...	...	...
Grand total	4,018	4,147	4,022	3,219	...	21	21	21	22	...

Table 1 (b): Eritrea and Ethiopia

	Eritrea					Ethiopia				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Cereals (total)	77	204	73	72	...	6,035	7,070	6,956	6,734	7,013*
Root crops & tubers (total)	115	120	109	109	...	2,078	2,074	1,965	2,018	...
Legumes (total)	26	35	13	13	13	824	815	802	800	800
Vegetables (total)	33	33	25	25	...	594	599	574	564	...
Fruits (total)	5	5	4	4	...	231	234	230	227	...
Grand total	256	397	284	223	...	9,762	10,792	10,527	10,344	...

Table 1 (c): Kenya and Uganda

	Kenya					Uganda				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Cereals (total)	2,770	2,833	2,006	3,481	2,731	1,576	1,743	1,881	2,031	....
Root crops & tubers (total)	1,551	1,630	1,680	1,752	....	5,268	5,069	5,435	5,923	....
Legumes (total)	189	215	200	200	200	492	512	550	572	510
Vegetables (total)	643	655	655	655	....	415	400	413	418	....
Fruits (total)	924	974	974	974	....	8,697	8,411	8,838	9,627	....
Grand total	6,077	6,307	5,515	7,062	....	16,438	16,135	17,117	18,576	....

Table 1(d): Rwanda and Somalia

	Rwanda					Somalia				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Cereals (total)	329	292	181	158	....	256	209	165	405	....
Root crops & tubers (total)	1,624	1,737	1,617	1,616	....	49	43	44	39	....
Legumes (total)	226	163	148	142	142	13	10	11	12	....
Vegetables (total)	132	133	134	120	....	47	26	47	48	....
Fruits (total)	2,859	2,961	2,962	2,655	....	269	212	231	207	....
Grand total	5,170	5,286	5,042	4,691	....	634	500	498	711	....

Table 1(e): Tanzania and Zaire

	Tanzania					Zaire				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Cereals (total)	3,792	3,538	3,876	3,594	4,042	1,588	1,589	1,752	1,798	....
Root crops & tubers (total)	7,981	7,578	7,323	7,716	....	21,312	21,035	21,672	20,447	....
Legumes (total)	424	312	337	302	360	193	195	196	198	200
Vegetables (total)	1,111	1,046	899	1,001	....	561	569	577	577	....
Fruits (total)	2,057	2,134	2,155	2,228	....	3,411	3,483	3,554	3,689	...
Grand total	15,365	14,608	14,590	14,841	....	26,065	26,867	27,751	26,709	....

Source: FAO, Production Yearbook, vol. 47. 1993 and vol. 48 1994.

- * (1) With regard to, the statistics furnished concern PDR Ethiopia up to 1992 and Ethiopia after 1993. The same applies to all the tables below.
- * 1995 data is provisional.
- * FAO estimates; and non-available or non-existing data.

2.1 AGRICULTURAL PRODUCTION

2.1.1 Burundi

12. Burundi's agricultural sector represented 48.7 per cent of the GDP in 1991 and 85.5 per cent of the country's export earnings in 1992. Consequently, in matters of job creation, production and export earnings, agriculture is one of the important economic activities of this country. Its main food crops comprise tubers and root crops, including sweet potatoes, cassava and potatoes; cereals such as maize, sorghum, rice, millet and wheat; legumes such as dried beans; vegetables; oil seeds such as groundnuts, soya beans and palm nuts as well as fruits, essentially, bananas

13. In 1990, food production recorded a slight increase of 1.9 per cent as compared to 1989, owing to good economic and climatic conditions. However, the 1993 production dropped by three per cent in relation to that of 1992 with some slight increase of 4.6 per cent of that of 1992 as compared to 1990. Nevertheless, the 1992 food production was the highest recorded over these past years. According to data provided in Table 1.1, agricultural production in 1994, declined by 19.9 per cent as compared to that of 1993. Furthermore, the scanty data available for 1995, reveals that the decline is instead increasing. For instance, this is the case with millet, sorghum and legumes including dried beans. Considering the situation prevailing in this country since 1993, agricultural production is expected to continue to decline in 1996 and even during the short term.

14. Dried beans, and bananas account for 47.3 per cent of food production in 1994; while the production of cereals and tubers and root crops represented 6.6 and 34.8 per cent respectively. For the same year, food crops occupied more than 70 per cent of arable land with 19.1 per cent for cereals and practically the same percentage for tubers and root crops, and 32.1 for legumes. Even though agricultural yield increased in 1992 as compared to the yields of the period 1978-81 (29.7 per cent for cereals, 1.2 per cent for tubers and root crops and 10.4 for dry legumes), 1994 recorded a generalized drop, in relation to 1995, in the main food crops some of which fell below the 1989-81 mark. As a matter of fact, it was remarked that cereals, tubers and root crops and legumes decreased by 12.7, 10.5 and 16.6 per cent respectively. The increase recorded in food production was due more to the surface area covered than to actual yields.

15. The shortfall noticed in food production during the period 1993-1994, was partially compensated for by an increase in the 1992/93 food imports and food aid during this period. This is probably the current situation of Burundi's food production, owing mainly to the political problems this country is facing. The return to normal conditions of peace and security are a prerequisite for the resumption of food production activities. The major guidelines for this country to develop its agricultural sector remain, the promotion of adequate food production coupled with the promotion of sufficient production of calories and other nutrients; the diversification of export crops; the promotion of rural development; on-the-spot processing of food products; the promotion of regional specialized production and even subregional trade and, of course, the return of peace to the whole territory.

2.1.2 Djibouti

16. As pointed out in paragraph 16 above, agriculture in Djibouti, an arid country considered much more as a city-State, is practically non-existent. Furthermore, the scarcity of water resources and unstable climate which make it a desert country, considerably limit any form of agriculture. In 1990, agriculture accounted for 2.8 per cent of its GDP. The arable land remain poor and is essentially destined for the production of vegetables. In 1994,

the production of vegetables stood at 21,000 tonnes according to Food and Agriculture Organization (FAO) statistics. Other speculations can still be made and even envisaged, particularly, as concerns the cultivation of jojoba (a desert plant which produces oil used in the manufacture of certain cosmetic products, in medicine, and textile industry and which has a high lubricating content) as well as palm cabbage (oil date palms).

17. Stock farming of goats, sheep, camels, cattle and donkeys (on a smaller scale), is likely to develop. It is, however, encountering a few obstacles which, particularly, include the quite frequent drought and the tradition which considers the number of cattle owned as a source of wealth and not as a contribution towards increased production and income accruing from speculation. The Government has, however, taken measures to promote this sector, particularly, by improving the infrastructures through the construction of slaughter-houses and a fodder plant, the drilling of wells in favourable areas and the construction of hides and skin drying facilities and, above all, by encouraging private initiatives. In addition, poultry is considered in Djibouti as a sector with many openings which should be judiciously developed.

2.1.3. Eritrea

18. The agricultural sector is of vital importance to the vast majority of the people of Eritrea. It is estimated that between 70 and 80 per cent of the population depends on agriculture, stock farming and fishing for their income and employment. However, preliminary national accounts data shows that agriculture, stock farming and fishing accounted for 26 per cent of the nation's production in 1992 while exports dropped. This situation could be attributed to the unusual conditions prevailing, during these last decades, in this country which went through a civil war, and to its limited access to external trade. Indeed, the historical facts of this country, reveal that the agricultural sector as a whole can contribute a lot more to national production than it is doing at the moment.

19. Eritrea has about 1,200,000 ha of arable land representing 9.9 per cent of the total area which is 121,140 km². The main food crops grown in this country are cereals such as wheat, maize (the most important food crop), millet and sorghum; tubers like potatoes; legumes like dry beans; vegetables; oil seeds such as soya beans, sesame and groundnuts; and fruits. Farming techniques are typically traditional, and very few inputs are used. Stock farming using animal draught also plays an important role in agricultural production.

20. The good distribution of rainfall in 1992 and the availability of inputs led to the substantial increase of 55.07 per cent in food production for the period 1991 to 1992. This increase is however low since most of the obstacles and bottlenecks that the agricultural sector in Eritrea is experiencing, have not been resolved. Furthermore, attacks by insects, environmental degradation and the poor rainfall distribution during the 1993 farming season did not make it possible to attain the expected food production level during that season. The area devoted to the cultivation of cereals and legumes declined slightly by 0.5 per cent in relation to that of 1992, thereby causing to a drop of 28.46 per cent in food production.

21. The 1993 drought and attacks by grasshoppers during this period, further damaged grazing land in certain areas and seriously affected livestock development accompanied by the current decline of about 40 to 50 per cent in cattle. According to FAO/World Food Programme (WFP) estimates, cereals imports stood at 320,000 tonnes in 1994 out of which 255,000 tonnes was expected from food aid. In reality, 1994 food production declined by 21.5 per cent as compared to the 1993 production.

22. For 1994, tuber production topped the list with 48 per cent including 17.2 per cent for potatoes. Cereals production accounted for 31.7 per cent of food production with 22 per

cent for sorghum. Legumes represented 5.7 per cent while vegetables, oil seeds and fruits represented respectively, 11, 1.8 and 1.8 per cent of this country's food production for the same year 1994. For the period 1993 to 1994, yields of tubers (essentially potatoes) and legumes remained unchanged. That of cereals slightly dropped by 2.4 per cent. In the course of 1994, the total area of arable land over which cereals, tubers and legumes were cultivated was 174,000 ha. representing 14.5 per cent; an almost identical area was cultivated in 1993. This shows that available farm land is not fully utilized. It is estimated that 1995 food production will attain the same level as in 1994.

23. In Eritrea, food security is the Government's prime objective to ensure not only food self-sufficiency but also to sufficiently contribute to its capacity to export, and trade with the outside world in a bid to ensure that adequate food can be imported to meet the domestic food needs of its population. This option, however, constitutes a long process which, in the intervening time, necessitates short- and medium-term food aid as shown in table 5 below:

Table 5: Development of food aid in Eritrea from 1988-1996 (tonnes)

Year	Total food needs	Domestic production	Food deficit	Food aid received	Food imports
1998	....	....	193,050	107,138	....
1989	....	....	188,700	87,280	....
1990	....	....	337,500	182,561	....
1991	....	....	436,000	300,000	....
1992	....	275,728	190,000	88,977*	....
1993*	466,000	276,000	190,000	140,000	50,000
1994	456,000	136,000	320,000	255,000	65,000
1995	494,000	443,000	51,000	....	51,000
1996*	470,000	179,000	291,000	191,000	100,000

Source: Eritrea Relief and Rehabilitation Agency (ERRA), charged with the distribution of food aid throughout the country. Annual Reports; World Food Programme (WFP).

* Estimates; and

Domestic production data in this table seemed to have been overestimated given the statistical data established by the FAO. See data in table 1 in particular.

24. It also seems that food aid received by Eritrea had disrupted food production in 1993, thereby reducing the production and prices of agricultural products on the market. This phenomenon is not peculiar to this country. Many other countries of the subregion have also been victims. In order to further enhance the growth of the agricultural sector, the Government is laying emphasis on a certain number of measures designed to promote and strengthen, mainly, the institutional framework, extension and research services, the rural credit system, the supply of production inputs, agricultural marketing, agriculture-oriented trade as well as to promote private initiative in the sector.

2.1.4 Ethiopia

25. Agriculture is one of the main economic sectors of Ethiopia. According to data from the United Nations Development Programme (UNDP) in Addis Ababa, agriculture currently accounts for 40 per cent of the GDP, 85 per cent of export earnings and more than 80 per cent of jobs. Smaller farms contribute about 90 per cent to agricultural production. Ethiopia's main food crops are: cereals such as maize, wheat, sorghum and millet; tubers and root crops such as potatoes, yams and sweet potatoes as well as legumes like dry beans.

26. This country's food production in 1991/1992 increased by 10.5 per cent. All groups of these food crops practically contributed to this increase. On the other hand, 1994 food production declined by 1.7 per cent in relation to the 1993 production. In 1994, the production of cereals topped the list with 64.9 per cent, followed by tubers and root crops, legumes, vegetables and fruits representing 19.5, 7.7, 5.5 and 2.2 per cent respectively. Regarding the production of cereals and tubers and root crops, a slight increase of 1.2 and 1.6 per cent was recorded, respectively, for cereals and root plants, with unfortunately, a decrease of .22 per cent in dry legumes during the period 1993/1994. According to data collected on the field, just like forecasts, 1995 would have recorded an increase in the production of cereals, legumes and oil seeds. The drop in food production in the course of the period 1992-1994, was compensated for by an increase in food aid and imports during the same period as shown by the data in tables 3 and 10.

27. Cultivated arable land was estimated at 100,000,000 ha. in 1993. Land cultivated with cereals, tubers and root crops as well as legumes was estimated at 9,130,000 ha. or 9.1 per cent. Just like Eritrea, Ethiopia still has enormous potentialities in farm land likely to be used for food production.

28. The development of food production, in general, and agriculture, in particular, needs, *inter alia*, the promotion of the use of agricultural inputs, especially, fertilizers and selected seeds, extension services; water for irrigated agriculture as well as systems for the marketing of agricultural, stock farming and fishery products. In this respect, the Government has adopted a long-term development strategy called "Agricultural-Development-Led-Industrialization (ADLI)", which seeks not only to ensure food self-sufficiency but also to supply an impetus to industry in order to facilitate economic transformation.

29. ADLI is laying emphasis on the need to implement policies which seek to encourage and ensure secured access to land and inputs adapted to small farms. It is also laying emphasis on the promotion of the private sector involved in agricultural development, thereby reducing the Government's role in that area. Programmes needing prime developmental attention concern small farms, commercial agriculture, the development of livestock and fisheries as well as the marketing and distribution of agricultural products.

2.1.5 Kenya

30. Agriculture and stock farming are the most important economic activities of Kenya. In 1993, the agricultural sector, including forestry and fishing accounted for 29 per cent of the GDP and 29 per cent of salaried jobs at the formal sector. The same sector is also important as concerns job creation at the informal sector though no statistical data exists at this level. More than half of the agricultural production is geared towards subsistence farming while tea and coffee together with flower growing accounted for 52 per cent of export earnings in the same year 1993.

31. Kenya with arable land of 4 million hectares, has enormous potentialities for the development of its food agricultural sector. The main food crops grown are: cereals such

as maize, wheat and sorghum; tubers and root crops like sweet potatoes and cassava as well as fruits, particularly, bananas and other fruits such as mangoes and citrus.

32. Food production for 1994 as compared with 1991, recorded an increase of 16.2 per cent which was considered in practically all food speculations. In 1994, the production of cereals, dominated by maize, was in the lead with 49.2 per cent. It was followed by that of tubers and root crops, fruits mainly bananas, vegetables and legumes, representing 28.4, 13.8, 9.3 and 2.8 per cent respectively. In 1995, according to forecasts, the production of cereals dropped owing to the decline in maize production (25.9 per cent drop as compared to 1994).

33. The increase in food production recorded in the country in 1994, was, essentially, due to increased yields, particularly, of cereals with 37.5 per cent and tubers with 1.5 per cent as against the 1979/81 average. The production of dry legumes however decreased by 33.5 per cent during this period 1978/81-1994. Increased yields are, essentially, due to efforts made to improve farming methods and to introduce better varieties, especially, of maize, and to ensure the proper use of production inputs. The decrease is, mainly, the result of eco-climatic conditions which hit the country during the same period, particularly, the serious drought of 1992 and 1993.

34. Furthermore, it should be noted that the rise in food production during the period 1989/81- 1994 was due to the increase in the area cultivated with these crops. As a matter of fact, during the period 1979/81-1994, the area devoted to the cultivation of cereals, tubers and root crops as well as to legumes recorded an increase of 9.6, 36.7 and 62.8 per cent respectively. According to 1993 statistics, this area totalled 2,554,000 ha. representing 63.8 per cent of the total area of arable land. This therefore presupposes the existence of additional potentialities that could be allocated to the development of food crops.

35. However, the population pressure of these past years led to crop cultivation on marginal lands whose unit yield is less competitive. Furthermore, the measures to intensify cultivation systems requiring, in particular, the use of more inputs, especially fertilizers and selected seeds, must be stepped up, if the Kenyan population is to attain a balanced food level.

36. Like other countries of the subregion, the drop in food production during the period 1992-1993, resulted in increased food aid and imports during the same period. Finally, it should be pointed out that Kenya is a big producer of coconuts the average production of which stood at 43,000 tonnes during the period 1992-1994.

37. The strategy to promote Kenya's agricultural sector, essentially, seeks to increase agricultural income and to ensure food security at the level of farms; improve the management of the dairy industry; promote the land redistribution and acquisition systems, especially for small-scale farmers; and intensify production as well as the liberalization of the production, processing and marketing systems.

2.1.6 Uganda

38. The agricultural sector in Uganda constitutes its economic base. According to currently available data, this sector, in 1991, accounted for 51 per cent of the GDP and more than 80 per cent of export earnings, while 80 per cent of its labour force was involved, particularly, in export related-agricultural activities such as the cultivation of coffee and tea. In response to incentives to diversify agriculture, restore stability and increase prices, food production in Uganda recorded an average annual increase of 5.77 per cent during the period 1986-1991. This increase however resulted from the slight recovery of the period 1976-

1981. Total agricultural production, particularly, of foodstuffs has attained the levels of the 1970s only very recently.

39. The main food crop of Uganda is banana. In 1994, this crop accounted for 48.8 per cent of the total food production, followed by tubers and root crops, with 31.4 per cent, cereals with 10.8 per cent and legumes per cent with 3 per cent. Food crops are cultivated on more than 73 per cent of arable land excluding banana which, in the years 1992-1993, was cultivated on about 30 per cent of total arable land. Though there was a considerable increase in the production of food crops in recent years, particularly, tubers and root crops as well as dry legumes (tubers and root crops: 13.2 per cent and legumes 23.2 per cent for the period 1979/81-1994), the production of food crops in Uganda remain, in general, below the potential level of farms. The extension of cultivated areas which substantially contributed to the agricultural growth of the 1980s, is still paramount to the efforts to increase this country's food production.

40. Generally speaking, 1994 food production increased when compared to 1991, viz: cereals: 29 per cent; tubers and root crops: 12.4 per cent; legumes: 16 per cent; vegetables: 0.7 per cent; oil seeds: 8 per cent and fruits: 10.7 per cent. According to 1995 forecasts, the production of millet, legumes and groundnuts dropped in comparison with 1994. Despite increased food production noted during the period 1991-1994, it was noted, according to the data in tables 4, 6.1 and 6.2, that food aid and imports increased during the period 1992-1993. This increase is, undoubtedly, due to increased domestic consumption.

41. The development objectives of Uganda's agricultural sector are, essentially, the production of sufficient food likely to ensure food security and adequate nutritional levels and the increase and diversification of agricultural production. The development of the sector further seeks to produce sufficient spare parts for national agro-based industries; create enough job opportunities as well as promote rural development in order to reach the vast majority of the population more than 90 per cent of whom essentially live on rural agriculture.

2.1.7 Rwanda

42. Though Rwanda is, essentially, an agricultural country, the contribution of agriculture to the GDP dropped from 41.9 per cent in 1985 to 38.1 per cent in 1990. In the years 1991, 1992 and 1993, the contribution of this sector to the GDP was estimated at 42.8, 43.8 and 40.5 per cent respectively. This development in recent years does not, however, signify that this sector was performing well, but rather that there was a decline in other sectors, particularly, since in 1993, this sector recorded a negative growth of 15.4 per cent according to data from "Country profile, Rwanda Burundi, E.I.U., The Economist Intelligence Unit, 1995-96".

43. In Rwanda, more than 90 per cent of the total population live on agriculture with small farms of less than one hectare for more than 50 per cent of family farms identified in the country. Furthermore, more than 74 per cent of Rwanda's arable land is cultivated with the main foodstuffs, namely: cereals: 18.4 per cent; tubers and root crops: 29.6 per cent; and legumes: 29.8 per cent.

44. In 1994, bananas, represented 55.3 per cent of total food production. This was followed by tubers and root crops with 34.3 per cent, cereals with 3.4 per cent, legumes with 3 per cent and vegetables with 2 per cent. In Rwanda, food production is, essentially, geared towards subsistence farming. Generally, 1994 food production declined drastically by: 51.97 per cent for cereals, 49 per cent for tubers and root crops, 37.1 per cent for legumes, 9 per cent for vegetables and 7.1 per cent for fruits. According to 1995 forecasts, this

decline was expected to continue and even at the medium-term, given the socio-economic situation currently prevailing in this country.

45. Diseases, less efficient market mechanisms, less favourable eco-climatic conditions and the impact of the 1990-1994 war, led to a global decrease of about 9.26 per cent of 1994 food production when compared to 1991. The main result of this unfavourable prevailing situation is the serious hunger raging almost throughout the country, increased food aid and imports (see data in tables 4 and 6) with a mid-1993 monthly average of 30,000 tonnes of food aid as well as a decrease in yields which reached 27.4 per cent and 13.2 per cent for the period 1979/81-1984, respectively for tubers and legumes. The disruption of food production activities resulting from the October 1990 - April 1994 war which continues to affect this sector, makes this country to increasingly depend on food aid, whereas in the 1990s, it had experienced food self-sufficiency under normal eco-climatic conditions.

46. The increase in this country's food production is therefore predicated upon the return to normal conditions of peace and security throughout the country. The national development strategy is focused on increased cultivation of food and export crops; the promotion of animal production; soil conservation and improvement of its fertility; better management and the rational cultivation of undeveloped fallow lands as well as regional specialized food production as a function of agro-ecological potential.

47. Furthermore, special emphasis is placed on: agricultural participation within programmes in view of a sectoral approach to agricultural speculations; the gradual decentralization of participation and support structures at the level of the Division, Subdivision and the Community; the promotion of imports substitution, essentially, cereals, as well as the promotion and rehabilitation of communication channels and physical infrastructures expected to facilitate the marketing of agricultural and food products.

2.1.8. Somalia

48. In 1990, Somalia's agricultural contribution to the GDP stood at 65.5 per cent. Somalia which is semi-arid, except in the south where irrigated cultivation of sugar cane, cotton and bananas essentially takes place, is responding to the low production of popular traditional foodstuffs. However, a certain number of food crops are grown here. Their yields are almost equal to Africa's average and exceed the subregion's production of potatoes and rice. The main food crops of this country are cereals like rice, maize and sorghum; tubers like potatoes; legumes like dry beans; oil seeds; vegetables, and fruits particularly bananas.

49. In 1994, food production increased by 12.1 per cent as compared to 1991. This was essentially due to the spectacular increase of 58.2 per cent in the production of cereals during the same period, despite a drop in the production of tubers and legumes which stood respectively at 20.4 and 7.6 per cent. For these same groups of crops, the production for the period 1979/81-1994 also plummeted by 13.5, 7.9 and 54.4 per cent respectively. The main cause of such a decline in the yield and production of tubers and legumes is the upset in eco-climatic conditions. It should be pointed out here that food production in this country is carried out, essentially, along the main rivers and depends on both irrigation and rain water. The disruption of production activities due to the armed socio-political conflict besetting this country, also contributes to the drop in food production. The increase in cereals production mentioned above, despite the fall in yields, results from an increase in the area devoted to the cultivation of cereals which stood at 54.7 per cent for the period 1979/81-1984. On the other hand, the area cultivated with legumes increased by about 170 per cent during the same period.

50. In 1993, the area of arable lands under cultivation was estimated at 1,000,000 hectares and that cultivated with cereals, tubers and root crops as well as dry legumes stood at 414,000 ha., representing 41.4 per cent of the total land area. Sorghum dominated with a cultivated area which represented 28 per cent of the said lands, followed by maize with 8 per cent. Furthermore, the two types of cereals (sorghum and maize) are the major food products of Somalia.

51. The decline in food production during the period 1992-1993 led to increase in food aid during the same period. Food imports also surged during the period 1991-1992. It is also important to point out that Somalia produces coconuts for which it recorded an annual average production of 8,000 tonnes during the period 1992-1994. The armed socio-political conflict currently afflicting this country, is seriously disrupting local food production activities. The return to normal conditions of peace and security is one of the prerequisites for increased national food production.

52. The national policy to promote the sector lays emphasis on incentives expected to stimulate the production of cereals; the promotion of irrigation-related investments; the expansion and diversification of agricultural production in the non-arid areas; the promotion of animal health services, highly productive breeds and fisheries.

2.1.9. Tanzania

53. In 1992, the contribution of Tanzania's agricultural sector to the GDP stood at 61 per cent while, at the level of export earnings, the agricultural sector exceeded 60 per cent. Since the mid-1980s, the increase in food production stabilized vis-à-vis the population growth. It was complemented by cereals imported (essentially, rice and maize) during the unproductive years. This positive growth was mainly due to the implementation of economic restructuring measures and to the favourable eco-climatic conditions that prevailed in the country.

54. However, the effect of the worst drought experienced by South Africa during the period 1991-1992, and the low rainfall recorded during the 1993-1994 planting season, led to a drop in food production in 1993 and 1994. Thus, total food production in 1993 fell by 11.8 per cent as compared to 1990 while that of 1994, declined by 3.4 per cent as compared to 1991. The 1994 food production decreased by 28.7, 9.9, 5.2 and 3.3 per cent respectively for legumes, vegetables, cereals and tubers as compared to 1991 owing to the above-mentioned reasons.

55. In 1994, tubers represented 51.5 of total food production. This was followed by cereals with 23.6 per cent, fruits, essentially, bananas with 14.9 per cent, vegetables with 6.7 per cent and legumes with only 2 per cent. During the period 1991-1994, the yields of certain food crops increased. These crops are, *inter alia*, cereals and legumes which increased by 14 and 6.38 per cent respectively. However, tuber yields dropped drastically by 12.86 per cent. The changeable eco-climatic conditions, the farming methods and incentives on the farms, provide an explanation for the change noted in Tanzania's food yields. In 1995, production was estimated to rise by 11 and 16 per cent in relation to 1994, respectively for cereals and dry legumes.

56. According to the data in tables 10 and 11 at the annex, the drop in food production during the period 1991-1993 led to increased food aid during the same period, whereas total food imports had already increased in 1991. With regard to coconuts of which Tanzania is a big producer, its annual average production during the period 1992-1994 was 358,333 tonnes. Tanzania also produces palm oil whose annual average production for the period

1991-1994 was 5,025 tonnes, and cocoa whose annual average production stood at 2,000 tonnes of cocoa beans for the period 1992-1994.

57. The programmes of action for the development of the agricultural sector seek, essentially, to increase prices paid to farmers in real terms; improve the quality of agricultural products; completely liberalize the marketing of cereals and export crops; restructure of cooperatives; privatize previously expropriated agricultural property as well as improve supply and distribution of inputs.

2.1.10. Zaire

58. The contribution of agriculture to Zaire's GDP in 1965 and in 1990 stood at 20 and 30 per cent respectively. This was, however, not due to increased efficiency in the agricultural sector. Rather, it was due to the deterioration of other economic sectors during that period. Agriculture in Zaire is practised over an arable land area of about 7,300,000 ha. developed into several farms by essentially traditional farmers. National food production comes mainly from cereals like maize and rice; tubers and root crops like cassava, sweet potatoes and yams; legumes like dry beans; oil seeds like groundnuts, oil palms and fruits, particularly, bananas. Vegetables are also produced in great quantities.

59. 1994 food production in relation to 1991 recorded an increase of about 2.4 per cent which was reflected in all food crops. In volume, cassava came first and was followed by bananas, maize and groundnuts.

60. In 1994, tubers represented 83.9 per cent of total food production followed by bananas with 9.8 per cent, cereals with 7.4 per cent and oil seeds with 3.9 per cent. During the 1991-1994 period, the 1994 yields, when compared to the 1979/81 average, recorded an increase on the whole. The main crops involved were cereals with 12.7 per cent, tubers with 15.14 per cent and legumes with 3.6 per cent. The highest yields were recorded by cassava (16.07 per cent) and maize (16.76 per cent); while the yields of beans and sweet potatoes declined by 2.33 and 6.8 per cent respectively. Finally, it is important to point out that the 1994 food production was lower than that of 1992 and 1993 as can be seen from the data in table 1.

61. In 1995, it was estimated that the production of dry legumes and fruits would slightly rise, while the production of paddy rice would decline. According to the Annual Report of the Bank of Zaire, food production was expected to increase in 1995 as compared to the previous financial year. This positive development was due to good climatic conditions, the increase in the areas cultivated and proper crop protection. However, according to the same report, the insufficient availability of food, particularly, in the major consumption areas, was due to the difficulties still faced in the evacuation of food products towards those centres.

62. With regard to other food crops, it should be pointed out that cocoa recorded an annual average production of 7,000 tonnes of cocoa beans during the period 1992-1994. Furthermore, Zaire is a big producer of palm oil the average annual production of which totalled 180,500 tonnes for the period 1991-1994.

63. Essentially, increased yields result from improved farming methods and the use of the most efficient seed varieties, supported by agronomic research and the popularization of the country's achievements. Plant diseases, unfavourable climatic conditions and poor guidance still noticeable in certain areas of the country, are responsible for the negative performance.

64. Food crops, excluding vegetables and fruits, were cultivated over a surface area of 5,018,000 ha., representing 68.9 per cent of total arable land. This means that, in addition

to unit yield improvement programmes, there still exist enormous potentialities for increased food production in this country.

65. The drop in food production noted during the period 1993-1994, led to increased food imports in 1993. However, food aid to this country declined in volume during the period 1989-1993. This trend which was the result of a positive development in food production during the period also shows the reduction of foreign aid to Zaire.

66. A wide consensus has been reached at the national level, on the necessity to promote intensive food production; further liberalize structures for determining the prices of agricultural products; strengthen agricultural popularization structures; encourage small-scale producers and private enterprises to produce and market agricultural products both for domestic consumption and export; and improve the planning of agricultural activities, including the definition of appropriate political guidelines for the sustained and sustainable development of the sector as well as the formulation of realizable investment proposals for the whole sector.

2.2 Animal and fish production

67. Stock farming in the East African subregion includes cattle, sheep, goats and pigs as well as poultry and even bees. Fishing is also highly developed in the subregion. Table 3 at the annex and table 3 below, show the detailed and global development of animal and fish production in this East African subregion for the period 1991-1995.

Table 3: Development of animal and fish production in the East African subregion for the period 1991-1995 (1000 tonnes)

Table 3 a: Burundi and Djibouti

	Burundi					Djibouti				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Meat (total)	23	28 ^F	28 ^F	24 ^F	...	7	8 ^F	8 ^F	8 ^F	...
Whole fresh cow milk	32	32 ^F	32 ^F	29 ^F	...	7	7 ^F	7 ^F	7 ^F	...
Cheese	...	...	...	...	...	...	...	...	...	...
Butter and ghee	...	0.89 ^F	0.91	0.94 ^F	...	...	...	...	...	...
Eggs	3 ^F	3.2 ^F	3.2 ^F	2.9 ^F	...	...	...	...	...	...
Fish and seafoods	21	23	22	...	...	0.25	0.27	0.3 ^F	...	...
Honey	0.33	0.34 ^F	0.35	0.30 ^F	...	...	...	...	...	...

Table 3 b: Eritrea and Ethiopia

	Eritrea					Ethiopia ⁽¹⁾				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Meat (total)	30 ^F	30 ^F	30 ^F	605	606 ^F	575 ^F	575 ^F	575 ^F
Whole fresh cow milk	36 ^F	36 ^F	36 ^F	752 ^F	774 ^F	738 ^F	738 ^F	738 ^F
Cheese	0.22 ^F	0.22 ^F	...	...	4.8 ^F	...	...	...
Butter and ghee	0.47 ^F	0.47 ^F	...	...	10.8 ^F	10.3 ^F	10.3 ^F	...
Eggs	5.5	5.3	5.9 ^F	5.9 ^F	6 ^F	79 ^F	79.3 ^F	73.3 ^F	73.3 ^F	73 ^F
Fish and seafoods	2.5	...	...	4.2	4.6	4.2	...	...
Honey	20.5	23.7 ^F	23.7 ^F	23.7	24 ^F

Table 3 c: Kenya and Uganda

	Kenya					Uganda				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Meat (total)	378 ^F	367 ^F	344 ^F	352 ^F	343 ^F	188	235 ^F	239 ^F	246 ^F	...
Whole fresh cow milk	2166	2000 [*]	1830 [*]	1830 [*]	1830 ^F	437	446 ^F	455 ^F	446 ^F	...
Cheese	...	0.18	0.22 ^F	0.21 ^F	...	...	...	...	...	...
Butter and ghee	...	3.1 [*]	3.45 ^F	3.48 ^F	...	...	...	...	...	...
Eggs	43	42 ^F	42 ^F	42.7 ^F	...	153	16.3 ^F	16 ^F	16.4	...
Fish and seafoods	198.7	163.2	185.4	...	...	254.9	250 ^F	219.8	...	...
Honey	18 ^F	22 ^F	23 ^F	24	...	0.23 ^F	0.24 ^F	0.25 ^F	0.25 ^F	...

Table 3 d: Rwanda and Somalia

	Rwanda					Somalia				
	991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Meat (total)	31 ^F	31 ^F	31 ^F	31 ^F	...	84 ^F	112 ^F	128 ^F	148 ^F	...
Whole fresh cow milk	88	89 ^F	91 ^F	85 ^F	...	370 ^F	340 ^F	450 ^F	550	...
Cheese	...	...	...	...	...	...	...	...	...	...
Butter and ghee	...	0.36 ^F	0.36 ^F	0.34 ^F	...	...	6.8 ^F	9.0 ^F	11 ^F	...
Eggs	2.0	1.9 ^F	1.95 ^F	2.0 ^F	...	2.0 ^F	0.8 ^F	2.0 ^F	2.4 ^F	...
Fish and seafoods	3.5	3.6	3.5	...	...	16.1	15.3	14.8	...	...
Honey	0.02 ^F	0.02 ^F	0.02 ^F	0.02 ^F	...	...	...	...	...	...

Table 3 e: Tanzania and Zaire

	Tanzania					Zaire				
	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Meat (total)	278 ^F	286 ^F	291 ^F	290 ^F	...	188 ^F	235 ^F	239 ^F	246 ^F	...
Whole fresh cow milk	529	541	545 ^F	471 ^F	590	8	8 ^F	8 ^F	8 ^F	...
Cheese	...	1.5 ^F	1.6 ^F	1.2 ^F	...	...	...	...	...	...
Butter and ghee	...	4.7 ^F	4.8 ^F	3.9 ^F	...	...	...	...	...	...
Eggs	45	51.6 ^F	51.6 ^F	51.6 ^F	...	8	8.3 ^F	8.4 ^F	8.5 ^F	...
Fish and seafoods	326.7	231.5	345.0	...	...	...	160 ^F	150 ^F	147 ^F	...
Honey	16 ^F	15.5 ^F	16 ^F	16.5 ^F	...	...	...	...	...	...

Source: FAO Production Yearbook, Vol. 47, 1993; and
FAO Production Yearbook, Vol. 48, 1994.

Scale: * (1) With regard to Ethiopia, the statistics furnished concern to PDR Ethiopia up to 1992 and Ethiopia after 1993. The same applies to all the tables which follow;

* 1995 data is provisional;

- *: Unofficial data
- F: FAO estimates; and
- ...: Existing or non-existing data.

68. In 1994, the East African subregion had 68,352,000 head of cattle, 49,877,000 sheep, 57,344,000 goats and 228,000,000 poultry. A few horses and camels particularly donkeys are also found in Somalia. In the same year 1994, the subregion recorded total meat production of 1,950,000 tonnes, 4,246,000 tonnes of whole fresh cow milk, 64,760 tonnes of honey and 205,720 tonnes of eggs; while 1993 recorded 944,905 tonnes of fish including seafoods.

69. Though the subregion's meat production dropped during the period 1991-1994, representing 9.4 per cent, national production within the countries of the subregion, on the other hand, experienced varying trends. In fact, while production in Djibouti, Eritrea and Rwanda practically stagnated, Burundi, Ethiopia and Kenya recorded a decline of 14.3, 14.9 and 6.8 per cent respectively for the period 1992-1994 and Uganda, Somalia, Tanzania and Zaire recorded an increase of 30.8, 76.2, 4.3 and 30.8 per cent respectively.

70. With regard to Zaire in particular, animal production in 1995 was maintained at the 1994 level, despite a drop in cattle population in North Kivu. Concerning fishing, the production of fresh fish was estimated at 133 thousand tonnes in 1995 as against 156 thousand in 1984, that is, a decrease of 14.7 per cent. This shortfall is essentially attributed to insufficient production means. It should be pointed out that Zaire's fish resources are annually evaluated at 707 thousand tonnes.

71. In most countries of the subregion, animal production does not meet the ever growing demand resulting from the high population growth rate. Furthermore, the products are not often as competitive as imports particularly from Europe. However, meat production remains each time lower than the world level. Indeed, in 1994, the yield stood at 119.4 kg/animal against 202 for cattle, 11.5 kg/animal against 15 kg for sheep, 10.9 kg/animal against 12 kg for goats and 49.6 kg/animal against 78 kg. for pigs.

72. Stock farming in the East African subregion is almost traditionally practised, with the exception of a few modern farms in certain countries. Furthermore, it is not well integrated into the industrial processing system and process. Fishing, on the other hand, is generally carried out at the artisanal level. At this level, huge losses occur in livestock products, in particular, dairy and fish products. These losses could be substantial and even exceed 50 per cent of dairy products which is indeed the case of certain areas in Kenya.

73. The poor health of cattle, frequent epidemics, forced migration due mainly to the lack of grazing land, drought, wars and armed socio-political conflicts, and sociological bottlenecks, considerably reduce animal production in the subregion in spite of abundant grazing lands and by-products than can be used as feed for cattle, poultry and even in fish farming. The same reasons are responsible for the deficient organizational and institutional structures as well as the lack of efficient animal research programmes.

74. Increasing the productivity of the livestock sector, currently constitute one of the socio-economic development priorities of the countries in the subregion. Generally speaking, efforts are focused on the following programmes:

(a) The campaign against animal diseases particularly rinderpest and trypanosomiasis through the eradication of the tse-tse fly;

(b) Food promotion particularly through improvement in the existing grazing lands, the search for better developed grazing lands and the development of agro-based industry for the production of animal feed;

- (c) Improvement in the health conditions of cattle;
- (d) Promotion of dairy farms, including dairy industry through the introduction of more productive breeds;
- (e) Promotion of interbreeding in order to introduce cross-breeds which are more productive, and more resistant to certain animal endemic diseases raging in the subregion;
- (f) Promotion of animal research in the most diverse areas;
- (g) Promotion of fishing and even fish farming, including research programme for this subsector;
- (h) Organization of channels and systems for the marketing of livestock and fish products and inputs of the sector; and
- (i) Rationalization of the official organic structure for the promotion and management of this sector.

2.3 The subregion's food production and security situation

75. An analysis of the development of food and livestock production, including fishery, in the subregion makes it possible to identify the main food crops grown therein. Thus, on the basis of the enormous quantities produced annually and the area cultivated specially in 1994, table 7 below reviews these main crops. They shall essentially be analyzed in the chapters dealing with storage and conservation means and systems as well as with post-harvest food losses.

Table 7: Main food crops grown in the East African subregion

	East African subregion									
	Burundi	Djibouti	Eritrea	Ethiopia	Kenya	Uganda	Rwanda	Somalia	Tanzania	Zaire
I. <u>Cereals:</u>										
• Maize	•			•	•	•	•	•	•	•
• Sorghum	•		•	•	•	•	•	•	•	
• Rice	•									•
• Wheat				•		•			•	
• Millet				•		•			•	
II. <u>Tubers and root crops</u>										
• Sweet potatoes	•			•	•	•	•		•	•
• Cassava	•				•	•	•		•	•
• Potatoes				•		•	•		•	
• Yams				•						•
III. <u>Dry legumes</u>										
• Dry beans	•			•		•	•		•	•
IV. <u>Oil producing</u>										
• Groundnuts						•				•
• Palm oil									•	•
V. <u>Fruits</u>										
• Bananas	•				•	•	•		•	•

Source: Table prepared by the expert for purposes of the survey.

76. The food crops listed in table 7 above, are very vulnerable to food losses in the farm and after harvest. As a matter of fact, in the farms like during storage and along distribution channels, these crops are attacked by depredators. Inappropriate handling often causes enormous food losses which could attain 50 per cent of the production. The eco-climatic characteristics, the deficient storage, conservation and processing means and systems as well as the lack of better seed varieties resistant to attacks by various depredators, are also responsible for the food losses mentioned above.

77. The traditional production systems mainly characterize food production in the East African subregion. However, crops grown on irrigated and as well as a certain number of other crops cultivated in a few countries benefit from modern cultivation systems. This characteristic is found in most countries, particularly, through the high percentage of the population involved in the agricultural sector which stood at 73.6 per cent for the subregion as against 43.4 per cent at the international level. Thus, in this subregion, agriculture is practised more for subsistence purposes than for marketing even though there is intense agriculture in certain countries.

78. Food losses due to the deficient systems for the storage, processing and handling of food products are also frequent at several levels. Furthermore, food availability and national and subregional agro-pastoral production are, on the whole, lower than the world and even African averages. This situation comes out clearly through the data in tables 8 and 9 at the annex devoted respectively to 1994 food production and food availability in calories, proteins and lipids for the period 1970-1992.

79. According to the data in tables 10, 11 and 12 at annex, devoted respectively to the development of food aid and the performance of the food production sector in the subregion, food aid is practically the highest in the world. Globally, food imports appear lower than the world and even African levels. The main reason for this trend is, undoubtedly, the negative balance-of-payments which makes it difficult for countries of the subregion to import such products. Table 13 devoted to the development of food imports in the subregion, gives a clear idea of the real situation. At the level of agricultural exports and according to statistical data from table 14 below devoted to the marketing of agricultural products in the subregion for the period 1990-1993 above, the volume of these imports has remained low.

Table 14: Trade of agricultural, fishery and forest products in the East African subregion (1990-1994)

	Imports (100000 US\$)					Exports (100000 US\$)				
	1990	1991	1992	1993	1994	1990	1991	1992	1993	1994
World	4884190	5039557	5357905	5047434		4540449	4649059	4966776	4695956	
Africa	210546	187541	213843	198616		157394	144594	140777	138063	
East Africa	11602	10483	12333	9598		18991	16105	15644	14532	
Burundi	261	321	235	248		712	908	688	635	
Djibouti	840	758	796	812		89	41	48	37	
Eritrea	---	---	---	---	---	---	---	---	---	---
Ethiopia	2487	1971	2847	---	---	2615	1597	1682	---	
Kenya	2434	2056	2692	2585		7182	6701	6403	7195	
Uganda	301	264	327	500		1766	1735	1422	1731	
Rwanda	523	509	479	742		946	851	602	467	
Somalia	837	766	1111	807		884	499	727	796	
Tanzania	889	1121	1420	1357		2950	2562	2830	2755	
Zaire	3030	2717	2426	2547		1846	1219	1242	916	

Source: • FAO Trade Yearbook, vol. 46, 1992; and
• FAO Trade Yearbook, vol. 47, 1993.

80. The problem of improving the food in-take of the population in the subregion, is a major concern to the public authorities the ever increasing population. The increase in overall agricultural productivity, is a major preoccupation not only as concerns export crops whose earnings could be used particularly to buy foodstuffs but also as concerns domestic crops designed to consolidate domestic food security. However, some bottlenecks are currently being noted in the process to increase food production, or to avert the worsening food security in certain countries of the subregion.

81. As a matter of fact, it is important that the countries of the East African subregion should put in place new strategies which would, at the same time, increase food and agricultural production, reduce poverty and ensure the conservation and protection of natural resources. These strategies should enable countries to implement concrete and integrated programmes and actions in order to attain food security as well sustained and sustainable development in the subregion. The programmes and actions to be implemented should, however, accord preference to the search for the comparative advantage of national production over that of neighbouring countries. Furthermore, in certain countries, there is an urgent need to improve the conditions of peace and security at the national level in order to enable the local population and structures to resume normal food and agricultural production activities.

III. STORAGE AND CONSERVATION OF FOOD PRODUCTS IN THE EAST AFRICAN SUBREGION

82. In the East African subregion, pre- and post-harvest food losses occur in the main food products. Before harvest, that is when the crops are still in the farms, these losses which could be very heavy for tubers and root crops, are mainly caused by rodents and other organisms such as mushrooms, bacteria and thread-worms. Concerning cereals, such losses are essentially caused by birds. The poor weather in certain areas is also responsible for food losses. At the level of storage, conservation, processing, transportation as well as distribution and marketing, food losses are also caused, in addition to the above-mentioned depredators, by various insects and poor handling.

83. The identification, the main characteristics and the magnitude of the damage as well as the insecticides and ratpoisons likely to be used in checking the depredators of stored foodstuffs, are analyzed in Chapter IV devoted to post-harvest food losses. A certain number of illustrations of the means and systems used in the storage and conservation of food products in the subregion have been presented at Annex III of the this report. These illustrations deal respectively with the main methods for the storage and conservation of food products by producers, and the food purchasing, distribution and processing centres found in the subregion.

3.1 Storage and conservation means

84. A diagnosis of food storage and conservation means in the East African region based on survey reports and other existing information items and data collected in the field for certain countries, has successively been established in 10 countries in the subregion, mainly at two levels:

(a) At the level of producers within family farms; and

(b) At the level of purchasing, distribution, marketing and processing centres. This level essentially comprises cooperatives, private traders as well as private and state-owned enterprises and organizations for the marketing and processing of food products.

3.1.1 Burundi

(a) Producers

85. The methods for post harvest storage and conservation of food products used by producers, are the most required to build a seed reserve, on the one hand, and meet subsequent consumption and/or marketing needs, on the other hand. According to a survey conducted on storehouses in Burundi^{1/} by A. Mertens, five main methods, essentially, for the storage and conservation of cereals and dry legumes, have been identified. This concerns storehouses on poles, clay pots, long and round baskets and various sizes of bags. Figure 1 at annex gives an illustration of the said conservation methods used.

86. Storehouse on piles is always built within the family house and in a fence. It is mostly used for the conservation of maize, wheat and sorghum ears. The clay pot changes according to the usage since it can serve, at the same time, as a container for the transportation and storage of water beer and milk, and as cupboards and pots. It is also found within the family house especially when it contains

^{1/} Republic of Burundi, Institute des Sciences Agronomiques du Burundi (ISABU) - A. Mertens, December 1981.

a product. These pots are only used for food conservation when they can no longer be used as containers as a result of their partial deterioration (burst or split). The long basket is not expected to be moved when it contains foodstuffs because of its huge size and hence its great weight. It is always found within the family house when it contains stored foodstuffs.

88. The storage and conservation of foodstuffs in Burundi constitute a specialized activity throughout the country. Thus, the Mugamba region (high altitudes of 2,000 metres) essentially uses storehouses built on piles. In the Imbo region (plains with a low altitude of 850 metres), bags are commonly used. In the Kirimiro region (plateaux of 1,600 metres), clay pots and long baskets are frequently used. It should also be pointed out that most of these storage methods used in Burundi as just described, are found in many other countries of the subregion. Of course, the methods vary at the national level.

(b) Purchasing, distribution, marketing and processing centres

89. The purchasing, distribution, marketing and processing centre has food storage and conservation facilities managed by cooperatives, private traders as well as state-owned and private organizations. The means used at this level essentially consists of hangars and silos and even in certain cases, containers (the case of MUSALAC).

3.1.2 Djibouti

90. As underscored in paragraph 22 above, Djibouti is not an agricultural but rather a stock-farming country. The only agricultural production recorded in this country concerns vegetables which are eaten fresh. As a result, the storage and conservation of food products are done at the second level of purchasing, distribution and processing centres for food products imported essentially to meet domestic food needs. The storage means used at this level, as in other countries of the subregion, consists of hangars and silos.

3.1.3. Ethiopia

(a) Producers

91. According to data collected on the field on producers, grains are usually stored in houses or huts built with local materials such as wood, bamboos and liana, using a mixture of straw and mud covered very often with cow dung. These storehouses like the Durama hut, are built on the ground (see illustration 2.g.). They can also be built underground where the grains are stored either in bulk or in bags and baskets (containers), or on mats woven with local materials such as reeds and liana, using the above-mentioned mixture.

(b) Purchasing, distribution, marketing and processing centres

92. At the level of the purchasing, distribution, marketing and processing centres, storage is done in hangars, stores and silos. The storage duration depends on how fast the stored products are sold. The storage of grains for cooperatives, projects or non-governmental organizations requires, in addition, the use of their own facilities where private stores and hangars are located, as it is done in other countries of the subregion. The Emergency Food Security Reserve Authority has four main warehouses at Makere, Kambojua, Daredawa and Nazareth with a total capacity of about 300,000 tonnes. Other enterprises and private traders use their own hangars, stores and silos. They, *inter alia*, include the Ethiopian Grain Trading Enterprise.

93. The storage and conservation of other foodstuffs, particularly, tubers and root crops, livestock and fish products, are not well developed. Furthermore, no in-depth study has been conducted on post-harvest food losses. This also applies to Eritrea whose data, now separated from Ethiopia's, appears only from 1992 onward.

3.1.4 Eritrea

(a) Producers

94. According to data collected on the field, the food storage and conservation methods used in Eritrea by producers are little developed even though national production is still low and geared towards subsistence farming. These methods are moreover identical to those used by its southern neighbour, Ethiopia.

(b) Purchasing, distribution, marketing and processing centres

95. At the level of the distribution of imported food products and food aid, storage is done in warehouses, hangars and silos. The Cereals Authority charged with the marketing and distribution of cereals has storehouses as well as open air storage facilities, particularly, at the Massawa Port. The initial objective of this enterprise is to manage 30 to 40,000 tonnes of cereals, representing some 50 per cent of the current national production of cereals. However, the organization is encountering many problems, mainly, the lack of training for its senior staff as well as the absence of storage facilities and handling and transport equipment.

96. Eritrea's storage capacity has also improved as some new 40 plastic warehouses (rubbhals) have been built each with a capacity of 500 tonnes. These warehouses are designed to serve Government distribution centres established throughout the country.

3.1.5 Kenya

(a) Producers

97. The main food storage and conservation methods used by Kenyan producers are storehouses, clay pots, baskets, roofs, poles, small huts and bags. Annex III devoted to illustrations, especially, Illustration 2, gives an idea of some of these methods.

98. The following paragraphs give the main characteristics of the essential storage methods used in family farms in Kenya which are:

(a) Storehouse: The storehouse is built in a simple way and is generally cylindrical in form. Raised above the ground, it is built with local plant materials. It is used for the storage of all food products and more especially, cereals and legumes;

(b) Clay pots: These clay pots are generally kept within the family house. They can be used for the storage and conservation of grains. The products are often mixed with ash before they are stored in the pots;

(c) Baskets: The baskets are of several sizes. They are made with local plant materials. They are used for the conservation of rice, beans, groundnuts and the seeds. They are often kept in the kitchen;

(d) Roofs: The roofs of living houses are also used for the storage and conservation of grains. Small bundles of ears or plants are prepared and then suspended from the roof. This method is commonly used in the storage and conservation of cereals;

(e) Pole: This is a vertical pole from which maize ears are suspended. This method is therefore used mainly for maize storage and conservation;

(f) Small hut: This is a small wooden hut often square in form with metallic walls. This improved traditional storage method is used for maize storage and conservation; and

(g) Bags: Bags, as previously treated with regard to the countries of the subregion, are also used in the storage and conservation of food products.

(b) Purchasing, distribution, marketing and processing centres

99. The available official storage capacity held by the National Cereal and Production Board (NCPB) which is 19.6 million bags, uses three main types of storage facilities namely: (i) conventional warehouses with 14.8 million bags; (ii) silos with 3.8 million bags; and (iii) containers (Cyprus bins) with 1 million bags. The storage network covers production and consumption areas as well as areas of low food production which have at least a storage, purchasing or distribution centre in most of the districts. Private individuals working in this food distribution area also own storage and conservation means which consist more often of stores and hangars.

100. According to the measures and programmes contained in the 1994-1996 development plan under execution in this country, the official storage development programme will in the future lay emphasis on increasing handling facilities, and building a high capacity storage facility at the Mombassa port. Similarly, cooperatives which have obtained good results in the mobilization of domestic resources are encouraged to increase their storage facilities. There are also plans to increase the capacity for the storage of fresh flowers grown in the production areas and at the main airports, especially, the Jomo Kenyatta International Airport in Nairobi.

3.1.6 Uganda

a. Production

101. In Uganda storage of family holdings is increasingly done through open baskets which is a system using clay and clay pots similarly to the storehouse in neighbouring Kenya. The main features of these systems are:

- (i) Open basket: This is a big open basket often raised one metre or more from the ground. It is used basically for the storage and preservation of maize;
- (ii) Uganda storehouse: This is a system using clay or mud with the walls and floor made up of unburnt sun-dried bricks or clay. It could be used for the storage and preservation of most food crops; and
- (iii) Clay pots: These pots are usually kept inside the house. They are used for the storage and preservation of maize and sorghum as well as other grains.

(b) Purchasing, distribution, marketing and processing centres

102. The most common form of storage is the use of silos and sheds which is a method generally practised in the countries of the subregion.

- (i) Silos: they are made up of several compartments and the capacity varies according to the quantity of produce to be stored. They are basically used for the storage and preservation of maize; and
- (ii) Sheds: the sheds are constructed with blocks and cement. They are used basically for the storage and preservation of maize.

3.1.7 Rwanda(a) Production

103. The storage and preservation methods for food crops which have been described earlier on for Burundi is also applicable to Rwanda. The OPROVIA/GRENARWA project carried out a survey in the middle of the 1980s on the storage methods and conditions of grains as well as on the management techniques of stocks in the country. Certain aspects of storage and preservation of food crops from family holdings was shown. They are basically the following:

- (i) The baskets account for two-thirds of this storage methods with few instances of outside granaries. The use of bags, sand pots, metal barrels and calabashes were also noted as well as the use of local materials involving grass and banana leaves particularly for the storage of beans;
- (ii) All the farm holdings that fell under the survey stored their produce inside their huts, and there was a link between the construction material and the food grain to be stored.
- (iii) Insecticides, ashes, kaolin, laterite, pepper powder and/or different local plants are used for the preservation of stored beans.

b. Purchasing, distribution, marketing and processing centers

104. These processes involve basically cooperatives societies, traders and other private operators as well as OPROVIA. Concerning the cooperatives, the traders and the private operators, storage is done through the use of silos for bulk storage and in sheds using bags for storage - at times storage is done in bulk. It has been observed that for the cooperative societies using silos these silos are not air tight and are poorly ventilated. These shortcomings lead to considerable losses due to fungal damage from moisture. Furthermore, gas and phosphine fumigation is done albeit with a risk to the personnel. The silos system does not allow for easy quality control as it is difficult to take samples and added to this problem is the low level of training of the managers and the lack of management tools.

105. As for the sheds there is a lack of pallets. This constraint can increase the moisture of the stored food items with the resultant decay of most of these items. As the level of fumigation as well as the use of insecticide are low, it is difficult to control the insects in the sheds. Finally, the damage done by rodents constitutes a serious problem.

106. For OPROVIA storage is done in the big depots where grains are stocked in bags on pallets. Although the use of insecticides (Actellic and Phostoxin) is properly done, difficulties still persist. Indeed, grain storage requires a lot of time and space. The quality control of grains as well as their storage conditions is not properly done. The heat which is produced gathers at the top of the bags as the roof tops are made up of corrugated sheets with inadequate ventilation. This situation thus leads to the growth of insects which are resistant to the insecticides used. The possibilities of food losses still remain.

3.1.8. Somalia

107. In the principal agricultural production zones in Somalia humidity varies from 55 to 85 per cent throughout the year but the humidity is higher in the coastal areas. These conditions make it difficult for proper drying of grains notably cereals and legumes. These items require a moisture of 13 per cent for proper drying which can promote the growth of insects during storage (temperature, humidity, moisture of the grains ...). These are the major issues facing the Agricultural Development Corporation (ADC). These are public organizations responsible for the marketing of grains as well as the storage of production and the preservation of food crops.

a. Production

108. Traditional family holdings have developed a simple system of storage and preservation of maize and sorghum in the ear namely pits in the ground (see illustration No. 3 to control the infestation by insects and rodents. This technology which is cheap and accessible to producers is very efficient. However, it leads to a change in the colour of the grain as well as its taste and smell in the preparation of food. Consumers in the urban areas in particular undoubtedly do not accept these stored products under such conditions. Furthermore, this technology has not been very successful with cooperative societies and other producer associations because the users do not master it well.

b. Purchasing, distribution, marketing and processing centres

109. Prior to 1981 only ADCs were allowed to participate in the collection and marketing of food crops. This monopoly has now been lifted due to ADC's failure to attain its twin objectives namely the reduction in food losses and the provision of a reliable and regular food supply in the country. At the moment, private concerns can participate in the marketing of food crops. It was also observed that the cooperative societies which were set up basically to ensure supplies from ADCs were not a spontaneous creation but an imposition on producers. This explains the basic reason for their low level of performance.

110. The analysis on the storage conditions shows that the structures and the know how have not been developed particularly as it deals mostly with family consumption. In effect most operators at this level only manage stocks ranging from two weeks to three months. In this way, stored products are not infected. The economic operator who is managing the stocks should therefore ensure that they are of a sound quality when they are received. Furthermore, there are few food processing plants in the country.

111. Fibre silos have also been introduced by ADCs as a method of storage. This experiment has been a failure because the silos are too large vis à vis the grain available locally for storage. Another reason for the failure has been an ineffective management technique coupled with low level training and expertise for the staff. This fibre silos turned out to be decorative rather than efficient means for the storage of grains in the country.

112. Even if the traditional method of storage and preservation of maize and sorghum is very good, it is geared rather towards small quantities meant for family consumption which is the main feature of subsistence agriculture in Somalia. This system does not promote other technologies which are adopted to market agriculture. It is a serious handicap for the future and local development in the growth of primary products and a high rate of food self-sufficiency in the country. In the short- and medium-term measures to improve an increase available food for this country should be directed among other things towards the establishment of a system of distribution and marketing of food crops in order to develop market agriculture.

3.1.9 Tanzania

113. According to available data it seems as if no study has been done recently on Tanzania on the techniques (methods and systems) of storage and preservation of food crops. Furthermore, at the time this report was written the questionnaire that was sent to the relevant technical services in Tanzania had not been received.

114. However, in view of the similar nature of the methods and systems of storage and preservation of food crops in the neighbouring countries notably Burundi, Rwanda, Uganda and Kenya it could be observed that the situation on the methods and systems of storage and preservation of food crops in Tanzania by producers as well as the situation on the collection, purchasing, distribution, marketing and processing centres are similar to those described above for the countries mentioned in this paragraph.

3.1.10. Zaire

a. Production

115. According to an FAO/ECA survey carried out towards the end of the 1980s the methods and system of storage currently in use in Zaire at the granary located inside or outside the family hut, sand pots calabashes, cribs and the silos. This method of storage will be used for maize and dried beans since sorghum is meant usually for family consumption and immediate sale.

116. The outstanding feature for family consumption of food crops in Zaire is reflected by the economic orientation of production as shown in the final outcome of the General Agricultural Census of Zaire from 1988 to 1990. This policy is particularly an off-shoot of the production cycle, of leading to the predominance of farm-level methods and systems of storage.

b. Purchasing, distribution, marketing and processing centre

117. According to the ECA/GSY/MULPOC/CS/3/06 report which has been mentioned above the Northern Shaba has 4,5000 litres capacity silos where maize can be preserved for two years in a tight manner after picking off and drying. This is the same in this region where insecticides are in the greatest use for the preservation of food stuffs. Other private economic operators and parastatal bodies participating in these activities do have storage infrastructures for their needs including most often stores, sheds, silos and containers.

3.2. Storage and preservation system

3.2.1 Production

118. The wide variety of storage and preservation methods for food crops on family holdings observed in the subregion is a result of a number of factors such as depredators, amount to be stored, destination, type of product, local eco-climatic conditions, storage methods available and how long the items are going to be stored.

119. For cereals rice is stored in the form of paddy in baskets, in pots and/or in bags. Damage due to insect infestation is rare. On the other hand, overheating might take place if adequate drying is not done. Maize is preserved in the ear or still surrounded by shucks and put in the storehouse on piles under the roof top above the cooking area. The crop ears are hanged using a rope between two stakes or preserved in the form of grains in metal barrels, baskets or bags.

120. For sorghum it is generally stored in panicles in the storehouse on piles or kept in pots, baskets and/or in bags in the form of grains. Insect infestation is common and usually after eight months of storage, the infected area can account for about 50 per cent of the stored product. It is not common practice in family holdings to use pesticides in the preservation of sorghum.

121. Generally, the producer dries maize and sorghum before preservation. The most common methods are:

(a) Drying on the farms, the maize is further dried on the ground in the family house on hedges, on trees, on rafts or in the various store houses or baskets available;

(b) The sorghum maturing in the farms is harvested by panicle with a sufficiently long stem and tied in a bunches to be dried and preserved later at the family hut. More often the entire stems of the sorghum plant which has matured on the farm are cut and put together in small heaps on the farms and left to dry;

122. For tubers and root plants, cassava is generally harvested, sun dried and baked for family consumption or for sale. If the husks are to stay for a long time in the hut they are stored in the warehouses on piles or in bulks on the drying tray. The losses due to weevil infestation are considerable and the longer the husks are kept, the more the food prepared from the flour of these husks is of poor quality.

123. These products that belong to the category of tubers and root plants are also kept on the farms until they are taken out of the ground for immediate consumption or put on the market for sale. Considerable losses often take place due to infestation by thread worms, moles and other depredators.

124. For vegetable plants in particular beans preservation is done on the farm using metal barrels, pots and bags after they have been treated by some producers with soumithion. Beans are dried before they are preserved. The matured beans are dried on the farm and later removed and brought to the family hut often for further drying. They are then threshed in order to separate the grain from the chaff. The grains are stocked and preserved mostly in bags, in barrels and in mud pots.

125. As indicated above the traditional Somalia method of storage and preservation of maize and sorghum in the ground has been successful to producers. However, this same method has rather been a failure with cooperative societies and ADC's in view of poor management vis à vis low mastery of this technology.

3.2.2. Purchasing, distribution marketing and processing centres

126. The food stuffs that are bought are stored in bags or in bulk in stores or collection points which are not properly done for that purpose and where damages can be considerable before the items are transported to the central stores better equipped from where the middle-man will evacuate his products. It must be understood that these two levels of storage can be a source of confusion. Some middle-men protect the collected products by the use of powder on the outside of bags or soaking these bags in solutions or in soumithion based solutions or the use of pyrethrum powder or the use of lindane specially for maize and beans. The correct dosage for the preservation of this product is often difficult to attain and the results do vary. Little damage takes place at this level as the middle man evacuates his products as quickly as possible. However, if the period of storage is extended damage due to rodent, insects, overheating and decay can be considerable particularly in cases where the stores and the collection points are not well adopted for that purpose.

127. The wholesale distributors and/or processing agents stock huge quantities for as long as possible. It is therefore at this level in the link that the problem of preservation is most delicate as it is possible that the produce could be contaminated. Storage generally is done in bags which are upright and some distance from the ground on pallets. Bulks storage is hardly done. The warehouses are often adequately treated and in some cases free from insects by sealing off the area. Some operators have been able to considerably reduce the damages to the construction of modern silos with proper air circulation. This silos can preserve these products in a healthy conditions for a long time provided that they have not been contaminated at the beginning of the cycle. However, the overall losses still remain high with the major causes being dryness and decay as well as the activities of insects and rodents. These losses vary according to the region, the produce and storage conditions.

128. In Tanzania in particular the harvest is more often bought in cash from the farmer by parastatal organizations, cooperatives and private traders and evacuated to warehouses and depots where they are stored either inside or outside of these storage facilities. At the purchasing point adequate logistics are not available often for weighing, fumigation, the measuring of moisture and other factors. The same situation is repeated in silos, depots and warehouses. Thus, it is often discovered that produce are stored with a moisture of 18 per cent with the grains already infested by weevils or contaminated and even with weight loss. During the 1980s it was estimated that 5 to 55 per cent of stored produce was loss per annum and this varied according to the type of stored produce, storage condition at the time of purchase and the place of storage. This situation that has been described in the case of Tanzania is unfortunately the same as in most other countries of the subregion.

3.3 Constraints regarding storage and preservation of food crops

129. Despite the consensus on the need to improve the methods and systems of storage and preservation of food products. A number of constraints persist in the promotion of programmes and actions for the prevention and reduction of food losses in the East African subregion. To this end the constraints that have been identified are basically socio-cultural and demographic. They are also technical, institutional as well as economic and financial. The difficulties in the transport and communications systems should also be taken into account in this respect.

130. The main features of these constraints are as follows:

(a) Socio-cultural and demographic constraints: food crop production is still traditionally directed towards family consumption rather than market production. This is a handicap for the promotion of programmes and actions for storage and preservation of huge quantities;

(b) Technical constraints: there are many technical deficiencies in these methods and systems of storage and preservation of food crops. There is principally a dearth of experts in this field and there is a weak link between research organizations and extension services about the spread of newly developed technologies. Marketing and inefficient distribution systems are of particular importance to products that are not easily perishable or products that can use easy preservation techniques that could be mastered at all levels in the distribution and collection chain;

(c) Transport and communication constraints: the landscape as well as the road transport infrastructure and communication does not often make for an easy and quick link between the production zones and the distribution points. Furthermore, the evacuation of products from the farms to the family homes and from there towards the market outlets or the collection points are painful as it is done by carrying the product on the head or on the back. Few family holdings can transport their harvest through the use of wheelbarrows, horse-cart, oxen or any motorized form of transportation;

(d) Institutional constraints: in addition to weak national and regional support structures in this area, research programmes have not been well developed. Furthermore, national coordination and in particular subregional coordination for research programmes is weak. The general use of some newly developed and improved methods of extension services is equally inefficient. This situation is due mainly to the lack of equipment and skilled personnel. The state structures are not very efficient and this leads to a combination of many factors which are equally inefficient; and

(e) Economic and financial constraints: The meagre financial resources available for agriculture are often spent on cash crops. Moreover, the low productivity of food crops and their seasonal nature in the subregion have led to major price fluctuations on the local market. As a result, there has been production and marketing disruption which in turn has led to a lack of commitment for investment in large scale storage and preservation activities. Furthermore, the existing infrastructure regarding purchasing, distribution, marketing and processing centres have often been destroyed through wars and other armed socio-political conflicts that have taken place in some countries of the subregion.

IV. POST-HARVEST FOOD LOSSES IN THE EAST AFRICAN SUBREGION

131. No storage technique can improve the quality of a stored food crop. As a living organism the stored grains continue to breath. This breathing results in different types of losses namely, water loss, emission of carbon dioxide and heat. Moreover these grains are constantly infested by parasites and other depredators, moulds and rodents. All these factors contribute to the decrease in the quality of the product and lead to considerable weight loss as well as change notably in the taste, colour and smell of the stored product. These situations on the whole arise mostly from the temperature and humidity, insects, rodents, birds and other micro-organisms.

4.1 Principal factors for food losses

4.1.1 Temperature and moisture

132. The relative moisture balance of any product depends on its water content, chemical composition and relative humidity and temperature. This balance is represented by a graph called hygroscopic balance graph or relative humidity or still hygroscopic balance isotherm. The graph is specific for each product. Sometimes the hygroscopic balance isotherm is presented in the form of two graphs: that is absorption by the grains making it possible to study the evolution of how they gather water during the storage period and another graph used in the drying process. Thus it seems that the relative humidity of the air is not always good for storage and preservation of food crops such as maize

and dried beans. Annex No. 5 shows certain cases of hygroscopic balance isotherms for some food crops.

133. The temperature and relative humidity can exert a considerable influence on the development of undesirable qualities such as the hardening, the change of taste and colour of the product as well as the loss of viability and ability to germinate. A study on the taste qualities and cooking of beans during food preparation was carried out in Rwanda under the OPROVIA/GRENARWA II. According to certain results the taste preferences vary according to the regions and customs of the consumers.

4.1.2 Insects

134. The insects which cause losses to stored food are those which develop around the food item or live within the product. The most destructive belong to two main groups namely coleopters and lepidopters. These principal insects that exist in the subregion and the products that they ravage are produced in table 15 below. The table No. 16 in the Annex indicates some insecticides that could be used for protecting stored food stuffs.

Table 15: Major insects destroying stored food grains in the East African subregion

English Name	Latin Name	Food stuffs destroyed
Rice weevil	Sitophilus oryzae	Maize, sorghum, rice paddy
Grain Capuchin	Rhizopertha dominica	Maize, sorghum, beans, wheat
Grain moth	Sitotroga cerealella	Maize, sorghum, process rice
The big capuchin	Prostephanus truncatus	Maize, cassava
Bean weevil	Acanthoscelides obtectus	Beans
Moths	Plodia interpunctella	Beans
Beetles	Zabrotes subfasciatus	Beans
Weevils cockroach	Dinoderus minutus	Maize
Moths	Trogoderma granarium	Maize, wheat, sorghum, groundnuts, vegetable plants, dried fish
	Corcyra cephalonica	Maize, wheat, rice paddy

Source: Agricultural Engineering, some essential considerations on the storage of food grains in Tropical Africa, No. 24 and ECA document ECA/GSY/MULPOC/CS/3/06.

4.1.3 Rodents

135. The damages caused by rodents and particularly by rats and mice are not necessarily due to their feeding requirements. The rodents are also obliged to gnaw constantly to provide for their shelter. They gnaw the hard material in order to sharpen their teeth (thus destroying the storage packaging system for example). They soil the fruit items and sometimes responsible for the outbreak

of fire and the transmission of certain infectious diseases to human beings. Moles are also responsible for considerable losses regarding tubers and root plants still on the farms. The main rodents that exist in the subregion and their features are outlined in table 17 below:

Table 17: **Rodents damaging food grains in the East African subregion and their main features.**

	Black Rats <i>Rattus rattus</i>	Brown rat <i>Rattus norvegicus</i>	Mice <i>Mus musculus</i>
Adult weight	120 - 350 g (ϕ 200 g)	150 - 500 g (ϕ 300 g)	10 - 25 g (ϕ 15 g)
Length (without tail)	150 - 220 mm	200 - 250 mm	60 - 90 mm
Tail	180 - 250 mm Longer than the head and the body and relatively thin and little hairy.	150 - 200 mm Shorter than the head and the body. Thick and often black at the top, bright at the bottom	80 - 100 mm, generally longer than the head and the body, black all over.
Colour	Generally black or grey.	Brown, black on parts of the body, grey or white slightly tinted.	Brownish grey with spots at times a bit brighter.
Ears	Smooth, translucent, big without hair.	Thick, opaque, short, with thin hair.	Big with few hair
Eyes	Relatively big	Relatively small	Relatively small
Muzzle	Pointed	Blunt	Pointed
Fur	Softer and smoother than <i>R. norvegicus</i>	Rough and thick	-
Excretion	Dispersed, in the form of sausage or banana (12 mm)	In solid form but sometimes scattered. (20mm)	Scattered in form of rods (3 - 6mm)
Preferred habitat	Cities and villages	Ports and cities	Growing cities

Source: Document CEA/GSY/MULPQC/CG/3/06, August 1991; et

Regional seminar on the reduction of post-harvest food losses, Niamey (Niger) from 6 to 11 November 1989 Report JEFAD/AMS/90/03.

4.1.4 Birds, moulds and handling

136. Birds and moulds can cause considerable losses to stored food stuff particularly when they are stored outside houses and depots and exposed to moisture. These birds can also cause huge losses on food crops still on the farms particularly cereals in the subregion several types of fungi have been observed on stocks of beans and sorghum including *aspergillus glaucus*. The rate of the fungi albeit difficult to notice could constitute a various serious problem in certain cases. Poor management has also been responsible for enormous food losses. These losses can take place at the time of harvesting or during storage or distribution as well as during transportation.

4.2 Food losses during storage and preservation

137. The East African subregion is situated in the Equatorial zone and has a high rainfall generally. This feature gives it high humidity which is generally above the normal limit of 13 per cent require for the adequate drying of food grains in this subregion, where preservation not easy. The food losses in general are due to the factors outlined above namely temperature and moisture, insects, rodents, birds, micro-organisms and poor management. Several studies have been made to estimate the losses that occur during storage and preservation of food grains in this subregion. However the conclusions have been different.

138. The weaknesses in the post-harvest system which is the origin of food losses in the subregion can be found throughout the cycle of the food grain from harvesting or maturity to consumption. This situation goes from the producer to the consumer through the trader/distributor, through the agro-industrial process or even the artisanal process as well as through the storage and preservation process. The outline of this cycle is valid for stock farming and fishing where the farmer is stock breeder and fisherman at the same time.

139. The agro-industrial processing of food grains is a good method of ensuring not only the proper preservation of this product but also to ensure that they have a huge value added. However, this processing is not sufficiently developed in the subregion despite their numerous potentials. In the subregion processing is done basically by flour mills and for vegetable canning, food and beef canning, by milk factories and for the canning of fish and sea food and the production of drinks (lemonade, juice and beer) as well as the production of edible vegetable oil. Considering the low level of industrial processing, processing takes place on the farm and/or at the artisanal level which carries with it huge food losses.

140. According to the report of the working group on the obstacles to the production and marketing of root crops, tubers and plantains in Africa held in Zaire from 30 September to 4 October 1985 under the auspices of FAO. The losses for these products stood at between 10 and 25 per cent as shown in table 18 below. This situation has hardly improved despite the programmes and activities that were implemented in the subregion.

Table No. 18 Estimate of post-harvest losses in the CEPGL countries from 1975-1977 (in thousand

Product	Production	Total amount available	Losses	% of losses
Cassava	11,778.9	10,502.5	1,276.4	10.8
Sweet potatoes	298.2	253.0	45.2	15.2
Yams	176.6	149.0	27.6	15.6
Taro	37.0	33.0	4.0	10.8
Potatoes	30.9	23.0	7.9	25.6
Other tubers & root crops	28.6	21.0	7.6	26.6
Plantains	1405.0	1093.0	312.0	22.2
Total	13755.2	12074.5	1680.7	12.2

Source: Report of the working group on the obstacles to the production and marketing of root crops, tubers and plantains in Africa, FAO, meeting held in Zaire from 30 September to 4 October 1985.

141. OPROVIA/GRENARWA II project - Research in Rwanda carried out also carried a study on the estimates of losses regarding stored dried beans and sorghum. The losses were defined as being the part of the product or of a food item which is available for consumption. Studies were carried out on the dry weight loss per volume as well as the losses based on the acute nature of the damages.

142. Concerning the weight, the losses observed in the stock of producers were less than 4 per cent for beans and 3 per cent for sorghum. These figures are far less than the 20 and 30 per cent that were generally reported by certain sources. However, one of the reasons for this low figures from producers is that the small quantities that were stored (around 100 kilos per farm) and the short period of storage (3 to 4 months) are hardly suited for any major proliferation and action of the most destructive factors accounting for weight loss especially when the drying and the separation of grains have been done before storage. Furthermore, there has been significant variation between the producers, the regions and the differences during the research study.

143. The loss of weight in respect of beans and sorghum in the purchasing and distribution centres notably in the cooperatives societies since the beginning and end of the storage which is almost about two and five months after harvest, the average loss was at least one per cent. The stored beans in the depots of OPROVIA which were between 5 and 13 months after harvest did not experience weight loss per volume while sorghum experience a weight loss per volume ranging from 0.1 to 1.4 per cent.

143. For the acuteness of the damages, the losses assessed by the consumers were higher. For the farms, 2 to 5 per cent of the quantities used as bean samples seemed unacceptable for consumption. This factor was 10 to 15 per cent in the storage facilities of cooperative societies 5 months after harvest. On the average, the percentage of beans that were unacceptable for consumption stood at 8 to 13 per cent at the time of reception in the depots 5 months after harvest. These percentages ranged from 14 to 17 per cent 15 months after harvest and according to the storage system in the depots with a wide variation according to the beans that were used as samples.

144. According to the assessment made in Somalia few losses were observed in food grains during storage. Indeed producers with their storage systems of maize and sorghum done in open pits, the losses from insects and rodents were only 0.5 to 2.9 per cent, see illustrations no 6. With regard to the ADC stocks the losses were assessed from 2 to 5 per cent. However the Somalia cereal production which is principally sorghum and rice suffered much losses as the result of ravages by birds particularly the "quelea" birds which live in the marshes in millions (about 10 millions). Three per cent of losses on sorghum production was recorded, and this figure can reach 60 per cent in some zones. The experience gained from bird control has shown encouraging results which could be used in the subregion.

145. In countries such as Eritrea and Ethiopia despite the fact no study has been done on food losses prior and post harvest, huge post harvest food losses have been recorded. For Eritrea, according to the data obtained on the ground, total food losses in cereals stood in the order of 10 000 tonnes and 8 000 tonnes in 1993 and 1994 respectively, that is 13.7 and 11.1 per cent of national production for this category of crops in the country. In the case of Ethiopia food losses for a period of 12 month storage in warehouses stood at 1 to 2 per cent.

146. However according to the data collected from the Ethiopian technical services, on the whole and during the last years, post harvest food losses was between 20 and 30 per cent of food grain production. These were basically due to the fact that farmers stopped production during the war as well as inappropriate farming techniques. Other factors included storage and handling with regard to distribution and transportation during processing especially at the farm. Farm losses were also due to insects and rodents infestation in view of the fact it was almost not possible to fumigate and apply other phytosanitary treatment on the farms.

147. In Uganda, climatic data show that most of the country has much rain and the humidity is high practically throughout the year. This situation is rather unfavourable for the storage of grains at all levels and requires the use of artificial facilities which are often not properly mastered and involving huge costs. This situation is notably made worse by the inefficient transport system. The weak evacuation system for grains to the depots of the marketing boards and other collection, distribution, marketing and processing centers for grains together with the easily perishable nature of major food grains and other losses that occur during harvest and distribution due particularly to an inefficient handling and processing contribute to making this situation worse. Thus the food losses are estimated at 30 per cent for plantains, 10 per cent for legumes and oil seeds and 30 per cent for fishing.

4.3 PROGRAMMES AIMED AT THE PREVENTION AND REDUCTION OF FOOD LOSSES

148. The systems of storage and preservation of food grains have often been successful. This is especially so in circumstances where the quantities involved are not very large and the storage period is also short. However it should be noted that the increase of food grain for commercial purposes which is presently noticeable in the subregion requires the modernization of the methods and systems of storage as well as the preservation methods, including the processing of food grains at all levels.

149. Considerable efforts have been made by the governments as well as private initiative to improve and promote the development of the different methods and systems of storage in use. The following paragraphs review some of the activities undertaken by family holdings and by purchasing and distribution centers by certain countries in the subregion regarding the storage of food grains.

4.3.1 On family holdings

150. With a view to improving the storage system by producers of Member States of CEPGL a certain number of criteria have been basically drawn up for maize, sorghum and beans. They are as follows:

- (a) The grains should be completely dried before storage and should remain dry during the period of storage;
- (b) The cleaned grains should be put in clean containers in order not to contaminate the new crop;
- (c) The grain should be kept in a cool place and protected against major external temperature variations.
- (d) The grain should be protected from insects while ensuring that it is clean and dry before it is placed in the storehouse which is accessible to rodents and other pests;
- (e) The containers should be tightly sealed to prevent rodents and other pests from entry; and
- (f) The grain should be regularly checked during storage to insure that it is not infected and if this happens appropriate treatment should be applied.

151. In addition to the current advice given in the subregion, major innovations have been implemented. It relates to projects FA/pf1/bdi.001 and BDI/81/026 in Burundi which use an appropriate insecticide (actellic), with improved storehouses and materials such as laterite ashes and straw in the treatment of food grains to be stored. Moreover, two different containers (metal and plastic barrels) were used as experiments in Rwanda for the OPROVIA/GRENARWA II projects. The

experiment was a considerable success considering the fumigation facilities that went along with it, its imperviousness its tightly closed nature and its use in the preservation of seeds. These developments could be adopted in other countries of the East African subregions.

152. The experience of Uganda as far as institutional infrastructure goes should be worthy of mention. At the ministerial level, the duty of post-harvest food losses reduction falls under the combined responsibility of the ministries of trade, agriculture, social affairs, health and labour. A number of implementing agencies and consultancy services have also been established. They are basically:

(a) Produce Marketing Board- this Board only manages however about 30 per cent of the commercial production due to its lack of appropriate technical equipment;

(b) Standardization Office - this Office is responsible for the standardization of quality control for the food and agriculture sector. It also plays a major role in the growth of exports notably cereals, legumes and horticultural products;

(c) Faculty of agriculture at Makerere University - this Faculty has a Department of Food Sciences which works closely with other universities in East Africa which have the same department. The Faculty also plays an important role in the preservation of food products through the advanced training and other professional services;

(d) Cooperative Unions - this unions are also responsible for the marketing of grains as well as storage, processing and the prevention of food grain losses; and

(e) The Kawanda Agronomic Research Station - the principal agronomic research station in the country, this station also implements research programmes on the prevention and reduction of post-harvest food losses. These programmes deal mostly with following crops, beans, cassava, horticultural products and plantains.

4.3.2 Purchasing, distribution and marketing centres

153. The principal means of storage for most of the operators are silos and sheds except traders and private distributors who use storage warehouses. In an attempt to improve the conditions of storage of beans and sorghum the OPROVIA/GRENARWA projects develop a system modifying the compartments of silos. A system of manual drilling for the improvement of the compartments of silos has also been developed by the same project. For storage in sheds the systems recommended as storage in bags on pallets rather than in bulk in order to minimize the damage done by rodents and moisture. Cribs which have been successfully used for drying and storage of maize by certain projects and village associations in Zaire are also equally recommended.

154. The OPROVIA/GRENARWA projects also had encouraging results from its experiments on the potential effect of insulation. The development of an insulation layer on the roof together with the improvement of the ventilation on the roof could have positive effects on the reduction of the rate of insect growth and on the rate of the hardening of the beans. An assessment of the different materials used for the fabrication of storage bags has shown that polythene and plastic woven bags are more efficient against insect penetration (such as weevils) than the jute bags which are generally used.

155. In Somalia the ADCs established their own storage and preservation systems for food grains. However, they did not provide a report on the outcome of the activities regarding the store houses. It was known that a huge quantities of pesticides and raticides was requested which could not have been used. With the assistance of FAO and DANIDA and through the storage project based in

Nairobi, Kenya, a centre was established for the training of farmers (the Farmers Training Centre, AFMET) for training in storage and preservation of food grains at Afgor and other centres in other agricultural regions of the country. The farmers were not very enthusiastic about these training centres as their activities did not include traditional storage method of digging a pit in the ground.

4.3.3 Underground storage system

156. Two highly successful experiments were carried out by the OPROVIA/GRENARWA II projects on underground storage on beans (batches of 8 to 11 bags of 90 kilos covered with polythene sheets). It was also observed that without the use of chemicals good quality beans stored for a year kept their taste and their ability to grow. They were not attacked by any depredators such as insects or rodents.

157. Poor quality beans which were infested by insects did not also show the presence of insects two years after they had been stored under ground. This system is however better use by cooperatives and other producer associations in view of the difficulties of construction of pits and the closure of bags which require techniques which are not within the reach of small farmers. The underground storage system for beans using develop local material by this Project could be spread to other areas of the subregion.

4.3.3 Standards and quality norms for sorghum and beans

158. The OPROVIA/GRENARWA II Projects had developed and experimented a system of standards and quality norms for sorghum and beans. This system aims at improving at the same time their storage conditions and their marketing by increasing the overall quality of the grains bought and reducing the losses incurred during storage. This system which has a subregional and even a regional scope could also facilitate and improve the trade in this product in the context of the subregion.

159. Efforts has been made specially by the services of the national flour mill company in Tanzania as well as private operators and cooperative unions with regard to storage of food grains albeit limited. These efforts were notably focused on the control of quality and quantities, on the fumigation systems and the supply of the necessary logistic equipment as well as the training of farmers. It also dealt with the implementation of handling methods for harvested crops, the estimate of existing capacities and storage needs as well as the reduction of transport and storage cost which also have an impact on prices.

4.4 Subregional observation

160. During the last few years food losses from agricultural products stock farming and fishing in the East African subregion did not feature in the major concerns of planners and policy makers in the search for long-term solutions to the prevention and reduction of food losses. However, this food losses have led to a major reduction in the food available in this subregion which has been hit by famine and chronic food shortages. However, a number of studies have been carried out on the storage and conservation of post-harvest food grains.

161. For the studies carried out to determine food losses the following should be pointed out: (i) estimates of post-harvest food losses for the period 1975-1977 in CEPGL countries; (ii) the studies carried out by OPROVIA/GRENARWA II Project Research in Rwanda; and (iii) survey on post-harvest food losses in the East African and Southern African subregion notably Uganda and Somalia.

162. It is therefore necessary to carry out a short-term indepth study on food losses in the countries of the subregion where such studies have yet been carried out. It is also important to update the data

on studies out before the 1990s. These studies should include tubers and root plants as well as produce from stock farming and fishing.

163. Several initiatives have been undertaken in the tuber processing project. These studies have not been implemented. It is the feasibility studies on the processing of tubers in the CEPGL countries carried out in December 1988 by ECA/FAO JEFAD Division.

164. The countries in the subregion have recorded short-term enormous pre-harvest food losses and post-harvest food losses. A number of countries have been able to formulate appropriate for the long-term solutions to eliminate or reduce the constraints mentioned above with regard to storage or preservation of food grains. Furthermore, in some countries, armed socio-political conflicts have led to the massive mount of peoples involved in agriculture abandoning their farms and stocks. The countries stagnation prevailing in the subregional does not enable some countries to import phytosanitary products for the treatment of their food products.

165. More dynamic measures should be implemented nationally and subregionally to prevent or reduce food grain losses in this subregion. Chapter V. makes a certain number of recommendations likely to improve the systems and methods of storage, preservation and processing of food crops in order to prevent or reduce food grain losses in the subregion.

V. Measures to improve storage and preservation of food crops in the East African subregion.

166. Maize, sorghum rice, wheat, millet, sweet potatoes, cassava, potatoes, yams, dried beans, groundnut, palm kernels and banana constitute, from the food processing view point, the basic diet of the peoples of the subregion of East African. However, the post-harvest losses on the farms, during storage and preservation as well as handling during distribution and processing can be very high. These losses represent a high shortfall for the economy and food requirements of the subregion.

167. An insight into the methods and systems of storage and preservation of food grains have revealed their differences as well as their performance and weaknesses. National studies and surveys have been carried out in certain countries aimed mainly at the preservations of food grains (basically sorghum, maize, beans) and their management improvement to reduce losses during storage.

168. It is worthy to note that few studies have been carried out on the methods and systems of storage for the preservation of tubers and root plants. The same applies to stock-farming produce and fishing. Nevertheless these products through vulnerable to the traditional method of storage and preservation at all levels, play a very important role in the economy and food requirements of the peoples of the subregion.

169. The efficient methods or systems of storage and preservation of food grains should also be capable of conserving the quantity and the taste of the food item stored or maturing still on the farms. Furthermore, it should take into account the needs and the priorities of all the beneficiaries as well as the organo-leptic qualities of the product and the eco-climatic vagaries. This will lead to a greater rationalisation of the available storage and preservation methods in use and their potentials to combat crop infestation efficiently. Industrial and artisanal processing of agricultural and stock farming products and fishing should be given prominence in the prevention and reduction of food grain losses in the subregion.

170. The following paragraph through in exhaustive outline programmes and activities that are likely to improve the short and medium-term methods and systems of storage, preservation and processing of food grains and basic food stuff in the subregion. The programmes and activities outlined aims at

improving and strengthening the national capacity and they could be launch in countries where such activities have not yet taken place. They could then be formulated at the subregion level.

5.1 At the national level

171. National programmes and activities which can be undertaken or which can strengthen the capacities are as follows:

- (a) Extension of the strategy aimed at improving the systems of storage and preservation of food grains (sorghum, maize and beans) which are outlined above;
- (b) Extension of the systems of storage, preservation and processing of agricultural products as well as the system of animal husbandry which have been successful. They are principally:

- (i) At the family holding:

- * Use of appropriate insecticide such as actellic for the storage and preservation of stored agricultural food items in the rural area which is meant for human consumption
- * The use of improved warehouses
- * The use of materials such as laterite, ashes and straw
- * The use of different containers

- (ii) Storage, distribution and processing centres:

- * Improvement of the system of the management and verification of silos and sheds in all aspects notably with regards to fumigation and the treatment against rodents
- * Insulation of the roofs of storage sheds and providing adequate ventilation
- * Promotion of the underground storage system
- * Promotion of the off-loading systems in the storage sheds
- * Promotion of the storage system in sheds by using bags on pallets rather than bulk storage
- * Promotion of the system of drying and preservation using cribs.

(c) Promotion of national research programmes on storage and preservation systems of agricultural, stock farm products and fishing and the use of new and renewable energy such as solar energy as well as appropriate and adaptable technologies for the artisanal and industrial processing and for their extension at all levels;

(d) Development of national agronomic research programmes on certain stored food grains whose varieties are resistant to certain depredators when stored or left on the farms or can resist certain storage conditions.

(e) Development of national training programmes and the exchange of experience on storage preservation and processing of agricultural products as well as stock farm products and fishing;

(f) Improvement and strengthening of national systems for the collection and dissemination of agricultural statistical data as well as data on stock farming, fishing and food grain losses; and

(g) Carrying out of indepth national studies on pre- and post-harvest food losses where such studies have not been carried out with a view to updating existing national studies. The terms of reference for such studies are presented in Annex I.1.

5.2 At subregional level

172. The subregional programmes and activities to be undertaken outlined below. For them to be attained account should be taken of programmes and activities outlined above. They are:

(a) Organization of subregional seminar on pre- and post-harvest losses. The terms and reference for its organization is found in Annex I.4. The seminar should bring together main beneficiaries, private individuals and parastatal bodies involved in storage and preservation of food grains. Representative of public bodies should have amongst their functions the planning and management of the agro-pastoral sector (promotion research agronomy and animal husbandry, protection of the vegetation, agricultural statistics as well as storage preservation, distribution, marketing and processing). The main task of the seminar will be to examine the recommendations of this report and future reports on the same subject with a view to taking action to prevent and reduce food grain losses in the subregion. The participation of donor agencies and NGOs involved in this sector will be required;

(b) The establishment of a subregional project for the prevention of pre- and post-harvest food grain losses including the development of centres for the exchange of information. The terms of reference relating to the preparation of this project is found in Annex I.3;

(c) The establishment of a subregional system for the collection and dissemination of statistical data on food grains including data on the food loss. The terms of reference for the preparation of this project is found in Annex I.2;

(d) Subregional project on the processing of tubers and root crops. The terms of reference for the preparation of this project are found in Annex I.5.

5.3 The implementation of the programmes and proposed activities

173. The implementation of the programmes and activities outlined above is very urgent for all those involved in activities aimed at preventing and reducing pre- and post-harvest food losses in the countries of the subregion. The proposed programmes and activities recommended at the national level as well as some other programmes and activities at the subregional level should be implemented as soon as possible. For the programmes and actions which require preliminary studies a timetable for implementation is presented in Table No. 19 below.

174. The three projects namely: (i) subregional programme on the collection of agricultural statistical data including data related to food losses; (ii) subregional programme on the prevention and reduction

of pre-and post-harvest food losses; (iii) subregional project on the processing of tubers and root plants which could be made a subregional programme to reinforce food security in the subregion. The advantage of such an approach is that the programme will be able to provide technical and financial support for the implementation of a certain number of programmes and actions proposed below at the national level. This will not be the case if these projects were to be implemented separately.

175. However, the implementation of this project on a separate basis will lead to an internal and external focalization of efforts with a view to achieving immediate and concrete results in the short- and medium-term as far as their objectives are concerned. It is therefore the duty of decision-making bodies of the East African MULPOC to examine indepth the two variants with a view to the selection of an efficient and judicious option which will satisfy the aspirations of their countries and the subregion.

176. Preliminary studies should be carried out before the consideration of the options. The conclusions of this study will be without any doubt indispensable to better clarify any decisions taken in this field. The East African MULPOC Secretariat could always provide technical assistance necessary for fund mobilization for the execution of the proposed feasibility studies and actions which will be programmed. The same assistance could also be provided for the coordination of these studies. The same will apply with regard to the promotion and the coordination of the implementation of programmes and proposed activities at the national level through the present study as shown in paragraphs 189 and 190. If such is the case the Secretariat of East African MULPOC would provide the necessary support for the studies proposed above.

VI. CONCLUSIONS AND RECOMMENDATION

177. Increased food production in the countries of the subregion of East Africa is a major objective for sustainable development in this region. However, protecting food production for human consumption and well-being of the peoples against infestations by different depredators while improving the local methods and systems as well as the preservation and transformation of food production constitutes a major priority for the countries of the subregion.

178. Considerable efforts have been made with a view to preventing and reducing food losses for the principal food grains with often encouraging results. However, the present observation indicates that the results are lagging the minimum requirements. Furthermore, some food products such as tubers and root plants as well as stock farming products and fishing have not been the subject of programmes aimed at the protection and reduction of food losses.

179. The improvement of this situation should come from the implementation of programmes and activities sighted above which are likely to bring lasting solutions in the short and medium term. It is therefore important to establish a mechanism which serve as an effective and efficient catalyst in its implementation. This is why it has been recommended that the subregional seminar/workshop should take place very soon on the prevention and reduction of pre-and post-harvest food losses.

180. This seminar will enable participants not only to take decisions as regarding methods and systems of improving storage and the preservation of basic food grains in the subregion but also take decisions regarding mechanisms for their implementation. It would also provide an opportunity to all the participants to examine measures aimed at increasing food production in the subregion.

181. The follow up action and the assessment of the implementation of the decisions and recommendations of the so called seminar will be carried out by an intergovernmental commission bringing together senior national officials dealing with the agricultural sector as well as officials dealing

with stock farming and fishing. The Eastern African MULPOC will organize the seminar and follow up the activities of the intergovernmental commission and act as the secretariat for the seminar.

182. The attainment of the present study focusing on pre- and post-harvest food losses of food grains in the subregion of East Africa is in the work programme of ECA/Eastern African MULPOC for the biennium 1996 to 1997. It is also to be noted that some time ago other studies and reports focusing on post-harvest food losses had been carried out with a view to strengthening food security for a number of countries in the subregion.

183. The programmes and activities recommended by the present study should constitute - for government officials in the countries of the subregion and other officials involved in this field - a basis for the formulation and implementation of strategic policies, programmes, and activities to promote food security in general and the prevention and reduction of pre- and post-harvest food losses in the East African Subregion. Other studies in this field specially within the framework of "Serving Africa better .. new direction for the Economic Commission of Africa", will be programmed for the East African subregion particularly with a view to implementing the programme and activities proposed by this study.

Table No. 19: Indicative timetable for the implementation of subregional measures for prevention and reduction of pre-harvest and post-harvest food losses in East Africa.

[illegible]

	Year 1996			Year 1997												Year 1998								
	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Sept.
(a) Preparation of project document and its approval																								
(b) Project implementation.																								
6. Subregional project for industrial processing of tubers and root plants:																								
(a) Preparation of project feasibility and approval:																								
(b) Project implementation.																								
7. Subregional seminar for Eastern Africa on the prevention of pre-harvest and post-harvest food losses:																								
(a) Preparation of working documents of seminar;																								
(b) Administrative preparation for the organisation of the seminar;																								
(c) Administrative preparation for the organisation of the seminar;																								
(d) Holding of seminar;																								
(e) Preparation of report of seminar.																								

Source: Table established by the expert for purposes of the survey.

ANNEX I.**TERMS OF REFERENCE OF THE SURVEY ON POST-HARVEST
FOOD LOSSES IN THE EAST AFRICAN SUBREGION**

The terms of reference of the survey on post-harvest food losses in the East African subregion comprise four items, namely:

- (a) A diagnosis of food production and security in the subregion;
- (b) An analysis of the methods and systems for food storage and conservation in the subregion;
- (c) An analysis of post-harvest food losses in the subregion; and
- (d) Formulation of measures to improve food storage and conservation in the East African subregion.

ANNEX II.**TERMS OF REFERENCE OF IDENTIFIED DRAFT STUDIES AND SURVEYS**

1. **Terms of reference for the preparation of a detailed survey on the prevention and reduction of pre-and post-harvest food losses and collection in countries of the East African subregion.**

The survey will be conducted for countries which have so far not benefitted from any such survey. It will mainly concern Eritrea, Ethiopia, Kenya and Djibouti. Its terms of reference essentially comprise:

- A. Determination and assessment of the necessary physical and financial resources;
- B. Preparation of questionnaire on:
 - (i) Methods and techniques of food storage and conservation before and after harvest, and collection;
 - (ii) Pre-and post-harvest food losses and collection;
 - (iii) Programmes and activities implemented or under implementation and those programmed for the prevention and reduction of food losses.
- C. Identification of work already done out in this area in other countries of the subregion, and determination of modalities for their updating;

- D. Determination and assessment of physical, human and financial resources necessary for the implementation of identified programmes and activities;
 - E. Identification of modalities for the survey organization, data analysis and report writing;
 - F. Conducting the survey; and
 - G. Data analysis and writing of survey document.
2. **Terms of reference for the preparation of a subregional project on the collection and dissemination of statistical data on agriculture, stock farming, fishery and food losses.**
- A. Diagnosis of existing national systems and services for the collection of agricultural statistical data, at all levels, on agriculture, stock farming, fishery as well as on pre- and post-harvest food losses and collection.
 - B. Identification and formulation of programmes and activities designed to improve and strengthen national systems, and to harmonize them at the subregional level, as well as mechanisms for their implementation and incorporation in structures existing or still to be created;
 - C. Determination and assessment of physical, human and financial resources necessary for the implementation of identified programmes and activities as well as their funding sources; and
 - D. Preparation of the project document and its implementation time-table.
3. **Terms of reference for the preparation of an East African subregional project on the prevention and reduction of pre-and post-harvest food losses and collection.**
- A. Diagnosis and assessment of the existing situation at the national and subregional levels;
 - B. Identification of mechanisms and systems for the collection and dissemination of techniques established and used in this area;
 - C. Formulation of the programme components and/or projects to be executed at the national and subregional levels, as well as the identification of their location;
 - D. Determination and assessment of physical, human and financial resources necessary for the project execution as well as their funding sources;
 - E. Establishment of the institutional framework and other mechanisms necessary for the project's execution; and

F. Preparation of the project document as well as its execution time-table.

4. Terms of reference for the preparation of a project to organize a subregional seminar on the prevention and reduction of pre-and post harvest food losses and collection in the East African subregion.

A. Determination of the objectives and choice of the seminar themes as well as the formulation of modalities for the preparation of documents to be presented as well as the determination of the venue and period of the seminar;

B. Identification of conference participants and moderators as well as other intervening parties;

C. Determination and assessment of physical, human and financial resources necessary for the organization of the seminar as well as the financing sources; and

D. Preparation of the seminar's work programme and agenda and the formulation of the project document.

5. Terms of reference for the feasibility study on the subregional project for the industrial processing of tubers and root crops.

The project is necessary because these crops are very vulnerable to damage during their storage and conservation. Besides, few concrete initiatives have been taken to prevent and reduce their food losses. The terms of reference comprise:

A. Diagnosis of the current situation of the industrial and small-scale production and processing of tubers and root crops in the subregion;

B. Choice of the capacity and location of the production plant or plants as well as the technology and equipment. This choice will take account of the criteria for determining the quality of products to be manufactured as well as the availability of raw materials and manpower;

C. Determination and assessment of the physical, human and financial resources necessary for the project execution as well as the financing sources; and

D. Establishment of the project's tender and feasibility studies as well as the socio-economic and financial analysis and preparation of the project document feasibility study.