AGRICULTURAL PERSPECTIVES IN THE TSETSE INFESTED AREAS IN AFRICA

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TSETSE INFESTED AREAS IN AFRICA

by

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Program for the Control of African Animal Trypanosomiasis

and Related Development

FOREWORD

Understanding the nature and dimension of the food problem and the policies available to alleviate it has been the focal point of the Food and Agriculture Programme (FAP) at the International Institute for Applied Systems Analysis (IIASA) since the program began in 1977.

Large areas of Africa are infested by tsetse flies which preclude certain types of agricultural development. Should one consider an international effort to eradicate or contain tsetse flies? The problem is complex, as the entire ecology of that vast area may be affected by it. Though one must evaluate these ecological consequences in such decisions, an understanding of the agricultural production potential of the tsetse infested areas is an important element in analyzing such policy questions.

Günter Fischer and Mahendra Shah have provided agricultural perspectives for the tsetse infested areas in Africa. We are grateful to the Food and Agriculture Organization of the United Nations for partially supporting this study.

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The study would not have been possible without the resources and excellent collaboration between FAO and IIASA.

SUMMARY

It is recognized that much of the land at present controlled by the tsetse is potentially good agricultural land and that plans for control of tsetse must be preceded by sound programmes for integrated land use.

Data on soil characteristics was collated in the FAO/UNESCO Soil Map of the World and that on climate and water availability was collated in the FAO agro-ecological zones (AEZ) study. The AEZ study assessed the potential productivity of the land resources by interactions of climatic conditions, land and soil characteristics, kinds of crops grown and farming practices. During 1978-83, a collaborative study entitled "Land Resources for Populations of the Future" was carried out by FAO in collaboration with IIASA with funding from UNFPA. This FAO/IIASA/UNFPA study developed and applied a methodology to assess the population supporting potential of arable land resources in developing countries. Altogether, 117 developing countries including 51 in Africa were included in the study.

With the availability of the above resource data base, it was therefore considered desirable to apply the methodology that had been developed, specifically to the tsetse infested areas in the 37 countries in Africa in which animal (and human) trypanosomiasis is an important constraint to development. The present study by IIASA for FAO provides a *first approximation* of the potential ecological and economic productivity of the tsetse "infested"/"likely infested" areas in Africa, and endeavours to provide answers to the following questions:

- How do the agro-ecological zones relate to the tsetse infested areas? What is their extent and what is the resident human and livestock population?
- What are the food and revenue producing potentials of these areas, given various levels of inputs and technology? How many people can be fed from this production, what is the revenue generating potential of these areas, and how does this potential compare with present and future requirements?
- What inputs (power, fertilizer and pesticides) would be required to achieve these potentials?
- Which particular areas (zones) should be given development priority, either because of large economic potentials or their "critical" (i.e. land resources insufficient to meet the food needs of the resident population) situation?

The means adopted to identify the tsetse infested areas was firstly to relate the accepted temperature and humidity requirements of tsetse to the classification of agro-ecological zones and secondly to abstract the data for six major climates which provide conditions in which *glossina* species could thrive from the 14 major climatic sub-divisions used in the original work. This data was processed with additional refinements for the 37 countries affected by African animal trypanosomiasis. In this analysis, three countries (Botswana, Niger, Somalia) known to have small proportions of their land area infested by tsetse (5.0, 0.1 and 3.0% respectively) did not show up in the climate subdivisions selected. Full details are therefore presented for 34 countries.

The calculations of the potential productivity of the various likely tsetse areas are made using the 1:5 million scale land resource inventory. Three levels of "inputs" assumptions are used in the study and alternative assessments for the baseline year 1975 and the projected year 2000 made as follows:

Population Supporting Potential Runs

A - pessimistic	Low technology, present crop mix, no soil conservation
B - likely	Intermediate technology, 0.5 present crop mix, 0.5 conservation
C - possible	Intermediate technology, optimum crop mix, full conservation

Maximum net revenue runs

D - low	Low technology, present crop mix, no soil conservation
E - likely	Intermediate technology, 0.5 present crop mix, 0.5 conservation
F - possible	Intermediate technology, optimum crop mix, full conservation

Results are now available in the following degree of aggregation:

- *Regional Africa:* aggregated results for all climate and length of growing period zones where tsetse could thrive in all the 34 countries in Africa.
- *Country results:* aggregated individual country results for the tsetse areas. These quantify the potential production, population supporting potential and potential income from the development of the tsetse infested areas in each country.
- *Individual country length of growing period zones:* for all tsetse areas in the 34 countries of the study. The priority areas for development in terms of high agricultural potential or critical nature of the length of growing period zones in each of the countries of the study are identified and analyzed in detail.

- *Individual agro-ecological cells:* for all tsetse areas in the 34 countries of the study. These results for over 20000 cells are available as computerized data. The software for extracting individual cells (e.g. identified from geographic-topographic location in a country) is also available to enable indepth analysis for particular sites.

This report presents a summary of the methodology and country results for the tsetse infestible areas in Africa.

1. INTRODUCTION

It is recognized that animal trypanosomiasis is a major constraint to development in Subsaharan Africa and that much of the land at present infested by the various species of tsetse fly (*Glossina*) is potentially good agricultural land. The present study, entitled "Agricultural Perspectives in Tsetse Infested Areas", was carried out by the Food and Agriculture Organization of the United Nations (FAO) in collaboration with the International Institute for Applied Systems Analysis (IIASA). This study is a first attempt to utilize the vast amount of data and information about soils and climates of Africa to assist planning of integrated land use in the tsetse infested and controlled areas. It is hoped that these results of the study will be useful for the selection of priority areas in which population density and high agricultural potential could justify costs of tsetse and trypanosomiasis control.

1.1. Prerequisites

This study was possible because of the work that had previously been undertaken by FAO and the UN Education Scientific and Cultural Organization (UNESCO) in appraising the world's soil resources in a common internationally accepted language (Dudal and Batisse, 1978) which resulted in the publicaton of the Soil Map of the World (FAO/UNESCO 1971-81). Subsequent work aimed at interpreting the "soils" information for assessing land suitability resulted in a Framework for Land Evaluation (FAO 1976) which forms the basis of many land evaluation activities throughout the world.

Applying the soils data to the principles of land evaluation led to a further FAO study (1976-78) of potential land use by agroecological zones. This determined the soil and climatic requirements of crops and matched them with soil and climatic inventories to arrive at estimates of crop potentials. Results of this work for all regions of the world were published in the four volumes of

World Soil Resources Report No.48 (FAO, 1978-81). The issue of this report attracted the attention of the United Nations Fund for Population Activities (UNFPA) which posed the question "can the agroecological zone crop potential estimate be converted into potential population supporting capacities, and if so can these crop potential estimates be compared with data on present and projected populations to identify critical areas where land resources are insufficient to meet food needs?" A collaborative study between FAO and IIASA with funding from the United Nations Fund for Population Activities (UNFPA) developed and applied a methodology to assess food production and population supporting potential of the arable land resources in 117 countries in five regions of the developing world at a 1:5 million scale. Of these 117 countries, 51 were in the Africa region.

1.2. Background

Animal trypanosomiasis is transmitted in Africa by some 30 species and sub-species of tsetse fly (*Glossina*) in 37 countries of the continent between latitudes 15°N and 21°S. The limits of tsetse distribution are determined by temperature and humidity and the presence of host animals (and man) which provide the blood on which the fly feeds. Nash (1937) suggested that the extent of the annual dispersal of *G. morsitans* and *G. tachinoides* was governed by the duration of the wet season.

Glossina lives well at 25-26°C. In general, a temperature above 38°C is damaging to the adults and below about 17°C adult flies cannot live a normal active life. A summary of environmental limits of different species is available (FAO, 1982; FAO, 1982a). Rainfall has an indirect effect on tsetse by:

- ensuring humidity which is essential to survival of tsetse pupae

- maintaining vegetation which provides the essential resting and breeding sites
- causing local flooding which may drown pupae.

Tsetse flies are completely dependent upon host animals for their food and the commonest hosts are the (wild) pig family, bushbuck, buffalo and cattle, but some species can feed on birds and reptiles.

Human activity, such as shifting cultivation, collection of fuelwood, hunting, settlement and crop farming locally disturbs the tsetse by destruction of vegetation and frightening or elimination of wild host animals.

Temperature and water are the major climatic factors that govern the adaptability and distribution of crops. In different parts of the world, temperature and water availability from rainfall act in different proportions as constraints to year-round rainfed crop production. In warm tropical regions, the major constraint limiting the time available for rainfed crop production is availability of water. In subtropical regions with winter rainfall, low temperatures and radiation during the winter period may limit crop growth although water may be available: during the summer period in such areas water availability may limit crop growth despite a favorable temperature and radiation conditions. There is thus considerable similarity in the environmental requirements for tsetse and crop production.

1.3. Objectives and scope

The principal objectives of this study were, firstly to utilize and apply the considerable data on climate, soils and crop production potential to the areas that could be infested by the tsetse fly (*Glossina*). Secondly to obtain more precise estimates of the population supporting and income generating potential of the tsetse infested areas and thirdly to provide an indication of tsetse infested

areas which require priority attention and which might justify tsetse control or eradication schemes.

Subsidiary objectives of the study were, to enhance awareness of the data available about agricultural productivity potential of land resources among those concerned with livestock production in Africa, to provide essential background information to assist in planning the development of the tsetse infested areas, and to provide a physical resource base which could be applied at the national level by the Sub-regional Development Support Units envisaged under the FAO Programme for the Control of African Animal Trypanosomiasis and Related Development.

The work was undertaken by collaboration between the Animal Production and Health Division of FAO and the Food and Agriculture Programme of IIASA. Following completion of the initial study it was decided to carry out some additional work to obtain estimates of the availability of crop residues and crop by-products from the potential crop production and assess the livestock feed supply and requirement. It was also considered desirable to estimate the contribution to energy inputs which could be made by working oxen.

2. METHODOLOGY AND RESOURCES DATA BASE

The methodology (Fig. 1) to assess population supporting capacities and to assess net revenue generated by food production potentials of land includes the following principles which are fundamental to any sound evaluation of land:

i. an inter-disciplinary approach is adopted, the evaluation being based on inputs from crop-ecologists, agronomists, climatologists, nutritionists, systems analysts, and economists, in addition to those from pedologists.

ii. land suitability is only meaningful in relation to a specific use, e.g. land suited to the cultivation of cassava is not necessarily suited to the cultivation of white potato:(land unit characteristics and crop production models);

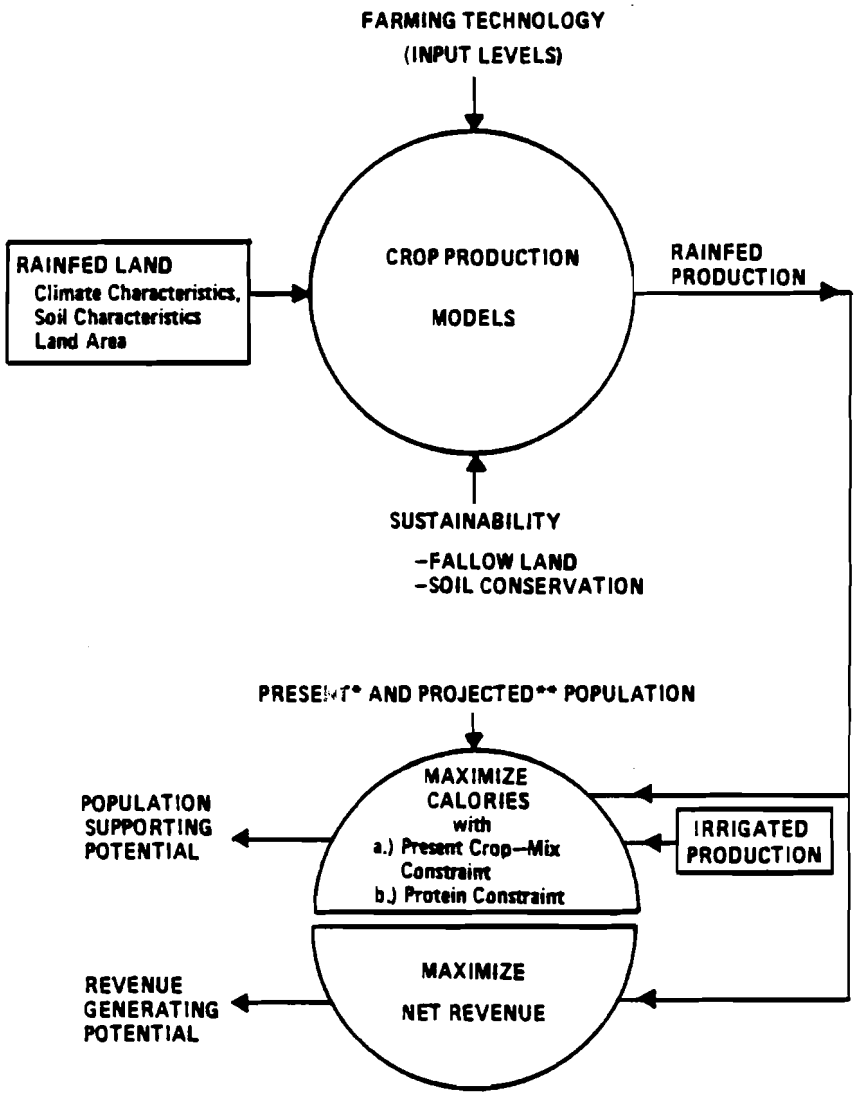
iii. suitability refers to use on a sustained basis, i.e. the envisaged use of land must take account of degradation, e.g. through wind erosion, water erosion, salinization or other degradation processes:(by means of fallow land and soil conservation;

iv. evaluation of production potential is made with respect to specified levels of inputs, e.g. whether fertilizers are applied, if pest control is effected, if machinery or hand tools are used:(farming technology);

v. different kinds of land use, e.g production of wheat or phaselous bean or white potato, are compared on the basis of food value (i.e. productivity for each use is assessed by comparing the caloric and protein content of the alternative crops) as well as net value of output (i.e. productivity assessed by comparing net value of output of alternative crops):(crop choice)

vi. population supporting capacity is assessed by a comparison of present and projected population with the population that can be supported by the potential food production.

Fig. 1 OVERVIEW OF METHODOLOGY
-ASSESSMENT OF FOOD PRODUCTION, POPULATION SUPPORTING AND REVENUE GENERATING POTENTIALS



*YEAR 1975
**YEAR 2000

The first four principles are described in a "Framework for Land Evaluation" (FAO, 1976a) and form an important part of the overall methodology.

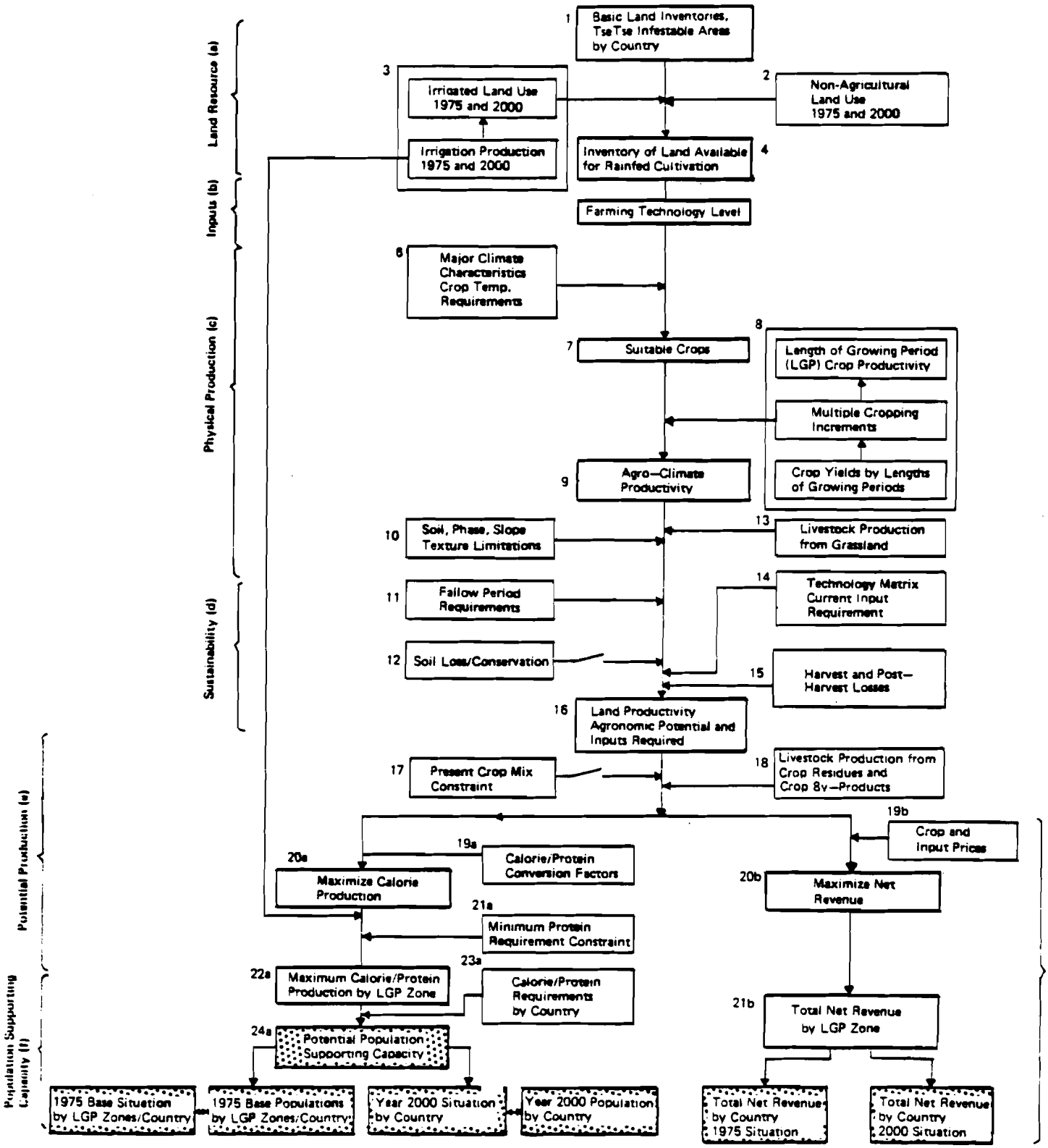
Limits to food and agriculture production are set by soil and climate conditions and by the use, and management, of the land. In the long run, any "mining" of land beyond these techno-ecological limits will result in degradation and decreased productivity. Accordingly, within an overall upper ecological limit, there are technology-specific finite levels of sustainable food and agriculture production obtainable, from any given land area and hence corresponding maximum levels of population that can be supported.

Fig.2 schematically illustrates the methodology developed to assess food production potential, population supporting capacities and income generating potential, the block numbers in the figure relating to step descriptions in the present section.

The starting point of the study was the computerized land and climate resource data base for each country. This inventory was compiled by an overlay of a specially compiled climatic inventory (providing spatial information on temperature and moisture conditions) onto the FAO/UNESCO Soil Map of the World, FAO, 1971-81, (providing spatial data on soil, texture, slope and phase). It should be noted that considerable time and effort were invested by the staff of the Land and Water Division of FAO in computerizing this land resources inventory for each country. The procedure involved the measurement of each soil mapping unit as it occurs in each length of growing period zone (moisture condition), in each major climate (temperature regime) and in each country. This measurement was achieved by a 2mm (10,000 Hectares) grid count (corrected for reported areas of countries' land masses) of the land inventory map, i.e. overlay of the climate map onto the soil map for each country. Information on the extents and composition of each mapping unit according to the listings

Figure 2

ASSESSMENT OF THE AGRICULTURAL POTENTIAL OF TSETSE INFESTABLE AREAS IN AFRICA



given in the texts of the soil map were used to derive the individual extents of each soil type in each mapping unit, by slope, texture class and phase.

2.1. Climate Inventory

The choice of the parameters used in the climatic inventory was based on climatic adaptability attributes of the crops. The climatic information was compiled from the FAO Climate Data Bank (FAO, 1976b) consisting of monthly records from some 730 meteorological stations in Africa of rainfall, maximum and minimum temperatures, vapour pressure, wind speed and sunshine duration. Fourteen temperature regimes referred to as *major climates* were delineated as shown in Table 1. Out of these fourteen major climates, six were assumed to be suitable for tsetse infestation (see Table 1) but two of them (climates 05 and 06) do not occur in Africa.

Crop adaptability is temperature dependent: prevailing temperature conditions determine which crops can be grown and which cannot. The above climatic inventory was therefore designed to match compiled information on the climatic requirements of plants which can be classified by photosynthesis characteristics into four temperature-related crop adaptability groups (Kassam, 1977a), Table 1.

Providing that temperature requirements are met, the degree of success in the growth of a crop is largely dependent on how well its optimum length of growth cycle fits within the period when sufficient water is available for growth. Quantification of moisture conditions was based on a water balance model comparing precipitation (P) with potential evapotranspiration (PET) and allowing for a reference value of 100 mm of soil moisture storage (S).

The moisture availability period (i.e. the period where P+S is greater than 0.5 PET) with mean daily temperatures above 5°C was considered suitable for

Table 1. Characteristics of major climates

MAJOR CLIMATES	Major climates during growing period		24-hr mean (daily) temperature (°C) regime during the growing period	Suitability for tsetse	Suitable crop group*
	No.	Descriptive name			
TROPICS All months with monthly mean temperatures, corrected to sea level, about 18°C	01	Warm tropics	More than 20°	Suitable	II and III
	02	Moderately cool tropics	15°-20°	Suitable	I and IV
	03	Cool tropics	5°-15°	Unsuitable	I
	04	Cold tropics	Less than 5°	Unsuitable	None
	05	Warm/moderately cool sub-tropics (summer rainfall)	More than 20°	Could be suitable but do not occur in Africa	II and III
	06	Warm/moderately cool sub-tropics (summer rainfall)	15°-20°		I and IV
SUB-TROPICS One or more months with monthly mean temperatures, corrected to sea level, below 18°C but all months above 5°C	07	Warm sub-tropics (summer rainfall)	More than 20°	Suitable	II and III
	08	Moderately cool sub-tropics (summer rainfall)	15°-20°	Suitable	I and IV
	09	Cool sub-tropics (summer rainfall)	5°-15°	Unsuitable	I
	10	Cold sub-tropics (summer rainfall)	Less than 5°	Unsuitable	None
	11	Cool sub-tropics (winter rainfall)	5°-20°	Unsuitable	I
	12	Cold sub-tropics (winter rainfall)	Less than 5°	Unsuitable	None
TEMPERATE One or more months with monthly mean temperatures, corrected to sea level, below 5°C	13	Cool temperate	5°-20°	Do not occur in Africa	I
	14	Cold temperate	Less than 5°		None

* Crop Adaptability Group I with photosynthesis pathway C_3: Spring wheat, winter wheat, highland phaselous bean, white potato, winter barley.
Crop Adaptability Group II with photosynthesis pathway C_3: Paddy rice, lowland phaselous bean, soyabean, sweet potato, cassava, upland rice, groundnut, banana/plantain, oil palm.
Crop Adaptability Group III with photosynthesis pathway C_4: Pearl millet, lowland sorghum, lowland maize, sugar cane.
Crop Adaptability Group IV with photosynthesis pathway C_4: Highland sorghum, highland maize.

Table 2. Length of growing period (LGP) zones in number of days when water is available for plant growth

Code No.	AEZ Study LGP zones (days)		Suitability for Tsetse
27	365+	(N)	Considered suitable for tsetse and utilized for study
01	365-	(N)	
02	330-364	(N)	
03	300-329	(N)	
04	270-299	(N)	
05	240-269	(N)	
06	210-239	(N)	
07	180-209	(N)	
08	150-179	(N)	
09	120-149	(N)	Considered unsuitable for tsetse and data discarded
10	90-119	(N)	
11	75-89	(N)	
12	1-74(N)		
13	0 dry		
14	1-74	(I)	
16	75-89	(I)	
17	90-119	(I)	
18	120-149	(I)	
19	150-179	(I)	
20	180-209	(I)	
26	0 cold		

(N) Normal length of growing period
(I) Intermediate length of growing period
365+ is year round humid growing period
365- is year round growing period

crop growth, and defined as the length of *growing period* (LGP). Two major types of length of growing period zones (LGP zones) were inventorized: a *normal* LGP zone with a humid (an excess of P over PET) period and an *intermediate* LGP zone without a humid period. These lengths of growing period zones, Table 2, were delineated by isolines of 0, 75, 90, 120, 150, 180, 210, 240, 270, 300, 330 and 365 days of growing period.

2.2. Soil Map

The FAO/UNESCO Soil Map of the World (FAO, 1971-81), provided data on the distribution of 106 soil units of 26 major soils inventorized in over 5000 soil

mapping units. Information on the texture (coarse, medium or fine) of the dominant soil in the mapping unit, the slope characteristic (level to gently undulating, rolling to hilly and steeply dissected to mountainous) and phases of land characteristics which are of significance in land use -- for example, stoniness, salinity or alkalinity was also available from the soil map.

2.3. Land Resources Inventory

Overlay of the climatic inventory on the soil map allowed delineation of unique land units each with a specific combination of soil and climatic conditions (Higgins and Kassam, 1980). These land units were registered in a computerized land inventory (Fig.2, Step 1) of extents of soil units, by slope, texture class and phase, as they occurred in each length of growing period zone, in each major climate and in each country. These unique land units, referred to as agro-ecological cells, provide the smallest (10,000 ha) unit of analysis. It should be noted that within a particular length of growing period in a country, land units with identical soil attributes have been aggregated and hence the extents of some of the agro-ecological cells in the inventory may be larger than 10,000 hectares.

An assessment of the 1:10 million tsetse infestation map of Africa with the length of growing period isolines revealed that the accepted areas of tsetse infestation coincides with nine lengths of growing period zones between 150 and 365 days as shown in Table 2. Note that a length of growing period of 150 days corresponds to about 800 mm annual rainfall.

The land resources of land areas encompassed by the LGP zones from 150 days to 365 days and four major climates, namely warm tropics, moderately cool tropics, warm sub-tropics (summer rainfall) and moderately cool sub-tropics (summer rainfall) were considered to be suitable for tsetse infestation. Altogether thirty-seven countries out of forty-five countries in mainland Africa have

areas suitable for tsetse infestation. Of the 37 countries known to be infested with tsetse, 13 are practically completely infested, namely, Benin, Central African Republic, Congo, Equatorial Guinea, Gabon, Ghana, Guinea Bissau, Ivory Coast, Liberia, Sierra Leone, Togo and Zaire. Eleven countries have between 25 percent and 95 percent of the land infested and the remaining 13 countries have less than 24 percent infested.

Not all the inventorized land in the computerized tsetse infestable land resources inventory for each country is available for rainfed agricultural production. Land requirements for non-agricultural land use and irrigated land use need to be taken into account in deriving the balance of land available for rainfed agricultural production.

2.4. Non-Agricultural Land Use

Non-agricultural land uses (Fig.2, Step 2) include areas for habitation, transportation, industry, mining, conservancy, recreation, etc. These requirements depend largely on population pressures, land-use practices and environmental conditions. No comprehensive estimates of non-agricultural land requirements are available and in the study, allowance for non-agricultural land uses equivalent to a per capita requirement of 0.05 hectare per person was made on the basis of some compiled data (Hyde et al, 1980).

2.5. Irrigated Land Use

Production from irrigated areas (Fig.2, Step 3) is a most important component of national agricultural production. Accordingly both the land under current and projected irrigation and the production therefrom need to be taken into account in the assessment of potential population supporting capacities.

Data for year 1975 and year 2000 irrigated crop areas and production in each country are recorded in FAO (1981). The present (year 1975) and planned

(year 2000) irrigated crop areas and production were allocated to particular land units in the country land inventory by a consideration of soil and climatic conditions (Wood, 1980). This irrigated production was translated into calorie and protein equivalent and incorporated in the assessment of population supporting potentials (in the relevant length of growing period zones).

2.6. Rainfed Production Potential

The above "deductions" for non-agricultural and irrigated land use in the basic land inventory of tsetse infestible areas of each country resulted in the quantification of the land resources available for rainfed cultivation (Fig.2, Step 4).

The physical crop production potential (Fig.2, Steps 6-16) of any given land area depends on the soil and climatic conditions as well as the farming technology utilized (Fig.2, Step 5). Three alternative assessments depending on the levels (Table 3) of farming technology are considered in the study as follows:

Pessimistic (Runs A,D):* Assuming only hand labour, traditional cultivation, no fertilizer or pesticide application; no soil conservation measures and hence full productivity losses arising from land degradation; cultivation of the presently grown mixture of crops on all potentially cultivatable rainfed land.

Likely (Runs B,E): Assuming manual labour with improved hand tools and animal traction with improved draught implements; some application of fertilizer and pesticides; some simple soil conservation measures lessening productivity losses from land degradation by about a half; and cultivation of an equal combination of the presently grown mixture of crops and the optimum (i.e. most calorie (protein) productive or most net revenue generating) crops, on all potentially cultivatable rainfed lands.

*Runs A to E are defined in Section 2.7.

Table 3. Attributes of farming technology levels

Attribute	Pessimistic	Likely	Possible
Production systems	Rainfed cultivation of presently grown mixture of crops	Rainfed cultivation with part change of optimum mixture of crops	Rainfed cultivation of optimum mixutre of crops
Technology employed	Local cultivars. No fertilizer or chemical pesticide. Duiseas and weed control. Some rest (fallow) periods. No long-term soil conservation measures.	Improved cultivars as available. Limited fertilizer application. Simple extension packages including some chemical pest, disease and weed control. Moderate rest (fallow) perods. Some long-term conservation measures.	Improved cultivars as available. Limited fertilizer application. Simple extension packages including some chemical pest, disease and week control. Modest rest (fallow) periods. Complete soil conservation measures.
Power resource	Manual labour with hand tools	Some manual labour with hand tools and animal traction with improved implements	
Labour intensity	High, including uncosted family labour	High, including part costed family labour	
Capital intensity	Low	Intermediate with credit on accessible terms	
Market orientation	Subsistence production	Subsistence production plus sale of surplus	
Infrastructure	Market accessibility not necessary. Inadequate advisory services	Some market accessibility necessary with access to some demonstration plots, services and research findings	
Land holdings	Fragmented	Sometimes consolidated	
Current inputs required	Seed traditional human labour	Seed traditional/improved human labour/animal power. Fertilizer N-P-K. Pesticides.	

Possible (Runs C,F): Assuming manual labour with improved hand tools and animal traction with improved draught implements; some improved cultivation, some application of fertilizers and pesticides; full soil conservation measures; cultivation of optimum (i.e. most calorie (protein) productive or most net

revenue generating) crops on all potentially cultivatable rainfed lands.

The presently (year 1975) grown mixture of crops, reflecting local preferences, is expressed in terms of percentage of areas occupied by each of the crops considered by the study. This information was obtained for each length of growing period zone, within countries, from sub-national administrative crop area data. Table 4 shows a summary of these results for the tsetse infestible major climates and length of growing periods in Africa; the distribution of food crops within length of growing period zones is, in general, consistent with ecological requirements of cultivation.

The above three levels of farming technology, namely, pessimistic, likely and possible, were selected for this study to represent subsistence, improved subsistence and simple commercial farming systems respectively. Note that these technology levels are more conservative than those used in the previous FAO/IIASA/UNFPA study. For each of the land units available for rainfed cultivation, the production potential of the most widely grown food crops, namely, wheat, rice, maize, barley, sorghum, pearl millet, white potato, sweet potato, cassava, phaselous bean, soyabean, groundnut, sugarcane, banana/plantain, oil palm and grassland (livestock) was assessed by using crop production models (Figure 3). The three main components of a crop production model are: agro-climatic suitability, soil suitability and sustainability of production.

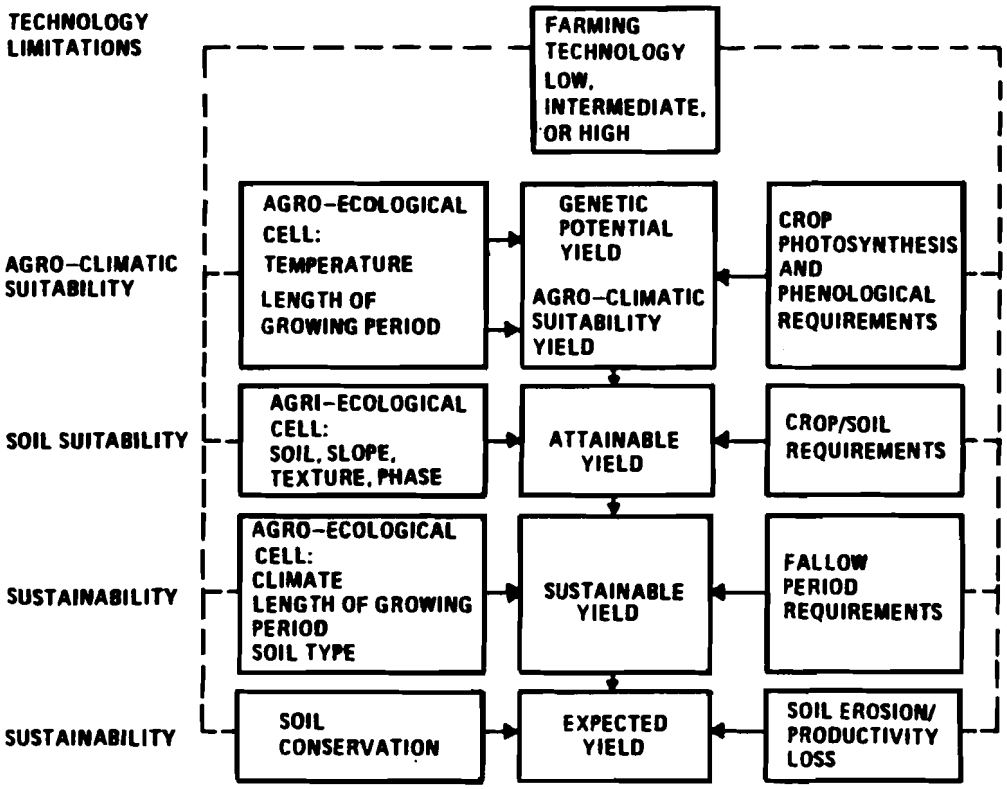
2.6.1. Agro-Climatic Suitability

For each crop that can be grown in a particular unit of land, there is a maximum agro-climatic yield potential dictated by climatic conditions. The photosynthetic and phenological requirements (Kassam 1977a-b, 1979a-b) were matched to the climatic attribute of each agro-ecological cell in quantifying the agro-climatic yield potential (Table 5) of each crop. It should be noted that

Table 4. Present crop distribution by tsetse infestible major climate and length of growing period zones in Africa

Length of growing period (days)	% zone area occupied	Warm tropics	Moderately cool tropics	Warm sub-tropics (summer rainfall)	Moderately cool sub-tropics (summer rainfall)
365+ humid	25-50	Cassava			
	10-25	Maize/Banana/ Rice/Groundnut			
365- humid	>50		Maize		
	25-50	Cassava	Beans		
	10-25	Rice/Maize/Banana	Sorghum		
	5-10	Groundnut			
330-364 humid	>50		Maize		
	25-50				
	10-25	Cassava/Rice/Maize	Beans/Sorghum		
	5-10	Groundnut/Banana			
330-329 humid	>50		Maize		
	25-50	Maize			
	10-25	Cassava/Rice	Beans/Sorghum		
	5-10	Groundnut/Banana	Wheat		
270-299 humid	>50		Maize	Maize	
	25-50	Cassava			
	10-25	Maize/Rice	Beans	Groundnut	
	5-10	Groundnut/Millet/ Beans	Sorghum/Wheat		
240-269	>50		Maize	Maize	
	25-50	Maize			Wheat/Maize
	10-25	Cassava/Millet/Rice	Beans/Sorghum/ Wheat	Groundnut	
	5-10	Groundnut/Beans/ Sorghum			Sorghum/Beans
210-239	>50		Maize	Maize	
	25-50	Maize			Wheat/Maize
	10-25	Millet/Cassava/ Groundnut	Beans/Sorghum/ Wheat	Groundnut	
	5-10	Beans/Sorghum/Rice			Sorghum/Beans
180-209	>50			Maize	
	25-50	Millet	Maize		Maize
	10-25	Maize/Groundnut/ Beans	Beans/Sorghum/ Wheat		Wheat/Sorghum/ Beans
	5-10	Sorghum/Cassava/Rice	White Potatoe	Groundnut	
150-179	>50				
	25-50	Millet	Maize		
	10-25	Groundnut/Sorghum/ Maize	Beans/Wheat		
	5-10	Beans White Potatoe	Sorghum/		

Fig.3 CROP PRODUCTION 'MODEL'



agro-climatic constraints due to pests, diseases, weeds, workability and rainfall variability have been considered in arriving at these potentials, as have increases in yield from sequential cropping as well as intercropping.

Table 5. Examples of Rainfed Crop Yields and Productivity under Various Climatic Conditions (Metric Tons per Hectare Dry Weight) – Low Level of Farming Technology

Major Climate and Length of Growing Period Zone (Days)	Crop			
	Pearl Millet	Wheat	Cassava	White Potato
Warm Tropics				
150-179	0.8(1.7)	NS	0.9(1.0)	NS
270-299	0.1(0.2)	NS	2.3(3.0)	NS
365	0.1(0.2)	NS	1.9(2.5)	NS
Cool Tropics				
150-179	NS	1.1(1.5)	NS	1.8(3.1)
270-299	NS	0.2(0.3)	NS	0.5(1.2)
365	NS	0.2(0.3)	NS	0.2(0.3)
Cool Sub-Tropics (Winter Rainfall)				
150-179	NS	0.9(1.0)	NS	NS
270-299	NS	0.8(0.9)	NS	NS

Figures in parenthesis refer to yield, including increments due to multiple cropping.

NS: not suitable

2.6.2. Soil Suitability

Soil conditions (soil, slope, texture and phase) may constrain the agro-climatic yield potentials and determine attainable yield. Crop-specific soil limitation ratings (Table 6) -- for main soils – (Sys and Riquier, 1980), were formulated by matching the properties of all soil units to the soil requirements of crops and applying these to the soil conditions of agro-ecological cells in estimating the attainable yields for all crops that could be grown in the cell.

Table 6. Limitation Soil Ratings for Maize by Level of Farming Technology.

Soil	Low Level Input	Intermediate Level Input	High Level Input
Lithosols	N2	N2	N2
Acric Ferralosols	N2	N1	S2/N1
Orthic Acrisols	S2	S2	S1/S2
Cambic Arenosols	N2	S2/N2	S2
Calvic Luvisols	S2	S1/S2	S1/S2
Calcaric Regosols	S2	S1/S2	S1/S2
Eutric Cambisols	S1	S1	S1
Eutric Gleysols	N2	N2	N1/N2

S1: very suitable
S2: marginally suitable
N1: not suitable but can be improved
N2: not suitable
e.g. "S2/N2" means 50% of area is of class S2 and 50% of area is of class N2

2.6.3. Sustainability of Production

The crop yield potential on the basis of agro-climatic and soil suitability assessment can be obtained on a sustainable basis only if any necessary fallow period requirements and soil conservation are taken into account.

Many soils cannot be continuously cultivated with annual food crops without undergoing some degradation. Such degradation is marked by a decrease in crop yields and a deterioration in soil structure, nutrient status and other physical, chemical and biological attributes. Accordingly, account must be taken of the fallow period requirement in estimating land productivity. On the basis of regional survey data, fallow period requirements for each of the farming technology levels have been estimated by major climate, length of growing period zone and major soils (Young and Wright, 1980). The application of these fallow period requirements (Table 7) according to the climatic and soil attributes of the agro-ecological cell enables modification of the attainable crop

yield.

Table 7. Fallow Period Requirements (Cultivation Factors)* for Some Major Soils in the Tropics According to Level of Farming Technology.

Soil	Low Level Input Humid** Tropics	Int. Level Input Humid Tropics	High Level Input Humid Tropics
Arenosols	10	30	50
Ferralsols	15	35	70
Acrisols	15	40	65
Luvisols	25	50	70
Cambisols	35	65	85
Nitosols	40	55	90
Vertisols	40	70	90
Gleysols	60	80	90

* The cultivation factor is the number of years in wich it is possible to cultivate the land as a percentage of the total cultivation and non-cultivation cycle.

** Humid: more than 269 days of growing period

In addition to the effect of crop fallow period requirements on sustainability of production, the climatic and soil conditions also greatly influence the rate of soil loss by erosion. Such soil loss results in decreased productivity and these reductions (in productivity) must be taken into account in reliable assessments of sustainable production potentials at various levels of farming technology. In the present study, the effects of water and wind erosion on soil loss are explicitly considered. This has been achieved by developing and applying a methodology for estimating rates of soil loss under the specific climatic, soil, crop and level of farming technology (FAO/UNEP/UNESCO, 1979).

The methodology used for estimating rates of soil loss is a parametric approach using climatic (rainfall and wind erosivity indices), soil, topograhic, texture and vegetation/land use factors. Prior to the present study, regional assessments of soil loss were not possible because of the lack of a suitable

climatic, soil, slope, texture and land use quantification on which to base the assessment.

The calculated rates of soil loss were translated into decreases in potential productivity according to the functional relationships estimated on the basis of theoretical considerations and empirical data from some 160 soil loss / productivity loss field experiments (Higgins and Kassam, 1981, and Shah et al., 1984).

Note that in the present study, soil loss and the resultant productivity losses are directly related to the level of farming technology:

Pessimistic: No conservation measures (full rate of soil loss)

Likely: Some conservation measures (50% rate of soil loss)

Possible: Complete conservation measures (acceptable rate of soil loss).

2.6.4. Current Input Requirements

The inputs (seed, power, fertilizers -- N, P, K -- and pesticides) required for the production of each crop* in a particular agro-ecological cell (Fig.2, Step 14) have been estimated (Fischer and Shah, 1984) according to crop production functions derived from the Global Technology Matrix (FAO, 1981).

2.6.5. Land Productivity Potential

The application of the crop production models to the characteristics of the agro-ecological cells results in an estimate of potential production of each crop that can be grown in the cell. Not all this production, however, is available for human consumption.

Certain quantities are required for seed and planting material for future cultivation. Complete crop specific allowance for seed and planting material requirements is included in the assessment (Fig.2, Step 14). Additionally,

*Inputs required for grassland (livestock) production are not considered.

harvest and post-harvest losses need to be taken into account. Complete crop specific estimates of these losses in each country are not available. In the present study, an overall 10 percent wastage has been assumed (Fig.2, Step 15).

Deductions for the seed requirements (Fig.2, Step 14) and harvest/post-harvest losses (Fig.2, Step 15) results in the quantification of the crop-wise agronomic potential production (Fig.2, Step 16) available for human consumption.

2.7. Crop Choice

The application of the above described methodology (Fig.2, Steps 1-16) results in the assessment of agronomic potential and input requirements for all suitable crops in each land unit of the land resource inventory. In the pessimistic and likely level scenarios the present cropmix in each length of growing period (LGP) zone was also introduced as a constraint in the zone crop choice (Fig.2, Step 17).

The choice of which crop to grow in each land unit depends on the criterion of choice.

In this study, two criteria of choice as to what crop to grow in each land unit have been used as follows:

Objective	Criteria of Crop Choice for Each
Assessment of Population Supporting Potential Run A: Pessimistic Run B: Likely Run C: Possible	Maximize Calorie Production with Protein Availability Constraint (Fig.2, Steps 19a-22a)
Assessment of Net Revenue Generating Potential Run D: Pessimistic Run E: Likely Run F: Possible	Maximize Net Revenue (Fig.2, Steps 19b-21b)

2.8. Livestock Supporting Potential

In each length of growing period zone the respective rainfed livestock supporting potential has been estimated for the three alternative levels of farming technology. This estimate is based on roughage production, and partial use of crop residues and crop byproducts available from the optimal crop-mix as determined by the two crop choice criteria discussed in Section 2.7 above. Furthermore, this potential livestock population is compared to the estimated livestock numbers in 1975 and 2000 (latter estimates taken from FAO AT2000 study). As in the case of human population, it has been assumed that the projected livestock populations in the year 2000 are distributed according to the 1975 distribution. A detailed description of the procedure for estimating livestock potential is given in Annex 2.

It should be recognized that the integration of crop and livestock production is important in the context of African agriculture. The results of our study demonstrate the importance and potential contribution of roughage, crop residues and crop byproducts to livestock feed.

2.9. Population Supporting Potentials

The rainfed crop and livestock (from grassland) production and irrigated production in calorie and protein equivalent in each length of growing period zone together with country level recommended calorie and protein requirements (Fig.2, Step 23a) for human consumption per capita (FAO, 1973) were applied to determine the population (Fig.2, Step 24a) that could be fed from this potential production (Fig.2, Step 22a). The results corresponding to the three levels of farming technology, respectively, Runs A, B and C, were assessed for two time periods, namely, present (year 1975) and future (year 2000). For the year 1975, the United Nations' country population estimates together with sub-national administrative area data from national population census were used to derive human population estimates by length of growing period zones. In assessing the present situation, the year 1975 population in a particular length of growing period zone is compared to the population that may be supported by the potential food production from that zone. For the year 2000, the assumed (i.e. U.N. Country Population Projections for the year 2000 - medium variant -, distributed according to the 1975 population distribution) year 2000 population in a zone can be compared to population that may be supported by the potential food production in that zone. Note that in reality there will certainly be population migration among the zones. The "deficiency" of not being able to project zonal migrations is in fact an advantage in the sense that from a policy maker's point of view the need is to know "where will the food surplus and food deficit areas be if food is not moved and/or people don't move?" This information could provide the basis for food and population distribution policies in relation to the productive capacity of the productive land resources in different parts of a country.

2.10. Income Generating Potential

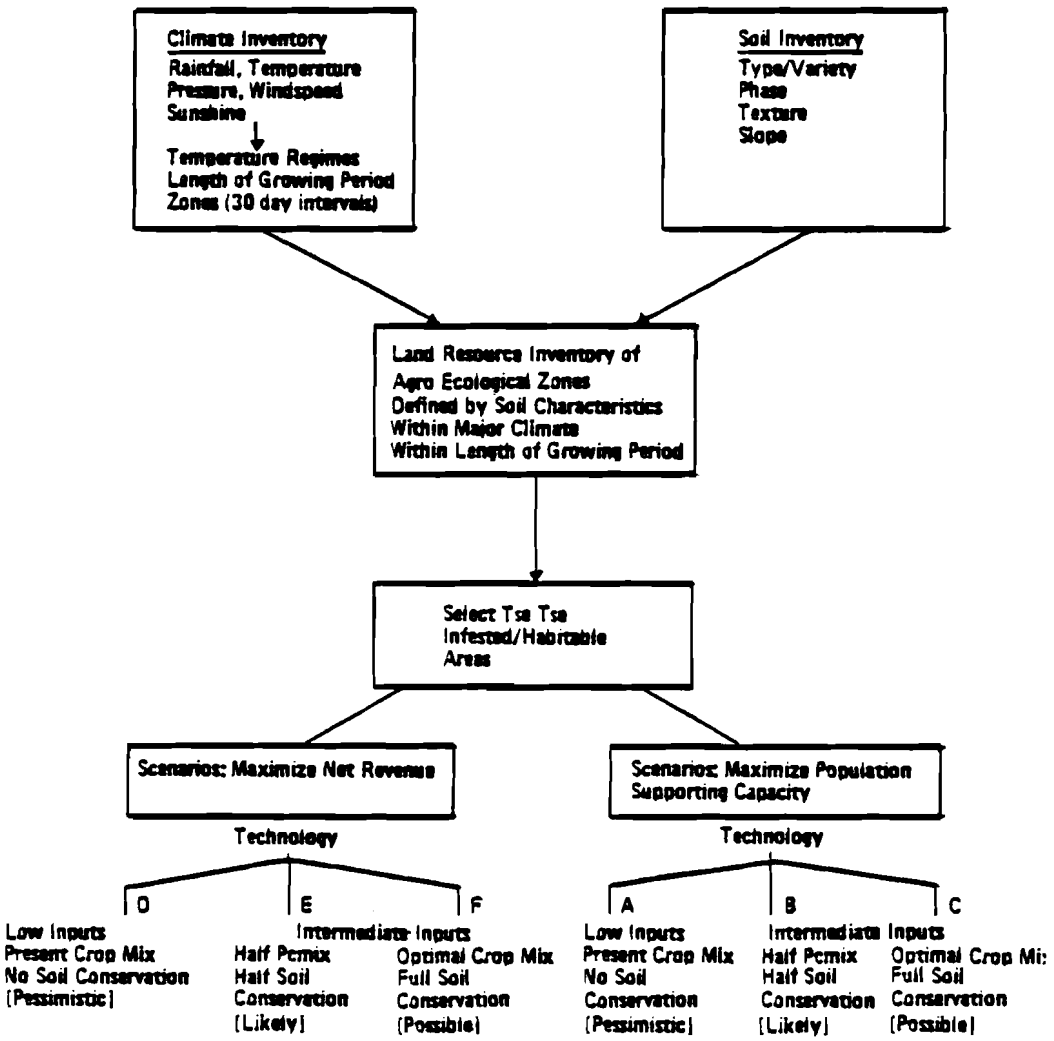
In the assessment of net revenue generating potential, the crop yielding the highest net revenue, i.e. value of crop production less value of inputs at 1975 constant prices (same for all countries), was chosen for each land unit (Fig.2, Steps 19b and 20b). These results were aggregated to obtain the total net revenue (equivalent to income) generated in each length of growing period zone (Fig.2, Step 21b) and at the country level. As in the case of the population supporting potentials, the results are assessed for the year 1975 and the year 2000 for each of the three levels of farming technology (Runs D, E and F).

2.11. Alternative Assessments

Altogether 12* alternative assessments, Fig.4, corresponding to each of the three levels of farming technology, two time frames (year 1975 and year 2000) and two criteria of crop choice (population supporting potential and income generating potential) have been obtained. These results are presented and discussed in the next section.

*Runs A to F for year 1975 and for year 2000.

Fig.4 ALTERNATIVE SCENARIOS FOR ASSESSMENT OF DEVELOPMENT POTENTIAL OF TSE TSE AREAS IN AFRICA



3. FINDINGS

The utilization of the lengths of growing period to obtain an estimate of tsetse infested areas provides a macro approximation of the extent of tsetse infestation and of the land resource potential. Of the 37 countries known to be infested by the tsetse, three countries (Botswana, Niger and Somalia) do not have the LGP zones which are assumed to be tsetse habitable in the study. In these countries tsetse survive in small areas of riverine vegetation and swamp representing 5.0, 0.1 and 3 percent of the national land areas respectively. It is possible that refinement of the study to include riverine swamp soils could include these areas. Conversely in those countries which have maintained campaigns for tsetse control (e.g., Cameroon, Nigeria, Zimbabwe) some of the areas within the 150 day LGP zones have been cleared of tsetse infestation.

3.1. Land Resources

The total land area of the tsetse habitable LGP zones and climates is given in Tables 8 and 9 respectively. These results show that the extent of the land areas where tsetse could thrive in the 34 countries amounted to 1085.6 million hectares, or 58.3 percent of the total land of these countries. At the country level, the percentage of total land area that is climatically suitable for tsetse infestation varies, Table 10. These results show that for twelve countries the total land base, for an additional twelve countries more than sixty percent of the land base and for the remaining ten countries up to forty percent of land base is suitable for tsetse infestation. Considering the inaccuracy of knowledge about the tsetse infestations in those countries which are not completely infested and the strong possibility of local variations in climate, these results provide a first approximation of the extents of the tsetse infestible areas.

Compared to the area subjectively estimated from local knowledge, reports

Table 8. Areas of length of growing period zones by country ('000 ha)

	27 365+	01 365-	02 330/364	03 300/329	04 240/299	05 240/209	06 210/229	07 180/209	08 150/109	19 150/149	Total
Angola	-	-	-	180	9831	26259	26398	23855	9495	-	96018
Burundi	-	-	-	-	225	1485	253	-	-	-	1963
Cameroun	-	1654	13865	14165	3646	2806	2925	3428	2943	-	45472
Centr.Afr.Emp.	-	235	5358	5367	19481	9430	9469	9898	3005	-	62241
Chad	-	-	-	-	-	50	396	7354	13852	-	21652
Congo	-	13821	7807	4000	7457	905	210	-	-	-	34200
Benin	-	-	-	-	330	1300	1321	5179	2665	-	10795
Eq.Guinea	-	-	5496	1309	-	-	-	-	-	-	2805
Ethiopia	-	-	697	638	4297	3903	5931	11464	3825	-	34755
Gabon	-	-	8256	8473	9471	-	-	-	-	-	26200
Gambia	-	-	-	-	-	-	-	-	1130	-	1130
Ghana	-	801	3434	4089	3208	2721	2607	4723	991	-	22574
Guinea	-	-	250	1385	2403	6470	6964	5534	580	-	24586
Ivory Coast	-	2883	6377	6301	4906	5072	5364	-	-	-	31528
Kenya	-	-	21	201	374	606	897	1403	1486	-	4982
Liberia	-	6433	2379	2300	-	-	-	-	-	-	11132
Malawi	-	-	27	57	864	773	802	4288	1908	-	8319
Mali	-	-	-	-	-	344	352	4516	11128	-	16340
Mozambique	-	-	-	-	3031	7906	8509	16432	17208	-	53116
Namibia	-	-	-	-	-	-	-	-	100	-	100
Nigeria	-	499	3429	3602	9033	9280	9725	21267	12650	-	69683
Guin.Bissau	-	-	-	-	-	-	-	3466	146	-	3612
Zimbabwe	-	-	-	-	-	378	378	6629	56631	-	15048
Rwanda	-	-	137	223	744	414	458	36	-	-	2032
Senegal	-	-	-	-	-	-	-	1638	7882	-	9490
Sierra Leone	-	-	1385	1335	3653	448	383	-	-	-	7174
Sudan	-	-	-	-	2453	8614	8636	18277	33311	-	71291
Swaziland	-	-	-	-	48	28	30	593	-	282	981
Tanzania	-	66	69	96	1836	4477	12938	27053	11583	-	58120
Togo	-	-	-	117	1375	1360	996	1328	210	-	5586
Uganda	-	232	214	215	4793	3808	3860	2366	1582	-	17268
Upper Volta	-	-	-	-	-	-	1129	4979	9118	-	15226
Zaire	19791	95169	19222	19144	34144	33656	7923	1436	-	-	230485
Zambia	-	-	-	-	-	22	12286	37461	19656	-	69225
Total	19791	121813	74411	73397	128003	135693	131365	227295	173587	282	1085637

and survey results, Table 11, to be infested with tsetse in 1982-83, this area is larger by 180.6 million hectares (20 percent). In Cameroon, Nigeria, Tanzania, Uganda and Zimbabwe tsetse control operations have been undertaken over varying periods of time and these could account for the difference between the two estimates. Agreement between the estimated area of infestation derived from other sources and from the LGP zones was within 10 percent error in 17 of the 34 countries studied. In 21 countries the likely infested areas were greater than estimated and markedly so in Angola, Burundi, Cameroon, Ethiopia, Malawi, Nigeria, Rwanda, Senegal, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zim-

Table 9. Areas of major climates by country ('000 ha)

	Warm tropics (01)	Moderately cool tropics (02)	Warm sub-tropics (07)
Angola	89344	6474	-
Burundi	657	1306	-
Cameroun	44737	735	-
Centr.Afr.Emp.	62241	-	-
Chad	21652	-	-
Congo	34100	-	-
Benin	10795	-	-
Eq.Guinea	2805	-	-
Ethiopia	12769	21986	-
Gabon	26200	-	-
Gambia	1130	-	-
Ghana	22574	-	-
Guinea	24586	-	-
Ivory Coast	31528	-	-
Kenya	2020	2968	-
Liberia	11132	-	-
Malawi	8433	286	-
Mali	16340	-	-
Mozambique	33116	-	-
Namibia	100	-	-
Nigeria	69474	211	-
Guin.Bissau	3612	-	-
Zimbabwe	15048	-	-
Rwanda	786	1246	-
Senegal	9490	-	-
Sierra Leone	7174	-	-
Sudan	70926	365	-
Swaziland	-	-	981
Tanzania	54451	3669	-
Togo	5386	-	-
Uganda	16594	674	-
Upper Volta	15226	-	-
Zaire	227000	3485	-
Zambia	68368	957	-
Total	1040244	44382	981

Table 10. Grouping of countries by percentage of land area that is habitable by tsetse

Percentage affected	
100	Central African Empire, Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Sierra Leone, Togo
95-99.9	Cameroon, Benin, Malawi, Zaire
70-89.9	Angola, Burundi, Nigeria, Rwanda, Uganda, Zambia
60-69.9	Mozambique, Tanzania
40-59.9	Zimbabwe, Senegal, Swaziland, Upper Volta
20-39.9	Ethiopia, Sudan
Less 19.9	Chad, Kenya, Mali, Namibia, Niger, Somalia

Table 11. Comparison of presumed tsetse infestable area with areas thought to be infested - 34 countries (area '000 ha)

	Total Area	Total inhabitable	Percent	Tsetse estimated	Percent
Angola	123917	96012	77	50000	40
Burundi	2584	1963	76	700	27
Cameroun	47229	45471	96	39800	84
Centr.Afr.Emp.	62298	62241	100	60000	96
Chad	127506	21651	17	29800	23
Congo	34200	34200	100	34200	100
Benin	11261	10745	96	11200	99
Eq.Guinea	2805	2805	100	2805	100
Ethiopia	120759	34755	29	20400	17
Gabon	26200	26200	100	26200	100
Gambia	1130	1130	100	1000	88
Ghana	22570	22570	100	22570	100
Guinea	24586	24586	100	24586	100
Ivory Coast	31528	31528	100	31528	100
Kenya	56991	4988	9	10200	18
Liberia	11132	11132	100	11132	100
Malawi	8830	8719	99	2000	23
Mali	123952	16340	13	20000	16
Mozambique	78281	53116	68	50000	64
Namibia	82317	100	<1	1000	<1
Nigeria	91201	69684	76	60000	65
Guin.Bissau	3612	3612	100	3612	100
Zimbabwe	38638	15047	39	4000	10
Rwanda	2549	2032	80	650	25
Senegal	19593	9490	48	5960	30
Sierra Leone	7174	7174	100	7100	99
Sudan	250481	71291	28	24800	10
Swaziland	1734	981	57	25	1
Tanzania	88919	58120	65	54000	61
Togo	5586	5586	100	5586	100
Uganda	19972	17268	86	16180	81
Upper Volta	27102	15226	56	18000	66
Zaire	232171	230485	99	230000	99
Zambia	74258	69325	93	25000	33
Total	1863072	1085537	58	904034	49

Table 12. Summary of land (million Ha) classes: results of "likely" assessment (Run B) for year 2000

Land by productivity class	Mainland Africa	34 tsetse infested countries	Tsetse infested areas	Tsetse infested areas as percent of mainland Africa
Very high	73.2	70.6	69.3	95
High	236.8	223.6	180.9	76
Medium	236.8	219.1	160.5	68
Low	466.4	309.2	152.3	33
Total	1013.3	822.5	563.0	56

babwe.

It should be emphasized that there is a strong possibility that extension of tsetse infestation could occur into climatically suitable areas in all these countries but particularly in Ethiopia, Uganda, Zambia and Zimbabwe.

The agricultural productivity of the tsetse infestable areas is relatively high; Table 12 shows an example of the crop land by productivity class for the "likely" scenario (Run B) for the year 2000. Examination of these results shows that 56 percent of the total productive rainfed land of mainland Africa occurs in the LGP zones selected for their similarity to the tsetse environment. Note that of the most productive rainfed land areas in mainland Africa, namely, 95 percent and 76 percent of the land with very high and high potential respectively, lies in the tsetse area zones.

3.2. Human Population

In terms of the population actually living (in 1975) on areas environmentally suitable for tsetse infestation, the results, Table 13, show that for twelve countries the total population, for nine countries, more than sixty percent of population and for the remaining nine countries up to forty percent of the population is affected.

The results of the population supporting assessments in Table 14 indicate that almost 54% of the human population in mainland Africa was residing in the presumed tsetse infested zones in 1975. As a percentage of the population of the tsetse affected countries, this is equivalent to almost 71% of the 1975 population. These land areas have good agricultural potential and generally account for more than 80 percent of the potential population supporting capacity of mainland Africa. Data on present, projected and potential populations by individual country in Africa are given in Annex 1, Tables A1 and A2.

Table 13. Grouping of countries by percentage of population living in tsetse habitable areas

Percentage affected	
100	Central African Empire, Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Ivory Coast, Liberia, Guinea Bissau, Sierra Leone, Togo
95-99.9	Cameroon, Benin, Malawi, Zaire
90-94.9	Zambia
70-89.9	Angola, Burundi, Nigeria, Rwanda, Uganda
60-69.9	Mozambique, Swaziland, Tanzania
40-59.9	Chad, Zimbabwe, Upper Volta
20-39.9	Ethiopia, Kenya, Mali, Senegal, Sudan
Less 19.9	Namibia, Niger, Somalia

Table 14. Comparison of area and population, mainland Africa, 34 tsetse infested countries and assumed tsetse infested areas

Location	Total[1] Land Area (mill.Ha)	Population Year 1975[2] (mill.)	Year 1975 Potential Population Pessi-mistic	Like-ly	Poss-ible	Population Year 2000[3] (mill.)	Year 2000 Potential Population Pessi-mistic	Like-ly	Poss-ible
Mainland Africa	2819	371	1192	4884	5304	761	1323	4973	5377
Tsetse Countries	1863	281	1094	4536	5114	586	1141	4724	5106
Tsetse Areas in the 34 Countries	1086	199	1023	4379	4634	416	1036	4353	4598
Tsetse Areas as Percentage of Tsetse Countries	58	71	94	97	91	71	91	92	90
Tsetse Areas as Percentage of Mainland Africa	39	54	86	90	87	55	78	86	86

1 Land areas derived from FAO/UNESCO Soil Map, and excludes areas mapped as water.

2 UN data for 1975, millions of persons (UN 1979).

3 Projected UN data for 2000, millions of persons. Medium variant (UN 1979).

3.3. Net Value of Output

The results of the maximum net revenue runs for the year 2000 are given in Table 15. For comparison, the net revenue generated from the population supporting assessments (Runs A to C) for the year 2000 is also given. As expected, maximizing net revenue yields a higher net value of production than maximizing population supporting potential. These results show the significant contribution that these areas could make to agricultural production in Africa. Data by individual country and length of growing period zones in Africa are given in Annex 1, Tables A3 and A4.

Table 15. Net value of output: Results of maximum revenue runs

	Pessimistic Run* A	Likely Run B	Possible Run C	Pessimistic Run D	Likely Run E	Possible Run F
	Billion Dollars 1975					
Tsetse Countries	51.9	236.4	288.3	73.6	258.6	349.6
Tsetse Areas in 34 Countries	50.4	225.0	269.6	70.9	244.3	321.9
Tsetse Areas as Percentage of Tsetse Countries	97.1	95.2	93.5	96.3	94.5	92.1

* Runs A, B, C respectively assume pessimistic, likely and possible levels of farming technology and crop-choice is based on maximizing calorie production whereas Runs D, E, F assume pessimistic, likely and possible levels of farming technology and crop-choice is based on maximizing net revenue.

3.4. Inputs

3.4.1. Land Use

Table 16 shows the data for the year 2000 on the extent of irrigated areas, rainfed crop land, and rangeland for the pessimistic, likely and possible levels of

farming technology under the assumption of crop choice on the basis of calorie as well as net revenue maximization. Note that in the assessments all cultivable land in the tsetse infestible areas has been used. For many countries it may not be necessary to bring all this land under cultivation due to demand constraints and furthermore for countries where there is a need to expand acreage, practical constraints will limit cultivated land expansion to a maximum of 3-4% per annum.

Table 16. Extent of irrigated areas, crop land and range land: Year 2000 results of alternative assessments for tsetse areas

	Maximize Calorie Production			Maximize Net Revenue		
	Pessimistic Run A	Likely Run B	Possible Run C	Pessimistic Run D	Likely Run E	Possible Run F
Year 2000 (Million Hectares)						
Irrigated Area	1.3	1.3	1.3	1.3	1.3	1.3
Rainfed Crop Land	385.9	554.4	558.9	466.0	551.2	545.5
Rainfed Fallow Land	466.5	263.0	253.2	351.7	260.2	264.5
Rainfed Range Land	308.6	243.0	243.2	283.2	248.1	252.5
(Grassland)	18.2	8.6	8.6	23.4	8.7	8.6
(Fallow Land*)	233.2	131.5	126.6	175.8	130.1	132.3
(NS Crop Land**)	57.2	103.0	108.1	83.9	109.4	111.7

* Half of the crop fallow land has been assumed to be used for production of roughage.

** This land area, representing part of the agro-ecological cell allocated to a particular crop, is used for production of roughage. Note that for a particular agro-ecological cell, only part of the land area may be suitable for crop production – the remainder is "NS (not suitable) crop land".

Land use data in terms of irrigated areas, rainfed crop land areas and rangeland areas by individual country in Africa are given in Annex 1, Tables A5 to A8.

3.4.2. Current Inputs

Summaries of the net value of output and input requirements for each of the twelve alternative assessments for the tsetse infested areas in the 34 countries are given in Table 17.

Table 17. Regional summary of value of output and input reqirements for tsetse infestible areas in Africa

	Maximize Calorie Production			Maximize Net Revenue		
	Pessimistic Run A	Likely Run B	Possible Run C	Pessimistic Run D	Likely Run E	Possible Run F
Year 1975						
Net Value of Output (Bill $75)	50	227	273	72	247	325
Input* Costs (Bill $75)	20	52	79	18	52	73
Ratio of Cost to Revenue	1:3.5	1:5.4	1:4.6	1:5.0	1:5.8	1:5.5
Fertilizer (Mill MT)	1	27	44	1	26	37
Power (Bill MDE**)	39	73	103	36	73	90
Year 2000						
Net Value of Output (Bill $75)	50	225	270	71	244	322
Input* Costs (Bill $75)	20	52	78	18	51	68
Ratio of Cost to Revenue	1:3.5	1:5.3	1:4.5	1:4.9	1:5.8	1:5.7
Fertilizer (Mill MT)	1	26	43	1	26	37
Power (Bill MDE**)	39	72	102	35	72	89

* (Power + Fertilizers + Pesticides + Seed) Costs

** Man Day Equivalent

The estimated power requirement for crop production activities in year 2000 can be compared to the year 2000 projected human power available and the projected and potential animal power, i.e. the use of oxen for crop production activities. This is particularly relevant in the context of the adoption of intermediate level of farming technology in the likely and possible assessments (Runs B-C and Runs E-F). Table 18 shows this data for the year 2000.

It should be noted that the estimates shown in Table 18 do not correspond to any real situation in the future; these estimates only demonstrate the power requirement if all land in the tsetse areas in the 34 affected countries were to be cultivated and potential oxen power that would be available if the livestock supporting potential were to be realized.

Data by individual country in Africa are given in Annex 1, Tables A9 to A16 (current inputs and power).

Table 18. Present and projected human and oxen power, power reqirements and potential oxen power in year 2000

Year 1975 Human Power	9.6	Billion Man-Days
Year 1975 Oxen Power	1.0	Billion Man-Days
Year 2000 Projected Human Power	20.0	Billion Man-Days
Year 2000 Projected Oxen Power	1.5	Billion Man-Days

	Maximize Calorie Production			Maximize Net Revenue		
	Pessimistic Run A	Likely Run B	Possible Run C	Pessimistic Run D	Likely Run E	Possible Run F
Year 2000 Billion Man-Days						
Power required	38.7	71.9	102.1	35.1	72.0	72.0
Power deficit	17.2	50.4	80.6	13.7	50.5	67.8
Potential* oxen power	5.8	11.8	14.4	5.1	11.8	12.7

*Estimated from livestock supporting potential.

3.5. Livestock Distribution and Potential

The estimated number of cattle, sheep and goats in the presumed tsetse areas in 1975 was 55057, 31388 and 49023 thousand respectively: a total of 27 million livestock units. In the year 2000, the total number of livestock units in the tsetse infestible areas is projected to be 43 million. The results in Table 19 show that considerable livestock potential exists in the tsetse areas esspecially if part* of crop residues and crop byproducts from the potential crop production are utilized as feed. Data on present and projected livestock distribution and livestock supporting potential by individual country in Africa are given in Annex 1, Tables A17 to A21.

3.6. Crop Production

The estimated crop production for each of the twelve alternative assessments for the tsetse infested areas by individual country in Africa are given in

*See Annex 2

Table 19. Livestock populations and potentials in the presumed tsetse inhabitable areas

	Cattle (Million)	Sheep (Million)	Goats (Million)
Year 1975:			
34 tsetse infested countries	114.4	73.5	86.6
Estimated at risk by FAO	43.4	27.4	28.3
Estimated from LGP zones	55.1	31.4	49.0
Percent in presumed tsetse areas	48.1	42.7	56.6
Year 1975 livestock units in tsetse areas			27 million
Year 2000 projected livestock units in tsetse areas			43 million

Year 2000 Livestock Potential	Potential LSU (Million)	Feed Source (%)		
		Range	Crop Residues	Crop Byproducts
Farming Technology				
Potential Population Runs				
Pessimistic (Run A)	169.4	79.0	16.8	4.2
Likely (Run B)	342.0	60.7	31.7	7.6
Possible (Run C)	418.9	50.8	39.4	9.8
Potential Revenue Runs				
Pessmistic (Run D)	147.2	78.5	17.3	4.2
Likely (Run E)	338.8	62.8	30.4	6.8
Possible (Run F)	369.5	58.8	34.1	7.1

Annex 1, Tables A22 to A33. A summary of the total crop production-mix for the tsetse areas in Africa for the six alternative assessments in the year 1975 is shown in Table 20. Comparing the results of the population supporting assessments with the maximizing value of output assessments, the results show in general that there is a shift away from the production of cereals (especially sorghum and maize) to the production of phaselous beans, white and sweet potatoe, groundnut, and banana/plantain. This aspect is explainable by relatively high prices for the latter crops in the year 1975. The results for the year 2000 are also similar.

Table 20. Crop production ('000 mt): A comparison of the six alternative assessments for the year 1975

Crop	Maximize Calorie Production			Maximize Net Revenue		
	Pessimistic Run A	Likely Run B	Possible Run C	Pessimistic Run D	Likely Run E	Possible Run F
Wheat	711	3017	2033	802	3080	124
Barley	120	7	576	198	3	-
Rice	90464	322046	667766	93146	333465	563974
Pearl Millet	3735	23071	7771	4960	26744	-
Sorghum	10593	46113	2173	4539	39314	8
Maize	43151	169272	193449	27934	110363	3810
Soyabean	9	40	12769	13	39	6621
Phaselous Bean	441	6977	-	2826	16384	26586
White Potato	571	4421	27580	1175	8589	56756
Sweet Potato	9279	55029	336471	9469	50782	473436
Cassava	17172	324635	124358	10521	319486	120864
Groundnut	12884	49569	60086	21644	86004	139633
Banana/Plantain	70740	356690	438398	76507	456632	819552
Sugarcane	38358	113510	221924	71639	106231	233510
Oil Palm	32257	134823	57075	71176	125662	23728

3.7. Priority Areas for Tsetse Control

The studies from which this investigation of the presumed tsetse infested areas was abstracted were directed to assessing human population supporting capacities. This was estimated by calculation of calorie and protein production in each length of growing period zone. This analysis enables identification of "critical" LGP zones in which calorie and protein production would not be able to support the estimated human population. It follows from this that such "critical" zones in the tsetse infested areas could also indicate priority areas for tsetse control.

Table 21 shows a summary of "critical" length of growing period zones in individual countries for the year 1975 and the year 2000 population supporting potential runs, namely, Runs A, B and C. It may be considered that population density identified in such areas would affect tsetse habitats through destruction of vegetation and disturbance of host animals so that some limited additional measures could ensure control of the tsetse if not eradication.

Table 21. Development priority: "Critical" length of growing period zones

LGP Zone	Country
YEAR 1975	
Warm Tropics	
270-299	Burundi, Nigeria, Rwanda, Uganda
240-269	Burundi, Kenya, Nigeria, Rwanda, Uganda
210-239	Burundi, Kenya
180-209	Ghana, Kenya, Malawi, Rwanda, Togo
150-179	Ghana*, Kenya, Malawi, Nigeria, Togo, Uganda
Moderately Cool Tropics	
365-	*Cameroon**, *Uganda**, Zaire
330-364	Cameroon, Ethiopia, Kenya*, *Rwanda**, Uganda*, Zaire
300-329	Angola, Cameroon, Ethiopia, Kenya, *Rwanda**
270-299	Burundi*, Kenya, Malawi, Nigeria, *Rwanda**, Tanzania, Uganda
240-269	Burundi, Kenya, Rwanda, Tanzania, Uganda*
210-239	Burundi, Kenya, *Uganda**
180-209	Tanzania, *Uganda**
150-179	Kenya, Uganda*
YEAR 2000	
Warm Tropics	
330-364	Nigeria
300-329	Nigeria, Sierra Leone, Uganda
270-299	Burundi, Benin, Nigeria, *Rwanda*, Uganda
240-269	Burundi, Benin, *Kenya**, Nigeria, Rwanda, Sierra Leone, Uganda
210-239	Burundi, Benin, *Kenya**, Nigeria, Rwanda, Sierra Leone, Togo, Uganda
180-209	Benin, Ghana, Kenya, Malawi, Nigeria, *Rwanda**, Togo, Uganda
150-179	*Ghana**, Kenya*, Malawi, Nigeria, Togo*, Uganda*, Upper Volta
Moderately Cool Tropics	
365-	*Cameroon**, *Uganda**, Zaire
330-364	Cameroon, Ethiopia, *Kenya**, *Rwanda**, *Uganda**, Zaire
300-329	Angola, Cameroon, Ethiopia, Kenya*, *Rwanda**, Uganda, Zaire
270-299	Angola, *Burundi**, Kenya*, Malawi, *Nigeria**, *Rwanda**, Tanzania*, Uganda, Zaire
240-269	*Burundi**, Ethiopia, Kenya*, Rwanda, Tanzania, *Uganda**
210-239	*Burundi*, Ethiopia, Kenya, Rwanda, Tanzania, *Uganda**
180-209	Ethiopia, Kenya, Malawi, Tanzania, Uganda*
150-179	Ethiopia, Kenya*, Uganda*

Run A ("Pessimistic" Scenario): All countries as shown
Run B ("Likely" Scenario): Countries marked with*
Run C ("Possible" Scenario): Countries in italics

For the year 2000, data on the number and extents of "critical" zones and the projected year 2000 population as well as potential supporting capacities is presented in Table 22.

These results show that 83 length of growing period zones in 17 African countries would be "critical" (i.e. year 2000 projected population in these areas cannot be fed by the potential food production from these areas) in the case of the pessimistic (Run A) assessment. Here the extent of the land area would amount to 147 million hectares with a projected year 2000 population of 213 million people. The "excess" population, i.e. the number of people whose food need cannot be met, amounts to 128 million. If intermediate level of inputs are adopted, i.e. likely assessment (Run B), then only 27 length of growing period zones with a land area of 9.2 million hectares in Africa would be "critical". Here the potential population would be 13.6 million in comparison to the projected population in these areas in the year 2000 of 27.6 million. Note that only 9 countries would be affected in terms of existence of "critical" length of growing period zones. If the possible (Run C) level of technology is adopted, the number of "critical" zones falls to 19 with a land area of 4.9 million hectares. The "excess" population under this assessment would be 9.2 million.

Taking into account the population pressure on land and the inability of land resources to provide the food needs of the population resident in particular critical zones may be considered as priority development zones in the context of a food strategy (maximizing calorie production), Tables 21 and 22.

In the maximum net revenue runs (Runs D, E and F), individual country length of growing period zones yielding the most effective cost to revenue ratios may also be considered as priority areas for the control of tsetse. Table 23 shows an identification of such zones by individual country. It is also relevant to identify the LGP zones which yield the maximum net revenue as zones for

Table 22. Number and extent of "critical" zones, year 2000 projected and potential populations and population densities: Individual country results

	Number of Critical Zones	Land Area '000Ha	Year 2000 Projected Population '000	Year 2000 Potential Population '000	Year 2000 Projected Density Pers/Ha	Year 2000 Potential Density Pers/Ha
	Pessimistic: Run A					
Angola	2	571	231	166	0.40	0.29
Burundi	6	1962	6053	1061	3.09	0.54
Cameroon	3	732	693	234	0.95	0.32
Benin	3	2940	2563	1995	0.87	0.68
Ethiopia	6	17683	10829	6545	0.61	0.37
Ghana	2	5712	11931	4975	2.09	0.87
Kenya	11	4987	10323	3083	2.07	0.62
Malawi	4	6244	12799	4906	2.05	0.79
Nigeria	8	69186	119341	47940	1.72	0.69
Rwanda	9	2031	6552	894	3.23	0.44
Sierra Leone	2	829	1019	713	1.23	0.86
Swaziland	1	47	33	30	0.70	0.64
Tanzania	4	2883	1061	395	0.37	0.14
Togo	3	2531	3269	1362	1.29	0.54
Uganda	14	16905	21307	7374	1.26	0.44
Upper Volta	1	9117	4269	3321	0.47	0.36
Zaire	4	2845	652	271	0.25	0.10
TOTAL	83	147005	212925	85285	1.45	0.58
	Likely: Run B					
Burundi	3	1303	4398	2328	3.37	1.79
Cameroon	1	115	72	29	0.63	0.25
Ghana	1	990	4416	1725	4.46	1.74
Kenya	8	3120	7476	5020	2.40	1.61
Nigeria	1	210	743	426	3.54	2.03
Rwanda	4	1044	4485	703	4.30	0.67
Tanzania	1	354	122	83	0.34	0.23
Togo	1	209	611	46	2.92	0.22
Uganda	7	1888	5263	3215	2.79	1.70
TOTAL	27	9233	27586	13575	2.99	1.47
	Possible: Run C					
Burundi	3	1303	4398	3317	3.38	2.55
Cameroon	1	115	72	59	0.63	0.51
Ghana	1	990	4416	2168	4.46	2.19
Kenya	3	674	3391	2103	5.03	3.12
Rwanda	5	1155	4841	1536	4.19	1.33
Uganda	6	616	2184	993	3.55	1.61
TOTAL	19	4853	19302	10176	3.98	2.10

priority development. Table 24 shows this data by individual countries. For example, in Kenya the length of growing period zone 180-209 days in moderately cool tropical climate yields the most effective cost to gross revenue ratio for all three assessments, namely pessimistic, likely and possible. On the other hand, the LGP zone yielding the maximum net revenue is 240-269 days in warm tropical climate for the pessimistic (Run D) and the likely (Run E) level of technology, whereas 180-209 days LGP zone in moderately cool tropical climate for the possible (Run E) assessment yields the maximum value of net revenue. Full details of the production mix and inputs for this one-country example (Kenya) are given in Table 25. This type of information provides the basis of identifying priority development zones in the context of an income strategy (generating maximum net value of output).

3.8. Effects of Population Density on Tsetse Infestation

Nash (1948) first appreciated the possible effects of human population density on tsetse populations when he suggested that: "Generally speaking, *G. morsitans* occurs with human population densities from 0-40 per square mile; occasional flies of this species are found in areas of 40-100, but never where the population exceeds 100 per square mile". Flies of the *G. palpalis* group are however much less affected by the process of human settlement.

Putt et al. (1980) concluded that in a few cases immigration *per se* seems to have been responsible for tsetse recession but that strategic eradication or control measures would have accelerated the uptake of land. They concluded that "the most important underlying factor in the success of the eradication campaign (in Nigeria) has been the rapid growth in human population which has resulted in an increasing demand for land for agricultural purposes". Buxton (1955) discussed experience in Zambia (the Northern Rhodesia) in which move-

Table 23. Identification of individual-country priority (zones yielding best returns, i.e. minimum cost to gross revenue ratio) development zone: Year 2000 results on the basis of maximizing net revenue

	Pessimistic - Run D				Likely - Run E				Possible - Run F			
	Major[1] Climate	LGP[2]	Cost/ Gross Revenue Ratio	Net Revenue Mill.$1975	Major Climate	LGP	Cost/ Gross Revenue Ratio	Net Revenue Mill.$1975	Major Climate	LGP	Cost/ Gross Revenue Ratio	Net Revenue Mill.$1975
Angola	1	4	16.7	534.1	1	5	13.8	4577.2	2	6	10.8	883.2
Burundi	1	5	15.5	3.3	1	4	13.6	11.0	2	6	10.6	30.5
Cameroon	1	2	7.3	2288.7	1	2	7.4	5995.2	1	2	7.6	7228.5
Centr.Afr.Emp.	1	2	11.9	569.1	1	2	11.0	1547.7	1	2	8.1	2302.4
Chad	1	5	13.6	3.4	1	5	10.6	7.5	1	5	15.6	10.1
Congo	1	2	13.6	1105.3	1	2	11.9	3166.9	1	2	9.3	3701.0
Benin	1	5	22.6	56.7	1	5	16.1	246.3	1	6	15.1	616.7
Eq.Guinea	1	2	12.7	159.5	1	2	15.1	431.3	1	2	12.9	635.1
Ethiopia	2	7	18.4	94.8	1	5	19.1	126.7	2	5	10.4	1269.5
Gabon	1	2	10.7	1625.8	1	2	18.4	3325.6	1	2	17.3	4158.8
Gambia	1	8	26.2	67.6	1	8	20.4	238.9	1	8	24.9	296.6
Ghana	1	2	7.2	883.5	1	1	5.4	350.2	1	1	4.9	295.3
Guinea	1	2	16.9	14.0	1	2	10.1	31.0	1	2	3.9	36.1
Ivory Coast	1	1	9.4	612.0	1	1	10.0	1350.3	1	1	7.1	1609.1
Kenya	1	5	12.9	10.2	1	5	13.6	23.7	2	7	10.1	476.4
Liberia	1	2	36.0	174.5	1	1	17.7	2548.4	1	2	12.3	1163.4
Malawi	1	4	9.3	84.5	1	2	6.6	7.2	1	3	4.4	6.0
Mali	1	5	11.0	27.9	1	5	11.9	57.1	1	8	14.3	2027.2
Mozambique	1	4	17.1	423.8	1	5	16.5	1731.1	1	5	14.8	2956.7
Nigeria	1	1	8.5	142.1	1	1	12.5	395.4	1	5	13.6	2203.4
Guinea Bissau	1	7	34.2	152.6	1	7	21.9	613.0	1	7	16.9	773.7
Zimbabwe	1	5	19.0	13.7	1	5	11.8	51.4	1	6	15.5	86.6
Rwanda	1	4	9.0	7.7	1	4	7.9	23.4	2	6	10.6	41.2
Senegal	1	8	28.6	223.1	1	8	21.4	1032.1	1	7	17.9	307.2
Sierra Leone	1	5	28.6	25.2	1	5	18.1	90.2	1	2	14.3	492.7
Sudan	1	4	19.6	184.0	2	5	14.3	16.3	2	7	10.4	16.0
Swaziland	7	4	6.4	7.9	7	4	12.7	9.4	7	6	15.7	9.5
Tanzania	1	1	7.9	16.6	1	2	10.1	31.8	1	1	7.6	31.0
Togo	1	3	16.6	15.6	1	4	13.4	337.2	1	6	16.4	235.7
Uganda	1	1	5.7	35.5	1	1	7.2	93.8	2	8	10.2	113.7
Upper Volta	1	6	24.8	38.7	1	6	24.9	120.2	1	6	16.0	302.6
Zaire	1	27	9.6	3995.9	1	27	8.3	11719.2	1	2	8.5	8332.0
Zambia	1	6	26.1	663.2	2	7	18.2	153.3	2	7	10.1	523.8
AFRICA	7	4	6.4	7.9	1	27	8.3	11719.2	1	27	9.2	8764.6

1. Major Climate 1: Warm Tropics, Major Climate 2: Moderately Cool Tropics and Major Climate 7: Warm Subtropics

2. Length of growing period zones

Zone 27 :	365^{+} days	Zone 5 :	240-269 days
1 :	365^{-} days	6 :	210-239 days
2 :	330-364 days	7 :	180-209 days
3 :	300-329 days	8 :	150-179 days
4 :	270-299 days		

Table 24. Identification of individual-country priority (zones yielding maximum net revenue) development zone: Year 2000 results on the basis of maximizing net revenue

	Pessimistic - Run D				Likely - Run E				Possible - Run F			
	Major[1] Climate	LGP[2]	Cost/ Gross Revenue Ratio	Net Revenue Mill.$1975	Major Climate	LGP	Cost/ Gross Revenue Ratio	Net Revenue Mill.$1975	Major Climate	LGP	Cost/ Gross Revenue Ratio	Net Revenue Mill.$1975
Angola	1	5	22.8	957.4	1	5	13.8	4577.2	1	5	18.3	6049.5
Burundi	1	5	23.8	23.2	2	5	14.7	161.6	2	5	10.8	369.8
Cameroon	1	2	7.3	2288.7	1	2	7.4	5995.2	1	2	7.6	7228.5
Centr.Afr.Emp.	1	4	15.3	853.4	1	4	13.4	3562.9	1	4	28.7	3987.4
Chad	1	8	34.2	466.8	1	8	23.7	2471.9	1	8	21.0	3765.2
Congo	1	1	25.5	1333.3	1	1	16.8	6171.6	1	1	14.9	7053.9
Benin	1	7	36.1	132.6	1	7	26.2	676.3	1	7	15.8	1226.1
Eq.Guinea	1	3	17.3	198.0	1	3	18.1	469.2	1	2	12.9	635.1
Ethiopia	1	7	37.2	103.5	1	7	32.7	478.9	2	7	10.8	1763.5
Gabon	1	2	10.7	1625.8	1	2	18.4	3325.8	1	2	17.3	4158.8
Gambia	1	8	26.2	57.6	1	8	20.4	238.9	1	8	24.9	296.6
Ghana	1	2	7.2	683.5	1	2	7.3	1727.7	1	2	15.7	1912.3
Guinea	1	5	23.2	244.5	1	5	17.1	805.7	1	5	17.4	1204.7
Ivory Coast	1	2	15.0	1120.9	1	2	12.4	2828.3	1	2	15.2	2867.4
Kenya	2	7	15.7	70.2	2	7	17.7	188.0	2	7	10.1	478.4
Liberia	1	1	37.8	432.9	1	1	17.7	2548.4	1	1	12.7	3247.2
Malawi	1	7	29.9	122.4	1	7	21.5	469.5	1	7	16.9	672.6
Mali	1	8	33.5	181.9	1	8	23.6	955.6	1	8	14.3	2027.2
Mozambique	1	5	21.7	516.7	1	8	20.2	2508.5	1	8	16.0	4308.7
Nigeria	1	4	21.4	619.8	1	7	20.7	2895.5	1	7	16.1	4436.2
Guinea Bissau	1	7	34.2	152.6	1	7	21.9	613.0	1	7	16.9	773.7
Zimbabwe	1	7	39.5	230.1	1	7	24.2	1313.6	1	7	15.8	2190.0
Rwanda	1	8	25.0	21.3	1	6	20.5	63.0	1	6	20.1	90.0
Senegal	1	8	26.6	223.1	1	8	21.4	1032.1	1	8	19.7	1337.7
Sierra Leone	1	4	39.3	139.6	1	4	22.6	641.7	1	4	32.2	662.2
Sudan	1	8	37.4	1007.1	1	8	24.7	5393.8	1	8	21.5	8445.9
Swaziland	7	7	31.8	24.4	7	7	27.2	86.3	7	7	17.4	151.8
Tanzania	1	7	34.1	658.3	1	7	24.8	2836.2	1	7	18.2	4438.0
Togo	1	5	21.0	68.7	1	4	13.4	337.2	1	5	24.2	487.4
Uganda	1	4	11.8	288.0	1	4	10.4	891.5	1	4	24.4	894.2
Upper Volta	1	8	39.7	139.7	1	8	27.6	745.3	1	8	17.6	1597.1
Zaire	1	1	14.4	16935.8	1	1	14.9	45932.8	1	1	12.2	52760.1
Zambia	1	7	28.0	1394.0	1	7	22.9	5325.3	1	7	18.5	8395.6
AFRICA	1	1	15.7	19881.4	1	1	15.0	57613.7	1	1	12.5	66244.9

1. Major Climate 1: Warm Tropics, Major Climate 2: Moderately Cool Tropics and Major Climate 7: Warm Subtropics

2. Length of growing period zones

Zone 27 : 365^{+} days
1 : 365^{-} days
2 : 330-364 days
3 : 300-329 days
4 : 270-299 days
5 : 240-269 days
6 : 210-239 days
7 : 180-209 days
8 : 150-179 days

Table 25. Detailed year 2000 results for Kenya: Development of priority zones on the basis of maximizing net revenue: Pessimistic and likely assessments (Runs D and E) for the year 2000

	Maximum Net Revenue		Most Effective Cost/Gross Revenue	
	Pessimistic Run D	Likely Run E	Pessimistic Run D	Likely Run E
Major Climate	Moderately Cool Tropics	Moderately Cool Tropics	Warm Tropics	Warm Tropics
LGP Zone (Days)	180-209	180-209	240-260	240-269
Gross Value of Production				
(Million $1975)	83.2	228.3	11.7	27.4
Cost/Gross Revenue Ratio	15.7	17.7	12.9	13.6
Production ('000mT)				
Sorghum	6	5		
Maize		215		12
Phaselous Beans	19	83		6
White Potato	303	890		
Cassava			1	23
Wheat	26	42		23
Barley	1			
Rice			4	13
Groundnut				
Banana/Plantain			3	1
Sugarcane			7	18
Oil Palm			18	34
Inputs				
Total Cost (Mill.$1975)	13.0	40.3	1.5	3.7
Power (Bill.MDE*)	23.7	41.8	3.0	6.5
Fertilizers ('000mT)	0.4	26.8	-	0.7
Pesticides (Mill.$1975)	0.9	2.4	-	0.1

*MDE is Man Day Equivalent

ment of people into tsetse affected areas was determined by the assessment of the productive capacity of the soils based on traditional farming methods. This assessment resulted in insufficient attention to *G. morsitans* and with the low population density of less than 30 persons per quare mile problems were encountered with sleeping sickness.

Population density in relation to productivity of the land and tsetse control is thus of considerable practical importance. These experiences are summarized in Table 26.

Table 26. Population density and tsetse infestation

Country	Density:persons per ha	Density:persons per km^2	Density:persons per $mile^2$	Source	Remarks
Zambia	0.12	12	30	Buxton (1955)	Density insufficient
Nigeria	0.27	27	70	Buxton (1955)	Density sufficient to "hold the position" after bush clearing
Nigeria	0.37	37	100	Nash (1948)	*G. morsitans* absent from areas exceeding the density

In 1975, the population density exceeded 0.37/ha in 11 countries (Burundi, Gambia, Ghana, Kenya, Malawi, Nigeria, Rwanda, Sierra Leone, Swaziland, Togo and Uganda).. This suggests that tsetse control programes in these countries would be supported by sufficiently dense human populations. By the year 2000, however, the potential population density in all 34 countries studied could exceed the level of 0.37/ha often by a significant margin. This suggests that in the long term the effects of population density on tsetse habitats in Africa are potentially significant.

4. CONCLUSIONS AND IMPLICATIONS

Based on the computerized land resources (soil and climate) inventories for African countries, the agro-ecological zone methodology has been used in this study to:

- identify the extent of land areas in African countries where various species of tsetse fly (Glossina) can thrive
- identify the present (year 1975) and projected (year 2000) human and livestock population in these tsetse infestible areas
- quantify the human and livestock population supporting potential as well as income generating potential from food production in these areas under three alternative levels of farming technology, namely
  - Pessimistic: Low level of inputs, continuation of presently grown mixture of crops and no soil conservation measures
  - Likely: Intermediate level of inputs, mix of presently grown and optimal crops, some simple soil conservation measures
  - Possible: Intermediate level of inputs, optimal crop-mix and full soil conservation measures
- identify areas and countries with priority for tsetse control and agricultural development.

It should be recognized that at present the level of farming technology practiced in most African countries is equivalent to the "pessimistic" level as above. The results of the study show that the ecological and economic productivity can be substantially increased by adopting likely and possible levels of farming technology. The ability of farmers to move nearer to an intermediate level of input will depend on the availability of appropriate extension services, infrastructure, credit, inputs, etc. It is important that these developments do

occur within the next decade or two, especially in light of the deteriorating food situation in many African countries during the last decade.

The results of the study show that altogether 34 African countries have land areas where the climatic conditions are such that tsetse could infest and thrive. The total extent of this land area amounts to some 1085 million hectares, i.e. 58% of the total land area of these 34 affected countries. Compared to the area subjectively estimated from local knowledge and survey results to be infested with tsetse in 1982-83, this above extent of land area is larger by 181 million hectares.

In 1975, 199 million people out of a population of 281 million in the 34 countries were living on land areas infestible by tsetse. The livestock population in these areas amounted to almost half of the 55 million livestock units in these countries in 1975. These numbers of humans and livestock "at risk" appear to be greater* than has previously been estimated by FAO.

The land areas were tsetse can thrive also generally have a large agricultural potential. In fact more than 90% of the total food production potential of the 34 countries occurs in these areas. The population supporting potential in the year 2000 of these tsetse infestible areas under the three levels of farming technology are:

Farming Technology	Potential Population (Million)
Pessimistic (Run A)	1036
Likely (Run B)	4353
Possible (Run C)	4598

*According to FAO estimates, 45 million people and about 32 million livestock units were at risk in the tsetse infested areas in 1975.

The population in the tsetse areas in the year 2000 is projected to be 416 million and hence, depending on the level of farming technology adopted, between 2.5 and 11.0 times the year 2000 projected population could be supported if all land in the tsetse areas would be used to grow food crops only. The production inputs required to achieve this level of food production would be:

Farming Technology	Fertilizers Mill.mT	Pesticides Bill.$1975	Power Bill.Man-Days
Pessimistic (Run A)	0.6	0.3	38.7
Likely (Run B)	26.3	2.8	71.9
Possible (Run C)	43.2	5.5	102.1

The results of the income generating potential from crop production also showed that the economic potential of the tsetse areas would be high:

	Farming Technology		
	Pessimistic (Run D)	Likely (Run E)	Possible (Run F)
Gross value of output (Billion $1975)	88.9	295.6	390.0
Cost of production (Billion $1975)	18.0	51.3	68.1
Net revenue/Ha ($1975)	74.8	250.7	330.3

The livestock supporting potential of the tsetse areas would be very large, especially if the crop and livestock activities were to be integrated. Assuming that part (see Annex 2 for details) of the crop residues and crop processing byproducts are used for feed then the livestock supporting potential (on the basis of population supporting assessment in the year 2000) in the tsetse areas would be:

Farming Technology	Potential Livestock Million LSU	Feed Source		
		Range %	Crop Residues %	Crop Byproducts %
Pessimistic (Run A)	169.4	79.0	16.8	4.2
Likely (Run B)	342.0	60.7	31.7	7.6
Possible (Run C)	418.9	50.8	39.4	9.8

The year 2000 livestock population in the tsetse areas is projected to be 43.5 million livestock units and hence considerable potential exists for increasing the number of livestock, specially in the context of integrating crop and livestock production systems.

The results of the income generating potential were similar to the above except that the potential livestock numbers were somewhat lower (about 10%).

The overal results for the tsetse infestible areas in 34 African countries have been summarized above. Individual country results are given in Annex 1 to this study. The country results (together with individual country length of growing period zones and agro-ecological cell results) provide information enabling the identification of areas and countries where tsetse control and eradication and the subsequent agricultural development should receive priority attention.

Selected social, economic and tsetse related indicators, Table 27, for the 37* tsetse infested countries show that:

Income

*In addition to the 34 countries considered in the study, some data for Botswana, Nigeria and Somalia which have small areas of riverine vegetation and swamp infested by tsetse are included in Table 27.

Table 27. African Countries Affected by Tsetse Infestation: Selected Indicators

	Average 1976-80 Popul. Million	GNP/ Capita 1979$	Agriculture as % GDP 1979	1979 Net Barter Terms of Trade 1975=100	1969-71 to 1977-79 Average Annual Growth Rate Volume of Agricultural Production	Per Capita Agricultural Production	Urbanisation % of Total Population 1980	% Population Average per Capita Calorie Intake 1966-68	1976-80	% Area Inhabitable by Tsetse	%Population living in Tsetse Inhabitable areas
Angola	6.9	440	46	113	-3.3	-5.6	21	1938	2110	77	80
Benin*	3.4	250	43	97	2.3	-0.6	14	2166	2310	96	96
Botswana*	0.8	720	21	n.a.	1.1	-1.1	n.a.	1952	2181	n.a.	n.a.
Burundi***	4.4	160	55	n.a.	2.6	0.6	2	2237	2152	76	77
Cameroon	8.2	560	32	144	3.1	0.9	35	2067	2451	98	99
Central Afr.Emp.	2.2	290	37	108	2.0	0.0	41	2043	2161	100	100
Chad	4.4	110	70	100	1.1	-0.9	16	2345	1808	17	53
Congo	1.5	830	15	91	-0.1	-2.6	45	2094	2200	100	100
Equatorial Guinea	0.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2025	1992	100	100
Ethiopia**	31.8	130	49	142	0.4	-1.7	15	2012	1729	29	34
Gabon	0.5	3280	8	105	0.1	-1.1	n.a.	2158	2844	100	100
Gambia*	0.6	250	46	93	0.1	-2.9	n.a.	2230	2250	100	100
Ghana*	11.3	400	66	144	-0.1	-3.1	36	2187	2016	100	100
Guinea	4.9	280	41	n.a.	0.2	-2.7	18	2025	1934	100	100
Guinea Bissau	0.6	170	54	111	1.4	-0.2	n.a.	1984	2357	100	100
Ivory Coast	7.6	1040	28	129	3.8	-1.7	36	2564	2623	100	100
Kenya**	15.6	380	34	110	4.0	0.6	14	2252	2055	9	31
Liberia	1.8	500	35	88	2.7	-0.6	33	2270	2474	100	100
Malawi*	6.0	200	43	84	4.0	1.2	10	2096	2219	99	98
Mali*	6.5	140	42	95	1.4	-1.2	20	2057	1996	13	36
Mozambique	10.2	250	44	75	-1.0	-3.5	9	2033	1691	68	60
Namibia**	1.0	n.a.	n.a.	n.a.	0.5	-2.3	n.a.	2268	2224	11	14
Niger*	5.2	270	44	90	1.3	-1.5	13	2105	2217	n.a.	n.a.
Nigeria**	74.8	870	22	119	1.7	-0.8	20	2190	2335	76	81
Rwanda***	4.7	200	42	145	3.9	1.1	4	1904	2202	60	73
Senegal*	5.5	430	29	76	1.1	-1.5	25	2262	2075	48	34
Sierra Leone*	3.4	250	36	108	1.7	-0.6	25	2231	2106	100	100
Somalia***	3.5	230	60	97	0.6	-1.7	30	2203	2131	n.a.	n.a.
Sudan	17.9	370	38	78	1.8	-0.8	25	1921	2371	26	24
Swaziland*	0.5	660	n.a.	n.a.	4.8	2.1	n.a.	2080	2499	57	60
Tanzania*	17.4	260	54	102	1.4	-2.0	12	2062	2025	65	65
Togo*	2.6	350	25	82	-0.4	-2.8	20	2213	2106	100	100
Uganda*	12.8	290	55	136	-0.5	-3.5	12	2176	1862	86	87
Upper Volta*	6.7	180	38	94	2.1	0.5	9	2010	2018	56	52
Zaire	27.5	260	33	91	1.2	-1.5	34	2192	2133	99	100
Zambia	5.5	500	15	100	2.8	-0.2	38	2115	1992	93	92
Zimbabwe*	7.2	470	12	n.a.	2.9	-0.4	23	2120	1911	39	53

n.a. Data not available

***Rainfed resources insufficient to meet food and agricultural needs of year 2000 population (even at high level of inputs)

**Rainfed land resources only sufficient to meet food and agricultural needs of year 2000 population at high level of inputs only.

*Rainfed land resources only sufficient to meet food and agricultural needs of year 2000 population at intermediate level of input only.

Source: Shah et al, 1984.

Countries shown in bold: Major share of foreign exchange earnings from the exports of non-agricultural products, e.g. metals, precious stones, petroleum, fertilisers, uranium, etc. (1979).

- Nineteen low income (per capita GNP below $300 in 1979) countries had a population of 156 million in 1978-80.
- Ten lower middle income (per capita GNP $300 to $600 in 1975) countries had a population of 83 million in 1978-80.
- Five upper middle income (per capita GNP $600 to $ 2000 in 1975) countries had a population of 85 million in 1978-80.
- One is a high income (per capita GNP above $2000 in 1979) country with a population of 0.5 million in 1978-80.

Food Intake

- In nineteen countries the food situation, in terms of per capita calorie intake, deteriorated over the period 1966-68 to 1978-80. The population of these countries in 1978-80 amounted to 177 million.

Agriculture Sector

- In seven countries agriculture accounted for more than 50% of the total GDP in 1979 and the terms of trade improved for six of these countries over the period 1975 to 1979.
- In fifteen additional countries agriculture provided 35% to 50% of the total GDP in 1979. Over the period 1975 to 1979, the terms of trade deteriorated for nine of these fifteen countries.

Agricultural Land Resources

- For seven countries, reserves of agricultural land resources are scarce or very scarce in terms of meeting the food and agricultural needs of the year 2000 population. Four of these seven countries could be selfsufficient in food and agriculture by adopting high level of farming technology. However, it is practicaly infeasible to reach this level of farming technology within the next 15-20 years. Of these seven countries, only Nigeria at

present has nonagricultural exports to finance the imports of necessary food.

- Fifteen countries will have to at least reach an intermediate level of farming technology to domestically provide the food and agricltural needs of the year 2000 projected population.
- The remaining fifteen countries would have sufficient reserves of agricultural land to be able to operate at between low and intermediate level of inputs and yet meet the future food and agricultural needs.

Due to the dimension of human suffering from tsetse related diseases, it is important that tsetse be eradicated in all areas. However, due to financial and time constraints this is unlikely to occur in all infested areas in the near and medium-term future.

From the data in Table 25 one could hypothetically evaluate the priority for assistance in financing tsetse control and eradication. Assuming that this priority score is calculated as follows:

	Score
Low income (below $300)	1
Scarce agricultural land resources	1
Deterioriation in food intake	1
Tsetse areas more than 60% of total land area	1

then the countries which should receive priority attention are:

Score of 3 to 4

Burundi, **Guinea, Zaire, Uganda,** Ethiopia, **Tanzania,** Somalia, **Mozambique**

Score of 2

Gambia, Benin, Togo, Sierra Leone, Guinea Bissau, Central African Empire, Chad, Mali, Rwanda, Malawi, Namibia, **Equatorial Guinea,** Zambia, Kenya, **Nigeria, Ghana**

Score of 1

Liberia, Upper Volta, Niger, Zimbabwe, Angola, **Gabon, Congo,** Senegal, **Ivory Coast, Cameroon.**

Taking into account the 1982/83 extent of tsetse infestation in the above countries (see Table 11), the countries (shown in bold above) may be considered as priority countries for tsetse control and eradication since tsetse infestation occupied more than 60% of land areas of these countries in 1982/83. In particular, this assessment (approximate and hypothetical in nature) suggests that top priority for assistance in tsetse eradication should be given to countries scoring a value of at least 2 and shown in bold above.

In the study, we have also identified the length of growing period zones in each country which should receive priority attention due to:

- The critical nature of a zone, i.e. land resources not sufficient to meet the food needs of the resident population.
- Agricultural and economic potential of the zone.

One important aspect that has to be borne in mind when planning the control and eradication of tsetse in particular areas is that there should be coordinated action in adjacent areas and countries since tsetse knows no political or administrative boundaries.

In conclusion, this study provides a resource data base for evaluating the agricultural and economic potential of tsetse infestible areas in African countries. The quantified data, available at the level of each agro-ecological cell and length of growing period zone in each country, provides the basis for the choice of target areas for tsetse control and subsequent agricultural development.

This information together with economic and environmental costs of tsetse control and eradication programmes is essential to plan the development of

tsetse infested areas in Africa. It should, however, be stressed that this study has been based on an approximate land resource data base (1:5 million scale) and in depth detailed country studies will be required at the project level.

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ANNEX 1

Statistical Annex:

Results by Individual Country in Africa

	YEAR 1975				YEAR 2000			
	Pop Year	Ratio of Potential/Present Population			Pop Year	Ratio of Potential/Projected Population		
COUNTRY NAME	1975 ('000)	Pessimistic Run A	Likely Run B	Possible Run C	2000 ('000)	Pessimistic Run A	Likely Run B	Possible Run C
ANGOLA	4981	9.7	60.0	65.8	9449	5.3	31.6	34.6
BURUNDI	3040	0.4	1.7	2.2	6053	0.2	0.8	1.0
CAMEROON	7463	6.7	37.2	30.1	12942	3.8	21.3	17.2
CENT AFR EMP	1996	19.7	118.3	115.4	3617	11.8	65.7	63.6
CHAD	2269	6.3	30.8	43.7	4190	3.4	16.6	23.6
CONGO	1357	33.8	133.7	127.7	2477	18.6	73.4	69.9
BENIN	3028	2.3	12.1	14.8	6497	1.0	5.5	6.8
EQ GUINEA	322	25.2	45.0	47.6	560	14.4	25.8	27.2
ETHIOPIA	9720	1.7	6.9	10.3	18699	0.9	3.5	5.3
GABON	461	131.9	321.7	336.4	665	91.8	222.8	232.9
GAMBIA	523	2.0	7.7	9.6	1011	1.4	4.2	5.2
GHANA	10937	2.3	11.0	10.6	23244	1.1	5.1	4.9
GUINEA	4504	2.8	14.0	15.4	8379	1.5	7.5	8.3
IVORY COAST	6528	8.1	28.0	24.1	13577	3.9	13.3	11.5
KENYA	4154	0.5	2.2	3.1	10323	0.3	0.9	1.3
LIBERIA	1801	7.6	33.8	31.5	3964	3.5	15.2	14.2
MALAWI	6825	1.1	3.9	4.3	15506	0.5	1.7	1.8
MALI	2122	3.1	15.8	22.1	4250	1.7	7.9	11.1
MOZAMBIQUE	5462	7.3	33.6	41.8	10763	3.8	17.1	21.2
NIGERIA	53052	0.9	4.4	5.2	120296	0.4	1.8	2.2
GUIN BISSAU	527	5.4	20.4	24.8	849	3.3	12.8	15.3
ZIMBABWE	3347	3.4	15.3	17.4	7495	1.8	7.0	7.9
RWANDA	2996	0.3	1.5	1.8	6552	0.1	0.6	0.7
SENEGAL	1714	2.4	11.8	15.2	3335	1.3	6.1	7.8
SIERRA LEONE	2951	2.0	11.4	8.7	5869	1.0	5.8	4.3
SUDAN	3920	12.6	63.0	84.3	7654	6.4	32.2	43.0
SWAZILAND	314	2.7	11.0	12.0	610	1.4	5.6	6.1
TANZANIA	10016	3.6	15.5	18.7	21990	1.7	7.1	8.5
TOGO	2377	1.7	9.1	10.8	5127	0.8	4.1	4.9
UGANDA	9844	0.8	4.7	6.0	21368	0.4	2.1	2.7
UPPER VOLTA	3221	1.9	9.8	15.3	6266	1.0	5.0	7.8
ZAIRE	24449	13.6	51.5	49.0	46053	7.2	27.3	25.9
ZAMBIA	2953	19.6	81.2	92.5	6390	9.0	37.4	42.6
TOTAL	199192	5.1	22.0	23.3	416038	2.5	10.5	11.1

Table A1: Present and projected populations and ratios to present and projected populations supporting capacities in tselse areas: By country: Results of potential population runs

	YEAR 1975				YEAR 2000			
	Pop Year	Ratio of Potential/Present Population			Pop Year	Ratio of Potential/Projected Population		
COUNTRY NAME	1975 ('000)	Pessimistic Run D	Likely Run E	Possible Run F	2000 ('000)	Pessimistic Run D	Likely Run E	Possible Run F
ANGOLA	4981	12.8	58.5	61.3	9449	6.7	30.7	32.2
BURUNDI	3040	0.4	1.4	1.7	6053	0.2	0.7	0.8
CAMEROON	7463	13.7	37.6	25.2	12942	7.8	21.7	14.4
CENT AFR EMP	1996	32.9	119.8	105.7	3617	18.1	66.0	58.2
CHAD	2269	6.9	29.7	36.2	4190	3.7	16.0	19.5
CONGO	1357	44.2	147.8	122.2	2477	24.3	80.9	66.9
BENIN	3028	2.6	11.8	13.6	6497	1.2	5.4	6.2
EQ GUINEA	322	25.5	52.9	42.1	560	14.6	30.3	24.1
ETHIOPIA	9720	1.5	6.5	7.2	18699	0.8	3.3	3.7
GABON	461	176.9	353.6	314.9	665	122.5	244.9	218.1
GAMBIA	523	2.0	7.6	9.4	1011	1.5	4.2	5.0
GHANA	10937	3.0	11.1	9.7	23244	1.5	5.2	4.6
GUINEA	4504	4.3	13.7	14.7	8379	2.3	7.3	7.9
IVORY COAST	6528	10.8	28.2	21.7	13577	5.2	13.4	10.3
KENYA	4154	0.5	2.0	2.6	10323	0.3	0.9	1.1
LIBERIA	1801	9.0	33.6	28.5	3964	4.1	15.1	12.8
MALAWI	6825	1.2	3.9	4.1	15506	0.6	1.7	1.8
MALI	2122	3.6	15.5	19.7	4250	1.9	7.8	9.9
MOZAMBIQUE	5462	9.0	32.7	39.2	10763	4.6	16.6	19.9
NIGERIA	53052	1.3	4.5	4.9	120296	0.6	1.9	2.0
GUIN BISSAU	527	5.3	19.8	23.2	849	3.3	12.3	14.4
ZIMBABWE	3347	3.4	14.8	15.5	7495	1.8	6.8	7.1
RWANDA	2996	0.3	1.3	1.6	6552	0.2	0.5	0.7
SENEGAL	1714	2.6	11.7	13.9	3335	1.4	6.0	7.1
SIERRA LEONE	2951	2.1	11.7	8.1	5869	1.1	5.8	4.0
SUDAN	3920	15.3	59.1	66.3	7654	7.8	30.2	33.9
SWAZILAND	314	3.2	10.6	10.2	610	1.6	5.4	5.2
TANZANIA	10016	3.8	14.8	17.1	21990	1.8	6.8	7.8
TOGO	2377	2.2	9.1	10.2	5127	1.1	4.2	4.6
UGANDA	9844	1.4	5.2	5.5	21368	0.6	2.3	2.5
UPPER VOLTA	3221	2.2	9.5	12.9	6266	1.1	4.8	6.6
ZAIRE	24449	20.4	49.8	44.4	46053	10.7	26.3	23.4
ZAMBIA	2953	19.6	78.6	89.1	6390	9.0	36.2	41.1
TOTAL	199192	7.1	21.8	20.9	416038	3.4	10.3	10.0

Table A2: Present and projected populations and ratios to present and projected populations supporting capacities in tsetse areas: By country: Results of maximum revenue runs

	YEAR 1975						YEAR 2000					
	Pessimistic: Run A		Likely: Run B		Possible: Run C		Pessimistic: Run A		Likely: Run B		Possible: Run C	
COUNTRY NAME	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent
ANGOLA	1756.7	43.9	13467.7	19.9	17726.8	18.9	1856.5	42.5	13352.6	20.0	17685.9	18.9
BURUNDI	56.4	34.9	226.6	21.7	259.1	21.3	49.5	35.9	208.7	21.7	238.7	21.2
CAMEROON	2928.7	17.0	13876.1	10.1	14360.1	25.7	2916.9	17.0	13756.9	10.2	14269.7	25.7
CENT AFR EMP	1594.1	32.6	10687.3	16.0	12153.3	24.4	1718.7	31.4	10764.4	15.9	12135.5	24.4
CHAD	611.4	36.8	3053.2	26.5	4216.3	28.3	604.5	37.1	3036.9	26.5	4188.8	28.3
CONGO	2597.3	27.5	10523.9	17.8	13318.8	18.6	2588.0	27.4	10469.3	17.9	13296.7	18.6
BENIN	182.1	47.2	1418.6	25.6	1877.6	24.2	179.5	47.1	1383.3	26.0	1842.3	24.2
EQ GUINEA	355.0	16.3	808.4	18.5	993.1	25.5	354.3	16.2	804.9	18.5	988.8	25.5
ETHIOPIA	344.6	49.7	1824.7	35.8	4965.3	23.1	347.5	48.9	1790.7	36.0	4900.8	23.1
GABON	2927.9	16.1	7871.1	20.3	9206.5	25.8	2936.4	16.1	7868.0	20.3	9203.1	25.8
GAMBIA	53.7	27.7	238.0	21.5	279.8	27.9	50.7	27.8	225.1	21.5	262.1	27.9
GHANA	1513.6	20.8	6134.5	15.6	6390.6	26.4	1458.2	20.8	5968.0	15.5	6212.7	26.4
GUINEA	495.6	38.5	2685.8	20.8	3715.5	22.3	494.5	38.6	2660.3	20.8	3693.3	22.4
IVORY COAST	2148.1	28.5	8581.8	17.7	8582.1	25.9	2096.6	28.9	8450.0	17.7	8463.4	25.8
KENYA	99.4	33.4	446.9	25.2	924.5	17.4	94.5	32.7	407.6	25.5	853.4	17.3
LIBERIA	663.9	43.8	4194.2	19.6	4519.5	20.2	651.8	43.8	4126.1	19.6	4450.4	20.2
MALAWI	260.0	32.6	1109.4	22.2	1664.6	20.4	242.4	32.7	1011.9	22.4	1545.3	20.4
MALI	209.4	40.5	1183.2	28.2	1750.0	26.4	205.5	40.5	1156.7	28.2	1712.8	26.4
MOZAMBIQUE	1461.6	37.4	7941.4	22.6	11941.0	18.8	1459.2	37.3	7620.4	23.1	11855.4	18.8
NIGERIA	2272.0	35.2	11838.7	21.0	14462.5	25.0	2148.1	35.0	11049.1	21.0	13537.0	24.9
GUIN BISSAU	160.0	35.8	536.6	26.2	544.8	26.1	159.3	35.8	527.4	26.1	542.4	26.1
ZIMBABWE	316.9	43.1	1736.5	29.2	2229.8	26.2	317.4	42.7	1686.8	29.2	2181.5	26.1
RWANDA	46.2	38.0	184.9	25.2	221.7	25.7	42.8	37.9	171.6	24.9	205.4	25.3
SENEGAL	207.1	34.3	1141.0	23.8	1121.8	28.4	206.3	34.2	1125.3	23.8	1107.0	28.5
SIERRA LEONE	316.0	39.6	1590.1	20.9	1435.7	30.0	308.3	39.5	1589.6	20.6	1399.5	30.0
SUDAN	2137.0	36.0	10114.6	25.9	14593.3	26.0	2129.8	36.1	10088.1	25.9	14555.9	26.0
SWAZILAND	24.8	44.3	110.5	29.6	140.0	27.1	25.0	43.8	109.0	29.5	137.8	27.1
TANZANIA	1435.4	39.0	6572.6	26.3	10269.6	19.7	1416.0	39.1	6523.0	26.2	10129.7	19.7
TOGO	118.5	41.5	870.0	18.2	1405.4	24.8	111.6	42.1	841.8	18.0	1361.3	24.9
UGANDA	519.4	29.3	2625.6	17.5	3361.6	21.6	506.2	29.0	2475.7	17.7	3237.6	21.7
UPPER VOLTA	142.6	54.2	1084.0	31.5	2088.1	25.3	140.1	54.5	1070.8	31.5	2065.6	25.3
ZAIRE	20387.2	21.8	82691.7	14.9	85103.0	21.3	20267.3	21.8	82575.8	14.9	84635.7	21.3
ZAMBIA	2309.2	34.9	10172.8	25.7	16720.6	19.5	2300.7	34.9	10106.5	25.7	16663.9	19.5
TOTAL	50651.9	28.3	227542.5	18.7	272542.8	22.4	50383.7	28.2	225002.4	18.6	269559.5	22.4

Table A3: Net value of output and ratio of cost to revenue in tsetse areas: By country: Results of potential population runs (year 1975 and 2000)

	YEAR 1975						YEAR 2000					
	Pessimistic: Run D		Likely: Run E		Possible: Run F		Pessimistic: Run D		Likely: Run E		Possible: Run F	
COUNTRY NAME	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent	Net Rev. mil.$75	Cst/GRev percent
ANGOLA	2894.1	28.3	14519.8	19.2	21779.1	17.5	2887.6	28.3	14250.1	19.2	21722.7	17.5
BURUNDI	68.8	28.9	338.2	15.6	624.2	13.9	63.3	28.8	309.8	15.6	569.3	14.0
CAMEROON	5279.4	9.6	14458.6	9.8	17717.5	15.6	5246.0	9.6	14447.8	9.8	17606.6	15.6
CENT AFR EMP	2917.4	18.7	11328.3	15.1	14392.3	20.5	2912.9	18.7	11311.4	15.1	14371.2	20.5
CHAD	792.4	31.8	3559.9	23.9	5745.8	20.4	787.7	31.8	3537.0	23.9	5711.6	20.4
CONGO	3247.8	19.8	12516.9	15.2	14104.1	16.9	3242.5	19.8	12498.6	15.2	14080.9	16.9
BENIN	310.2	33.5	1573.9	24.0	2773.5	17.1	304.3	33.5	1546.2	24.0	2725.5	17.0
EQ GUINEA	359.1	15.3	904.3	16.7	1210.3	17.8	357.5	15.3	900.5	16.7	1205.1	17.8
ETHIOPIA	484.2	33.4	2248.1	30.3	7871.4	14.9	477.8	33.4	2218.1	30.3	7763.6	14.9
GABON	3804.4	12.8	8485.7	19.5	10195.6	23.5	3803.0	12.8	8482.6	19.5	10191.8	23.5
GAMBIA	61.4	26.3	251.8	20.4	315.1	25.0	57.6	26.2	238.9	20.4	296.6	24.9
GHANA	1952.5	14.9	6475.4	15.4	7747.7	21.1	1896.2	14.7	6293.2	15.3	7527.0	21.1
GUINEA	825.0	25.6	2721.5	20.3	4125.3	20.5	819.4	25.6	2705.9	20.3	4102.0	20.5
IVORY COAST	3021.3	20.1	8857.2	17.1	10432.5	20.5	2972.5	20.1	8724.4	17.1	10286.9	20.4
KENYA	151.2	21.4	505.5	21.7	1263.2	13.6	140.2	21.2	468.9	21.7	1182.3	13.5
LIBERIA	777.3	37.3	4200.5	19.5	5339.8	13.5	762.8	37.3	4134.1	19.4	5263.5	13.4
MALAWI	374.0	23.8	1273.2	19.5	1999.6	16.9	351.0	23.6	1192.1	19.4	1864.0	16.8
MALI	325.8	31.8	1394.0	24.2	2953.4	15.0	320.2	31.8	1367.5	24.1	2908.1	14.8
MOZAMBIQUE	2289.9	26.1	9050.5	19.8	14912.9	17.1	2271.8	26.1	8943.1	19.9	14812.8	17.1
NIGERIA	3779.0	24.0	13240.7	20.4	17809.3	20.2	3500.6	24.1	12351.8	20.4	16719.3	20.0
GUIN BISSAU	162.4	34.4	648.8	22.1	823.1	17.5	161.7	34.4	645.9	22.1	819.4	17.5
ZIMBABWE	375.8	38.8	2151.6	23.9	3711.2	15.8	368.9	38.8	2103.8	23.9	3632.0	15.7
RWANDA	62.5	25.6	219.0	20.0	329.0	21.1	58.1	25.4	203.8	19.8	306.6	20.8
SENEGAL	275.0	29.0	1238.7	21.6	1664.4	19.4	271.5	28.9	1224.5	21.6	1644.9	19.4
SIERRA LEONE	331.4	37.7	1642.3	20.5	1728.2	24.1	322.6	37.7	1595.9	20.6	1685.4	24.1
SUDAN	2780.6	30.5	11138.6	23.7	18131.3	20.8	2773.6	30.5	11109.2	23.7	18084.2	20.8
SWAZILAND	42.0	30.4	130.0	25.4	229.2	18.3	41.3	30.4	128.0	25.4	225.6	18.3
TANZANIA	1971.4	29.9	7308.4	23.8	12129.5	17.6	1940.6	29.9	7212.7	23.8	11971.9	17.6
TOGO	207.1	28.8	947.4	20.1	1516.1	24.8	199.6	28.8	917.0	19.9	1468.6	24.8
UGANDA	819.0	20.0	2970.0	15.9	3869.4	20.1	793.1	19.9	2872.3	15.8	3729.3	20.1
UPPER VOLTA	296.9	36.9	1322.2	26.6	2982.1	17.2	293.7	36.9	1306.9	26.6	2948.8	17.2
ZAIRE	27837.8	15.6	88330.8	14.0	96192.7	14.6	27677.9	15.6	87865.0	14.0	95664.0	14.6
ZAMBIA	2834.2	28.1	11253.7	23.4	18863.7	18.0	2824.1	28.1	11215.6	23.4	18803.4	18.0
TOTAL	71711.1	20.3	247205.7	17.4	325482.8	17.5	70901.4	20.2	244322.6	17.4	321895.2	17.5

Table A4: Net value of output and ratio of cost to revenue in tsetse areas: By country: Results of maximum revenue runs (year 1975 and 2000)

L A N D (1000 ha)

COUNTRY NAME	Total Land	Irrigated Land	Rainfed Crop Land			Range Land		
			Pessimistic Run A	Likely Run B	Possible Run C	Pessimistic Run A	Likely Run B	Possible Run C
ANGOLA	96017	0	25943	45732	44946	32509	24923	24602
BURUNDI	1962	2	625	738	736	532	642	642
CAMEROON	45471	1	18250	30198	29557	12501	6657	8375
CENT AFR EMP	62240	0	17067	31748	26952	24076	17780	20735
CHAD	21651	2	8210	11267	11081	5742	5135	5190
CONGO	34199	3	18474	22707	24429	7390	6070	5433
BENIN	10794	0	2976	4789	4812	4122	3446	3371
EQ GUINEA	2804	0	1924	1661	1947	489	631	512
ETHIOPIA	34754	0	6851	8039	7858	11168	12497	12356
GABON	26199	0	15392	14958	15952	5914	7082	6570
GAMBIA	1129	30	503	754	750	275	151	150
GHANA	22573	21	10041	12230	11569	5765	4849	5453
GUINEA	24585	46	5248	8325	6912	4842	3495	4338
IVORY COAST	31527	22	14334	19007	17451	9524	7543	7721
KENYA	4987	12	904	1353	1379	1462	1366	1356
LIBERIA	11131	3	5940	8304	7445	3764	1350	1767
MALAWI	8718	12	2613	3498	3380	1855	1717	1868
MALI	16339	52	2967	4421	4372	6250	5494	5502
MOZAMBIQUE	53115	51	14442	22233	21602	16068	16140	16378
NIGERIA	69684	11	20437	33888	34396	19651	13996	13828
GUIN BISSAU	3611	0	1796	1801	1622	474	470	559
ZIMBABWE	15047	28	4811	7124	7146	4358	3240	3224
RWANDA	2031	1	474	638	604	558	613	641
SENEGAL	9489	17	2441	4386	4516	3115	2293	2174
SIERRA LEONE	7173	3	2720	4251	3008	2453	1022	1780
SUDAN	71290	3	26087	35181	34623	16220	12246	12671
SWAZILAND	980	0	364	409	404	210	282	286
TANZANIA	58119	59	18714	24939	24739	15975	15239	15259
TOGO	5585	3	1619	2727	2475	1672	1146	1245
UGANDA	17267	6	5467	8461	8315	4922	3672	3723
UPPER VOLTA	15225	5	3591	5018	5411	6511	6470	6116
ZAIRE	230484	4	105736	146406	161907	60617	42713	36177
ZAMBIA	69324	11	21553	32868	32935	20865	15675	15638
TOTAL	1085536	408	388532	560074	565247	311863	246057	245655

Table A5: Land use in tsetse areas: By country: Results for potential population runs for year 1975

	LAND (1000 ha)							
			Rainfed Crop Land			Range Land		
COUNTRY NAME	Total Land	Irrigated Land	Pessimistic Run A	Likely Run B	Possible Run C	Pessimistic Run A	Likely Run B	Possible Run C
ANGOLA	96017	0	26617	45644	44842	32027	25164	24539
BURUNDI	1962	3	572	677	676	486	585	585
CAMEROON	45471	5	18123	30009	29371	12445	6616	8325
CENT AFR EMP	62240	0	17643	31842	26917	23761	17625	20707
CHAD	21651	21	8160	11201	11015	5713	5109	5164
CONGO	34199	10	18386	22511	24389	7409	6154	5420
BENIN	10794	3	2929	4902	4728	4052	3237	3316
EQ GUINEA	2804	0	1918	1654	1938	486	629	510
ETHIOPIA	34754	0	6352	7952	7756	11655	12334	12191
GABON	26199	0	15449	14952	15946	5882	7080	6567
GAMBIA	1129	58	473	711	710	264	148	145
GHANA	22573	92	9671	11850	11207	5684	4711	5289
GUINEA	24585	6	5272	8280	6880	4784	3470	4306
IVORY COAST	31527	49	14468	18780	17223	9278	7447	7637
KENYA	4987	39	795	1228	1250	1400	1277	1270
LIBERIA	11131	39	5858	8183	7334	3723	1336	1751
MALAWI	8718	85	2432	3256	3139	1751	1623	1768
MALI	16339	132	2915	4326	4270	6176	5450	5463
MOZAMBIQUE	53115	101	14363	22068	21443	15973	16062	16297
NIGERIA	69684	193	19411	31837	32289	18553	13371	13219
GUIN BISSAU	3611	0	1788	1729	1614	472	500	557
ZIMBABWE	15047	120	4719	6989	7013	4287	3190	3173
RWANDA	2031	4	435	588	556	503	549	577
SENEGAL	9489	30	2422	4335	4465	3084	2273	2155
SIERRA LEONE	7173	43	2631	4240	2906	2402	885	1743
SUDAN	71290	1	26016	35089	34534	16195	12217	12640
SWAZILAND	980	0	359	403	398	206	278	282
TANZANIA	58119	143	18595	24672	24406	15957	15019	15110
TOGO	5585	33	1604	2648	2390	1589	1104	1214
UGANDA	17267	17	5268	8180	8020	4787	3539	3593
UPPER VOLTA	15225	19	3558	4966	5351	6462	6403	6055
ZAIRE	230484	21	105161	145965	161051	60362	41987	36045
ZAMBIA	69324	39	21475	32757	32823	20819	15636	15599
TOTAL	1085536	1306	385853	554441	558866	308639	243023	243228

Table A6: Land use in tsetse areas: By country: Results for potential population runs for year 2000

	LAND (1000 ha)							
			Rainfed Crop Land			Range Land		
COUNTRY NAME	Total Land	Irrigated Land	Pessimistic Run D	Likely Run E	Possible Run F	Pessimistic Run D	Likely Run E	Possible Run F
ANGOLA	96017	0	30832	43589	40650	32127	26346	27889
BURUNDI	1962	2	677	706	653	507	664	715
CAMEROON	45471	1	29378	30044	32358	7117	6947	6014
CENT AFR EMP	62240	0	25024	30877	28328	20720	18432	20078
CHAD	21651	2	8115	11103	10908	6002	5473	5534
CONGO	34199	3	20064	25205	25646	7683	4651	4796
BENIN	10794	0	3376	4652	4586	4041	3539	3579
EQ GUINEA	2804	0	1858	1791	2304	580	535	265
ETHIOPIA	34754	0	5772	8055	7990	13006	12492	12210
GABON	26199	0	17646	15873	18006	5555	6473	5188
GAMBIA	1129	30	520	758	750	265	147	150
GHANA	22573	21	11025	12267	12640	5782	4701	4551
GUINEA	24585	46	7321	8006	6853	3954	3707	4359
IVORY COAST	31527	22	18657	18685	18099	8447	7646	7616
KENYA	4987	12	994	1278	1285	1517	1419	1413
LIBERIA	11131	3	5699	8264	8545	3992	1380	972
MALAWI	8718	12	2781	3526	3506	1957	1708	1747
MALI	16339	52	3233	4400	4345	6296	5531	5532
MOZAMBIQUE	53115	51	17810	21276	20033	15145	16871	17650
NIGERIA	69684	11	26895	34038	34755	16875	14050	13570
GUIN BISSAU	3611	0	1709	1801	1587	551	472	588
ZIMBABWE	15047	28	4880	7097	7072	4386	3307	3320
RWANDA	2031	1	554	591	526	538	650	699
SENEGAL	9489	17	2567	4364	4476	3135	2315	2208
SIERRA LEONE	7173	3	2728	4186	3639	2499	1053	1322
SUDAN	71290	3	30090	33988	33523	14697	13131	13465
SWAZILAND	980	0	391	403	398	200	287	291
TANZANIA	58119	59	20256	24235	24479	16146	16099	15930
TOGO	5585	3	1992	2591	2418	1619	1202	1329
UGANDA	17267	6	7859	8371	8255	3871	3789	3876
UPPER VOLTA	15225	5	3754	5023	5510	6807	6477	6076
ZAIRE	230484	4	136176	148081	145285	47747	42452	45767
ZAMBIA	69324	11	20804	32155	32439	22177	16409	16236
TOTAL	1085536	408	471452	557297	551863	285957	250370	254950

Table A7: Land use in tsetse areas: By country: Results for maximum revenue runs for year 1975

	LAND (1000 ha)							
			Rainfed Crop Land			Range Land		
COUNTRY NAME	Total Land	Irrigated Land	Pessimistic Run D	Likely Run E	Possible Run F	Pessimistic Run D	Likely Run E	Possible Run F
ANGOLA	96017	0	30760	43738	40557	26466	32049	27818
BURUNDI	1962	3	622	648	598	605	462	653
CAMEROON	45471	5	29195	29856	32154	6905	7074	5979
CENT AFR EMP	62240	0	24987	30834	28290	18409	20695	20052
CHAD	21651	21	8072	11037	10843	5446	5965	5507
CONGO	34199	10	20026	25161	25603	4640	7669	4784
BENIN	10794	3	3316	4572	4507	3480	3975	3520
EQ GUINEA	2804	0	1850	1784	2294	533	578	264
ETHIOPIA	34754	0	5697	7949	7887	12325	12834	12047
GABON	26199	0	17639	15867	17999	6470	5553	5186
GAMBIA	1129	58	486	718	710	142	256	145
GHANA	22573	92	10679	11875	12240	4562	5614	4415
GUINEA	24585	6	7273	7965	6821	3680	3935	4327
IVORY COAST	31527	49	18390	18432	17848	7572	8371	7543
KENYA	4987	39	892	1164	1161	1323	1419	1323
LIBERIA	11131	39	5608	8149	8426	1365	3953	962
MALAWI	8718	85	2590	3278	3256	1616	1843	1655
MALI	16339	132	3188	4304	4243	5485	6212	5493
MOZAMBIQUE	53115	101	17675	21121	19868	16786	15065	17572
NIGERIA	69684	193	25068	31916	32593	13467	16166	13005
GUIN BISSAU	3611	0	1701	1793	1580	470	548	585
ZIMBABWE	15047	120	4787	6964	6939	3256	4315	3268
RWANDA	2031	4	509	544	482	584	483	630
SENEGAL	9489	30	2534	4317	4425	2292	3107	2188
SIERRA LEONE	7173	43	2631	4046	3525	1046	2450	1295
SUDAN	71290	1	30012	33898	33435	13101	14662	13433
SWAZILAND	980	0	385	397	392	283	197	286
TANZANIA	58119	143	19976	23924	24134	15932	15977	15786
TOGO	5585	33	1927	2514	2338	1159	1572	1285
UGANDA	17267	17	7595	8080	7967	3651	3727	3738
UPPER VOLTA	15225	19	3713	4966	5449	6412	6737	6015
ZAIRE	230484	21	135451	147351	144546	42265	47555	45573
ZAMBIA	69324	39	20726	32047	32331	16367	22121	16194
TOTAL	1085536	1306	465979	551227	545457	248114	283151	252543

Table A8: Land use in tsetse areas: By country: Results for maximum revenue runs for year 2000

	Pessimistic: Run A				Likely: Run B				Possible: Run C			
COUNTRY NAME	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75
ANGOLA	2696.3	19.2	32.4	1377.1	5207.1	1130.9	170.6	3343.1	6061.9	1698.9	221.6	4117.9
BURUNDI	58.3	0.6	1.1	30.3	81.2	36.5	3.6	62.9	89.2	44.9	4.0	70.2
CAMEROON	1184.9	17.7	5.8	601.2	2381.8	655.8	57.5	1567.3	6561.3	2595.0	437.8	4968.6
CENT AFR EMP	1520.4	13.5	11.3	771.5	3232.3	647.4	96.4	2035.0	5109.8	2100.0	345.6	3915.7
CHAD	703.1	6.6	4.7	356.1	1464.8	668.3	50.5	1100.5	1912.0	1326.8	88.2	1661.0
CONGO	1954.4	17.7	7.5	984.9	3620.8	796.8	81.2	2281.2	4329.8	1446.7	186.9	3043.4
BENIN	320.4	2.9	2.6	162.7	640.7	302.4	25.7	488.6	733.2	422.4	33.3	600.3
EQ GUINEA	136.5	2.3	0.2	68.9	295.6	61.9	6.3	183.0	477.2	160.4	24.2	339.4
ETHIOPIA	640.8	31.8	8.0	340.3	988.5	979.7	68.0	1017.2	1392.7	1356.6	104.8	1494.0
GABON	1075.4	36.6	9.5	560.9	2709.1	1044.4	153.6	2004.6	3747.3	2112.2	328.1	3193.3
GAMBIA	41.1	0.3	0.1	20.6	96.6	31.0	1.7	65.2	140.7	69.9	5.0	108.0
GHANA	781.4	11.2	5.4	398.4	1521.7	625.8	63.8	1133.9	2745.9	1441.9	219.0	2290.0
GUINEA	608.8	7.3	4.6	310.1	944.9	393.7	37.7	703.4	1282.2	702.9	80.6	1069.2
IVORY COAST	1676.5	33.6	7.4	855.0	2530.1	926.8	126.7	1842.1	3798.2	1683.4	287.9	2992.4
KENYA	94.5	2.5	1.7	49.9	178.4	98.6	9.1	150.6	218.6	124.5	12.3	194.3
LIBERIA	1024.9	11.6	3.0	517.2	1431.5	502.3	68.8	1024.3	1563.1	578.3	86.8	1145.3
MALAWI	246.7	3.1	1.9	125.6	451.8	154.2	14.5	316.3	546.9	264.3	21.4	427.4
MALI	279.2	3.6	2.6	142.6	560.1	340.3	26.0	463.6	702.3	496.8	40.9	627.2
MOZAMBIQUE	1680.7	31.3	22.9	871.6	2903.9	1483.0	141.0	2320.8	3375.2	1672.9	177.7	2760.3
NIGERIA	2408.1	43.6	16.6	1233.8	4393.8	1656.6	141.2	3139.5	6061.6	3025.0	332.2	4818.0
GUIN BISSAU	177.4	1.0	1.0	89.4	261.2	109.1	7.8	190.3	259.0	117.5	8.1	192.4
ZIMBABWE	472.6	4.2	3.8	239.8	932.4	465.6	36.2	714.8	1021.2	479.3	43.6	789.8
RWANDA	53.9	1.1	0.9	28.3	75.9	40.4	3.9	62.4	88.6	55.6	5.3	76.6
SENEGAL	216.0	1.4	0.6	108.3	554.1	140.0	10.3	355.6	644.3	222.7	18.3	445.9
SIERRA LEONE	402.1	9.6	2.7	207.6	543.0	244.2	34.5	421.1	717.2	408.6	65.2	616.3
SUDAN	2383.4	19.6	14.3	1204.1	4466.0	2458.7	160.9	3539.6	5815.1	4056.4	280.4	5117.9
SWAZILAND	39.0	0.3	0.3	19.8	56.3	34.9	2.4	46.4	63.6	36.6	3.2	52.1
TANZANIA	1805.2	14.9	15.7	917.5	3145.0	1360.4	113.3	2345.5	3434.3	1248.5	128.8	2522.4
TOGO	165.8	1.8	1.0	84.0	297.3	78.3	7.9	193.8	550.6	319.6	35.9	464.5
UGANDA	424.3	2.5	3.4	214.9	849.8	208.4	23.6	557.2	1244.1	488.3	60.7	928.2
UPPER VOLTA	328.8	4.9	3.4	168.5	641.1	322.7	26.9	499.0	835.5	491.1	39.8	706.3
ZAIRE	11059.8	223.4	91.1	5685.6	20677.3	6477.8	873.3	14523.8	32358.5	10659.3	1583.7	22992.2
ZAMBIA	2423.0	22.8	27.0	1239.5	4657.0	2090.2	168.1	3512.3	5461.5	1830.1	209.1	4045.1
TOTAL	39083.7	604.3	314.8	19985.8	72791.2	26567.1	2813.3	52205.2	103342.8	43737.3	5520.5	78785.7

Table A9: Current inputs required for rainfed production in tsetse areas: By country: Results of potential population runs for year 1975

	Pessimistic: Run A					Likely: Run B					Possible: Run C				
	POWER (mill. MDE)					POWER (mill. MDE)					POWER (mill. MDE)				
COUNTRY NAME	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.
ANGOLA	2696	282	239	42	2414	5207	282	239	42	4925	6061	282	239	42	5779
BURUNDI	58	155	145	9	-97	81	155	145	9	-74	89	155	145	9	-66
CAMEROON	1184	397	358	39	787	2381	397	358	39	1984	6561	397	358	39	6164
CENT AFR EMP	1520	106	95	10	1414	3232	106	95	10	3126	5109	106	95	10	5003
CHAD	703	121	108	12	581	1464	121	108	12	1343	1911	121	108	12	1790
CONGO	1954	66	65	0	1888	3620	66	65	0	3554	4329	66	65	0	4263
BENIN	320	156	145	11	163	640	156	145	11	484	733	156	145	11	576
EQ GUINEA	136	15	15	0	120	295	15	15	0	280	477	15	15	0	461
ETHIOPIA	640	667	466	200	-26	988	667	466	200	321	1392	667	466	200	725
GABON	1075	22	22	0	1053	2709	22	22	0	2686	3747	22	22	0	3725
GAMBIA	41	30	25	5	10	96	30	25	5	66	140	30	25	5	110
GHANA	781	541	525	16	240	1521	541	525	16	980	2745	541	525	16	2204
GUINEA	608	242	216	25	366	944	242	216	25	702	1282	242	216	25	1040
IVORY COAST	1676	322	313	9	1353	2530	322	313	9	2207	3798	322	313	9	3475
KENYA	94	234	199	34	-139	178	234	199	34	-55	218	234	199	34	-15
LIBERIA	1024	87	86	0	937	1431	87	86	0	1344	1563	87	86	0	1476
MALAWI	246	338	327	11	-92	451	338	327	11	112	546	338	327	11	208
MALI	279	110	101	8	168	560	110	101	8	449	702	110	101	8	591
MOZAMBIQUE	1680	271	262	9	1408	2903	271	262	9	2632	3375	271	262	9	3103
NIGERIA	2408	2643	2546	96	-235	4393	2643	2546	96	1750	6061	2643	2546	96	3418
GUIN BISSAU	177	28	25	3	149	261	28	25	3	232	258	28	25	3	230
ZIMBABWE	472	201	160	40	271	932	201	160	40	731	1021	201	160	40	820
RWANDA	53	151	143	8	-97	75	151	143	8	-76	88	151	143	8	-63
SENEGAL	215	99	82	16	116	554	99	82	16	454	644	99	82	16	545
SIERRA LEONE	402	145	141	3	256	542	145	141	3	397	717	145	141	3	571
SUDAN	2383	279	188	91	2103	4465	279	188	91	4186	5815	279	188	91	5535
SWAZILAND	39	18	15	2	20	56	18	15	2	38	63	18	15	2	45
TANZANIA	1805	574	480	93	1230	3145	574	480	93	2570	3434	574	480	93	2859
TOGO	165	117	114	3	47	297	117	114	3	179	550	117	114	3	432
UGANDA	424	546	472	74	-122	849	546	472	74	303	1244	546	472	74	697
UPPER VOLTA	328	183	154	29	145	641	183	154	29	457	835	183	154	29	651
ZAIRE	11059	1188	1173	14	9871	20677	1188	1173	14	19488	32358	1188	1173	14	31170
ZAMBIA	2422	164	141	23	2258	4657	164	141	23	4492	5461	164	141	23	5296
TOTAL	39083	10513	9561	952	28570	72791	10513	9561	952	62277	103342	10513	9561	952	92829

Table A10: Power required and supply for rainfed production in tsetse areas: By country: Results of potential population runs for year 1975

COUNTRY NAME	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75
ANGOLA	2685.2	19.1	31.0	1370.3	5185.2	1134.6	169.0	3333.7	6048.1	1695.0	221.1	4108.5
BURUNDI	53.3	0.5	0.9	27.7	74.5	33.4	3.3	57.7	81.7	41.0	3.7	64.3
CAMEROON	1177.9	17.6	5.8	597.6	2365.6	655.5	56.8	1557.9	6519.4	2578.4	435.1	4937.0
CENT AFR EMP	1548.4	14.1	10.8	785.1	3235.9	641.0	96.5	2035.1	5102.1	2096.6	345.0	3909.7
CHAD	705.4	6.3	4.5	356.9	1456.4	665.5	50.2	1094.8	1899.6	1318.7	87.7	1650.5
CONGO	1941.2	14.8	6.8	975.9	3616.3	795.6	81.5	2278.5	4322.7	1443.0	186.5	3037.7
BENIN	314.8	2.8	2.5	159.7	646.2	296.7	24.2	486.4	720.1	415.1	32.7	589.6
EQ GUINEA	136.0	2.3	0.2	68.6	294.4	61.7	6.2	182.3	475.2	159.7	24.1	337.9
ETHIOPIA	624.7	31.5	7.9	332.1	978.5	973.2	67.2	1008.4	1375.0	1339.3	103.4	1475.0
GABON	1081.8	36.3	9.4	563.8	2708.0	1044.0	153.5	2003.9	3745.8	2111.4	328.0	3192.0
GAMBIA	38.9	0.2	0.1	19.5	91.1	29.4	1.6	61.6	132.3	65.3	4.7	101.4
GHANA	749.7	10.4	5.1	381.9	1470.0	604.8	61.9	1095.7	2663.2	1401.0	213.2	2222.9
GUINEA	611.1	7.3	4.6	311.2	939.5	392.4	37.4	699.7	1275.6	699.2	80.0	1063.5
IVORY COAST	1670.0	32.1	6.9	850.6	2500.0	911.7	124.8	1817.8	3741.8	1655.9	283.4	2946.7
KENYA	86.6	2.4	1.6	45.9	162.6	93.5	8.5	139.3	198.1	116.5	11.4	178.3
LIBERIA	1007.0	11.1	2.8	508.0	1408.5	490.8	67.5	1005.7	1535.1	566.1	85.1	1123.8
MALAWI	230.9	2.9	1.8	117.6	415.2	146.3	13.3	292.6	505.0	246.6	19.8	395.9
MALI	274.2	3.6	2.6	140.0	546.9	335.9	25.7	454.6	684.2	488.9	40.3	613.8
MOZAMBIQUE	1673.3	31.1	22.6	867.7	2836.8	1506.0	135.9	2293.9	3349.9	1660.3	176.6	2740.1
NIGERIA	2254.1	40.1	15.4	1154.3	4112.0	1547.0	131.2	2935.7	5639.4	2807.9	305.6	4477.3
GUIN BISSAU	176.6	1.0	1.0	89.0	252.9	110.1	7.8	186.7	257.8	117.0	8.1	191.5
ZIMBABWE	466.5	4.1	3.6	236.6	912.3	451.9	35.2	697.3	1000.4	462.3	42.4	770.2
RWANDA	49.9	1.0	0.9	26.2	69.5	36.3	3.5	56.9	80.9	50.0	4.7	69.5
SENEGAL	213.9	1.4	0.6	107.3	547.3	137.8	10.2	351.0	636.5	219.9	18.1	440.4
SIERRA LEONE	390.0	9.4	2.6	201.4	530.7	239.4	33.8	412.0	697.0	400.1	63.8	600.8
SUDAN	2384.5	19.5	14.1	1204.4	4453.9	2451.9	160.5	3530.0	5799.1	4044.9	279.6	5103.6
SWAZILAND	38.5	0.3	0.3	19.5	55.4	34.3	2.4	45.7	62.7	36.0	3.1	51.3
TANZANIA	1793.9	15.0	14.4	910.7	3112.0	1345.4	111.7	2318.9	3387.9	1231.0	127.2	2488.4
TOGO	160.6	1.7	0.8	81.3	283.2	73.9	7.5	184.3	533.8	310.9	34.8	450.9
UGANDA	407.9	2.4	3.3	206.6	810.3	205.5	21.7	532.9	1201.2	472.2	58.8	896.6
UPPER VOLTA	327.5	4.8	3.3	167.8	633.8	318.6	26.5	493.0	826.1	484.6	39.3	697.9
ZAIRE	10997.8	222.2	90.8	5653.9	20549.6	6437.5	868.5	14435.3	32172.1	10601.1	1574.9	22861.6
ZAMBIA	2413.7	22.7	26.9	1234.8	4638.0	2083.0	167.2	3498.3	5442.1	1822.5	208.4	4030.3
TOTAL	38685.9	592.1	306.3	19773.6	71892.5	26284.7	2772.7	51577.0	102112.0	43158.3	5450.6	77818.9

Table A11: Current inputs required for rainfed production in tsetse areas: By country: Results of potential population runs for year 2000

	Pessimistic: Run A					Likely: Run B					Possible: Run C				
	POWER (mill. MDE)					POWER (mill. MDE)					POWER (mill. MDE)				
COUNTRY NAME	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.
ANGOLA	2685	537	453	83	2148	5185	537	453	83	4647	6048	537	453	83	5510
BURUNDI	53	304	290	14	-251	74	304	290	14	-230	81	304	290	14	-222
CAMEROON	1177	703	621	82	474	2365	703	621	82	1662	6519	703	621	82	5816
CENT AFR EMP	1548	190	173	17	1357	3235	190	173	17	3045	5102	190	173	17	4911
CHAD	705	228	201	27	476	1456	228	201	27	1227	1899	228	201	27	1670
CONGO	1941	120	118	1	1820	3616	120	118	1	3495	4322	120	118	1	4202
BENIN	314	333	311	22	-19	646	333	311	22	312	720	333	311	22	386
EQ GUINEA	136	27	26	0	108	294	27	26	0	267	475	27	26	0	448
ETHIOPIA	624	1122	897	224	-497	978	1122	897	224	-143	1375	1122	897	224	252
GABON	1081	32	31	0	1049	2708	32	31	0	2675	3745	32	31	0	3713
GAMBIA	38	58	48	9	-19	91	58	48	9	33	132	58	48	9	74
GHANA	749	1144	1115	28	-395	1469	1144	1115	28	325	2663	1144	1115	28	1518
GUINEA	611	451	402	49	159	939	451	402	49	487	1275	451	402	49	823
IVORY COAST	1669	668	651	16	1001	2500	668	651	16	1831	3741	668	651	16	3073
KENYA	86	549	495	53	-462	162	549	495	53	-386	198	549	495	53	-351
LIBERIA	1007	191	190	0	815	1408	191	190	0	1217	1535	191	190	0	1343
MALAWI	230	768	744	24	-537	415	768	744	24	-353	505	768	744	24	-263
MALI	274	221	204	17	52	546	221	204	17	325	684	221	204	17	462
MOZAMBIQUE	1673	532	516	15	1140	2836	532	516	15	2304	3349	532	516	15	2817
NIGERIA	2254	5933	5774	159	-3679	4112	5933	5774	159	-1821	5639	5933	5774	159	-294
GUIN BISSAU	176	45	40	4	130	252	45	40	4	207	257	45	40	4	212
ZIMBABWE	466	432	359	73	33	912	432	359	73	479	1000	432	359	73	567
RWANDA	49	326	314	12	-277	69	326	314	12	-257	80	326	314	12	-246
SENEGAL	213	190	160	30	23	547	190	160	30	356	636	190	160	30	446
SIERRA LEONE	390	288	281	6	101	530	288	281	6	242	696	288	281	6	408
SUDAN	2384	504	367	136	1880	4453	504	367	136	3949	5799	504	367	136	5294
SWAZILAND	38	34	29	5	3	55	34	29	5	20	62	34	29	5	28
TANZANIA	1793	1217	1055	161	576	3111	1217	1055	161	1894	3387	1217	1055	161	2170
TOGO	160	252	246	6	-91	283	252	246	6	30	533	252	246	6	281
UGANDA	407	1129	1025	103	-721	810	1129	1025	103	-319	1201	1129	1025	103	71
UPPER VOLTA	327	343	300	42	-15	633	343	300	42	290	826	343	300	42	483
ZAIRE	10997	2229	2210	18	8768	20549	2229	2210	18	18320	32172	2229	2210	18	29942
ZAMBIA	2413	349	306	42	2064	4638	349	306	42	4288	5442	349	306	42	5092
TOTAL	38685	21464	19969	1495	17220	71892	21464	19969	1495	50427	102112	21464	19969	1495	80647

Table A12: Power required and supply for rainfed production in tsetse areas: By country: Results of potential population runs for year 2000

	Pessimistic: Run D				Likely: Run E				Possible: Run F			
COUNTRY NAME	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75
ANGOLA	2235.4	15.6	24.9	1139.8	5416.4	1103.1	166.7	3440.4	6835.6	1747.0	260.2	4625.0
BURUNDI	53.8	0.5	1.0	27.9	90.5	23.5	3.9	62.6	145.4	33.0	7.4	101.2
CAMEROON	1103.1	24.4	3.2	561.1	2387.6	671.4	55.6	1575.6	4489.0	1617.5	242.7	3285.0
CENT AFR EMP	1328.8	14.7	6.5	672.3	3246.9	594.7	87.3	2010.0	4916.0	1939.6	313.8	3720.1
CHAD	730.8	6.3	4.4	369.5	1510.8	646.9	47.6	1116.0	1798.4	1073.6	56.9	1477.0
CONGO	1591.5	17.7	5.3	802.7	3525.0	816.1	77.9	2239.5	4071.7	1387.1	173.2	2875.4
BENIN	309.2	2.4	2.0	156.2	654.8	308.5	23.8	497.7	748.9	337.6	25.8	570.4
EQ GUINEA	128.8	2.3	0.2	65.1	290.7	64.3	5.7	181.1	385.8	111.1	15.0	261.2
ETHIOPIA	458.0	20.8	5.5	242.4	948.9	936.8	60.1	978.7	1625.2	770.1	89.0	1372.8
GABON	1037.0	60.4	10.0	556.2	2736.6	1116.8	159.2	2057.1	3713.6	2030.7	323.1	3134.1
GAMBIA	43.8	0.3	0.1	21.9	96.6	29.5	1.5	64.4	139.5	65.1	4.5	105.0
GHANA	669.9	11.0	4.1	341.5	1579.6	649.8	66.0	1175.5	2554.5	1245.7	184.2	2073.6
GUINEA	555.9	7.5	4.3	283.7	943.2	387.4	34.5	692.7	1294.3	676.9	78.5	1063.4
IVORY COAST	1478.9	35.9	7.1	758.1	2502.7	913.2	129.6	1825.5	3390.1	1504.3	254.7	2682.8
KENYA	77.6	1.4	1.8	41.2	170.5	84.2	7.6	140.2	261.6	76.4	14.0	199.5
LIBERIA	913.5	11.6	2.9	462.1	1411.9	503.9	69.6	1016.0	1175.2	402.0	51.8	835.0
MALAWI	229.4	3.0	1.9	117.0	453.1	138.1	12.3	307.7	551.8	207.8	17.3	408.0
MALI	299.6	3.0	2.2	152.0	561.5	297.6	22.7	443.9	669.9	312.1	23.1	519.7
MOZAMBIQUE	1562.4	30.3	18.1	808.3	2898.6	1306.9	119.8	2239.4	3880.3	1583.4	204.7	3070.8
NIGERIA	2312.8	55.2	18.4	1195.6	4555.8	1949.2	175.5	3397.0	5734.4	2730.1	301.0	4511.9
GUIN BISSAU	169.1	0.9	1.0	85.2	256.7	101.5	6.6	183.8	251.0	88.4	5.4	174.3
ZIMBABWE	471.5	4.0	3.3	238.7	917.8	409.0	30.9	677.4	987.5	320.3	26.8	694.5
RWANDA	41.2	0.4	0.8	21.5	72.3	29.0	3.0	54.8	107.3	53.8	6.1	88.1
SENEGAL	223.6	1.4	0.6	112.1	544.6	121.9	8.0	340.9	619.0	159.8	11.1	400.3
SIERRA LEONE	388.5	9.6	2.6	200.8	545.7	247.5	34.9	424.4	648.2	357.3	55.1	547.8
SUDAN	2417.2	17.7	13.0	1218.8	4391.2	2361.9	139.9	3457.1	5414.5	3731.3	195.6	4764.5
SWAZILAND	36.1	0.3	0.3	18.3	56.3	29.5	2.2	44.3	71.3	19.7	3.4	51.5
TANZANIA	1652.8	13.4	13.3	839.3	3137.8	1234.9	99.8	2283.5	3640.5	1155.4	125.4	2595.4
TOGO	165.5	1.9	0.9	83.9	346.5	115.8	10.0	238.4	592.4	342.6	37.9	499.1
UGANDA	405.6	2.2	2.6	204.6	862.1	203.7	22.0	559.5	1318.3	496.3	61.9	973.9
UPPER VOLTA	341.8	3.8	2.7	173.8	664.0	254.0	23.3	479.9	810.5	348.8	24.0	621.5
ZAIRE	9990.2	244.1	66.5	5140.0	20402.3	6399.5	868.8	14371.2	21769.7	8837.2	1120.1	16488.9
ZAMBIA	2161.3	22.3	23.3	1106.5	4731.2	1859.2	146.0	3429.9	5748.4	1681.1	214.6	4141.9
TOTAL	35584.3	646.1	255.1	18218.2	72910.2	25909.4	2722.4	52006.0	90359.9	37442.9	4528.6	68933.5

Table A13: Current inputs required for rainfed production in tsetse areas: By country: Results of maximum revenue runs for year 1975

	Pessimistic: Run D					Likely: Run E					Possible: Run F				
	POWER (mill. MDE)					POWER (mill. MDE)					POWER (mill. MDE)				
COUNTRY NAME	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.
ANGOLA	2235	282	239	42	1953	5416	282	239	42	5134	6835	282	239	42	6553
BURUNDI	53	155	145	9	-101	90	155	145	9	-65	145	155	145	9	-10
CAMEROON	1103	397	358	39	705	2387	397	358	39	1990	4489	397	358	39	4091
CENT AFR EMP	1328	106	95	10	1222	3246	106	95	10	3140	4916	106	95	10	4809
CHAD	730	121	108	12	609	1510	121	108	12	1389	1798	121	108	12	1676
CONGO	1591	66	65	0	1525	3524	66	65	0	3458	4071	66	65	0	4005
BENIN	309	156	145	11	152	654	156	145	11	498	748	156	145	11	592
EQ GUINEA	128	15	15	0	113	290	15	15	0	275	385	15	15	0	370
ETHIOPIA	458	667	466	200	-209	948	667	466	200	281	1625	667	466	200	957
GABON	1036	22	22	0	1014	2736	22	22	0	2714	3713	22	22	0	3691
GAMBIA	43	30	25	5	13	96	30	25	5	66	139	30	25	5	109
GHANA	669	541	525	16	128	1579	541	525	16	1038	2554	541	525	16	2013
GUINEA	555	242	216	25	313	943	242	216	25	700	1294	242	216	25	1052
IVORY COAST	1478	322	313	9	1155	2502	322	313	9	2179	3390	322	313	9	3067
KENYA	77	234	199	34	-156	170	234	199	34	-63	261	234	199	34	27
LIBERIA	913	87	86	0	826	1411	87	86	0	1324	1175	87	86	0	1088
MALAWI	229	338	327	11	-109	453	338	327	11	114	551	338	327	11	212
MALI	299	110	101	8	188	561	110	101	8	450	669	110	101	8	559
MOZAMBIQUE	1562	271	262	9	1290	2898	271	262	9	2626	3880	271	262	9	3608
NIGERIA	2312	2643	2546	96	-330	4555	2643	2546	96	1912	5734	2643	2546	96	3091
GUIN BISSAU	169	28	25	3	140	256	28	25	3	228	251	28	25	3	222
ZIMBABWE	471	201	160	40	270	917	201	160	40	716	987	201	160	40	786
RWANDA	41	151	143	8	-110	72	151	143	8	-79	107	151	143	8	-44
SENEGAL	223	99	82	16	124	544	99	82	16	445	619	99	82	16	519
SIERRA LEONE	388	145	141	3	242	545	145	141	3	400	648	145	141	3	502
SUDAN	2417	279	188	91	2137	4391	279	188	91	4111	5414	279	188	91	5134
SWAZILAND	36	18	15	2	17	56	18	15	2	38	71	18	15	2	53
TANZANIA	1652	574	480	93	1078	3137	574	480	93	2563	3640	574	480	93	3065
TOGO	165	117	114	3	47	346	117	114	3	228	592	117	114	3	474
UGANDA	405	546	472	74	-141	862	546	472	74	315	1318	546	472	74	771
UPPER VOLTA	341	183	154	29	158	663	183	154	29	480	810	183	154	29	626
ZAIRE	9990	1188	1173	14	8801	20402	1188	1173	14	19213	21769	1188	1173	14	20581
ZAMBIA	2161	164	141	23	1996	4731	164	141	23	4566	5748	164	141	23	5583
TOTAL	35584	10513	9561	952	25070	72910	10513	9561	952	62396	90359	10513	9561	952	79846

Table A 14 Power required and supply for rainfed production in tsetse areas: By country: Results of maximum revenue runs for year 1975

COUNTRY NAME	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75	Power mil.MDE	N-P-K 1000mt	Pestiz. mil.$75	Tot.Cost mil.$75
ANGOLA	2230.3	15.6	24.8	1137.2	5365.9	1060.0	167.5	3394.5	6819.2	1743.1	259.6	4614.0
BURUNDI	49.3	0.4	0.9	25.6	82.9	21.7	3.6	57.4	133.1	30.5	6.8	92.7
CAMEROON	1096.1	24.3	3.2	557.5	2373.4	668.9	55.2	1566.9	4460.8	1607.0	241.2	3264.2
CENT AFR EMP	1327.0	14.6	6.4	671.4	3242.6	593.9	87.2	2007.3	4909.1	1936.5	313.3	3714.6
CHAD	726.9	6.3	4.4	367.5	1500.4	642.3	47.3	1108.3	1786.5	1066.6	56.5	1467.3
CONGO	1588.6	17.6	5.3	801.3	3519.3	814.6	77.7	2235.8	4064.9	1383.5	172.8	2869.8
BENIN	303.8	2.3	2.0	153.5	643.3	303.3	23.4	489.0	735.1	331.0	25.3	559.6
EQ GUINEA	128.2	2.3	0.2	64.8	289.5	64.1	5.7	180.3	384.1	110.6	14.9	260.1
ETHIOPIA	452.2	20.5	5.5	239.3	936.7	924.9	59.4	966.2	1603.8	760.9	87.8	1355.0
GABON	1036.6	60.4	10.0	556.0	2735.5	1116.3	159.1	2056.3	3712.1	2029.8	323.0	3132.8
GAMBIA	40.9	0.3	0.1	20.5	91.6	28.1	1.4	61.1	131.1	60.6	4.2	98.4
GHANA	643.2	10.7	4.0	328.0	1526.9	628.1	64.1	1136.6	2478.1	1213.0	179.7	2014.6
GUINEA	552.7	7.4	4.2	282.0	939.1	385.4	34.3	689.5	1287.4	673.3	78.0	1057.6
IVORY COAST	1456.6	35.2	7.0	746.5	2465.0	897.0	127.5	1796.8	3340.5	1480.3	250.7	2642.6
KENYA	71.0	1.3	1.7	37.8	156.4	79.2	7.2	129.9	240.2	70.5	13.1	184.2
LIBERIA	896.7	11.1	2.8	453.4	1389.3	492.1	68.1	997.6	1151.0	391.2	50.5	816.5
MALAWI	211.9	2.8	1.8	108.2	420.4	130.1	11.6	286.6	509.0	192.8	16.0	377.0
MALI	294.9	3.0	2.2	149.6	548.2	293.4	22.4	434.9	652.1	305.5	22.6	507.1
MOZAMBIQUE	1549.7	30.0	18.0	801.8	2880.4	1287.9	119.6	2220.5	3852.8	1572.2	203.4	3049.5
NIGERIA	2151.9	50.3	17.0	1111.6	4257.7	1814.8	161.8	3169.6	5347.3	2520.8	275.5	4192.4
GUIN BISSAU	168.3	0.9	1.0	84.8	255.5	101.0	6.6	182.9	249.9	88.0	5.4	173.5
ZIMBABWE	462.5	3.9	3.3	234.1	899.6	393.9	30.0	660.6	969.4	306.5	26.2	677.8
RWANDA	38.0	0.4	0.7	19.8	66.6	26.2	2.7	50.2	98.5	48.3	5.5	80.4
SENEGAL	220.6	1.4	0.6	110.6	538.7	120.6	7.9	337.2	611.4	157.5	11.0	395.2
SIERRA LEONE	377.0	9.4	2.6	194.9	529.9	243.0	34.4	413.8	629.4	349.9	53.9	533.7
SUDAN	2410.7	17.6	13.0	1215.5	4379.4	2355.4	139.5	3447.7	5399.8	3720.8	195.0	4751.3
SWAZILAND	35.5	0.3	0.3	18.0	55.4	29.1	2.1	43.6	70.2	19.4	3.4	50.7
TANZANIA	1630.1	13.1	13.1	827.7	3095.4	1216.7	98.5	2251.9	3594.2	1140.1	124.0	2562.5
TOGO	159.0	1.8	0.9	80.6	331.7	111.0	9.6	228.3	572.5	332.6	36.8	483.3
UGANDA	391.7	2.1	2.5	197.6	832.2	196.5	21.2	540.0	1272.9	479.9	60.0	940.7
UPPER VOLTA	338.0	3.7	2.6	171.8	656.3	250.5	23.0	474.1	801.8	344.0	23.8	614.3
ZAIRE	9933.7	242.8	66.2	5111.1	20290.4	6361.2	863.5	14290.3	21660.5	8791.3	1114.3	16405.1
ZAMBIA	2152.9	22.2	23.2	1102.2	4714.7	1851.9	145.5	3417.5	5728.4	1673.7	213.9	4126.9
TOTAL	35126.2	636.2	251.5	17982.2	72010.3	25503.2	2688.7	51323.6	89257.0	36931.6	4467.9	68065.5

Table A15: Current inputs required for rainfed production in tsetse areas: By country: Results of maximum revenue runs for year 2000

	Pessimistic: Run D					Likely: Run E					Possible: Run F				
	POWER (mill. MDE)					POWER (mill. MDE)					POWER (mill. MDE)				
COUNTRY NAME	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.	Requd	Supply	Hum.Lab	Ox.Pow	Resid.
ANGOLA	2230	537	453	83	1693	5365	537	453	83	4828	6819	537	453	83	6282
BURUNDI	49	304	290	14	-255	82	304	290	14	-221	133	304	290	14	-171
CAMEROON	1096	703	621	82	392	2373	703	621	82	1670	4460	703	621	82	3757
CENT AFR EMP	1326	190	173	17	1136	3242	190	173	17	3051	4909	190	173	17	4718
CHAD	726	228	201	27	497	1500	228	201	27	1271	1786	228	201	27	1557
CONGO	1588	120	118	1	1468	3519	120	118	1	3398	4064	120	118	1	3944
BENIN	303	333	311	22	-30	643	333	311	22	309	735	333	311	22	401
EQ GUINEA	128	27	26	0	101	289	27	26	0	262	384	27	26	0	357
ETHIOPIA	452	1122	897	224	-669	936	1122	897	224	-185	1603	1122	897	224	481
GABON	1036	32	31	0	1004	2735	32	31	0	2703	3712	32	31	0	3680
GAMBIA	40	58	48	9	-17	91	58	48	9	33	131	58	48	9	73
GHANA	643	1144	1115	28	-501	1526	1144	1115	28	382	2478	1144	1115	28	1333
GUINEA	552	451	402	49	100	939	451	402	49	487	1287	451	402	49	835
IVORY COAST	1456	668	651	16	788	2464	668	651	16	1796	3340	668	651	16	2672
KENYA	70	549	495	53	-478	156	549	495	53	-393	240	549	495	53	-309
LIBERIA	896	191	190	0	705	1389	191	190	0	1198	1150	191	190	0	959
MALAWI	211	768	744	24	-556	420	768	744	24	-347	508	768	744	24	-259
MALI	294	221	204	17	73	548	221	204	17	326	652	221	204	17	430
MOZAMBIQUE	1549	532	516	15	1017	2880	532	516	15	2347	3852	532	516	15	3320
NIGERIA	2151	5933	5774	159	-3781	4257	5933	5774	159	-1675	5347	5933	5774	159	-586
GUIN BISSAU	168	45	40	4	122	255	45	40	4	209	249	45	40	4	204
ZIMBABWE	462	432	359	73	29	899	432	359	73	466	969	432	359	73	536
RWANDA	37	326	314	12	-289	66	326	314	12	-260	98	326	314	12	-228
SENEGAL	220	190	160	30	30	538	190	160	30	348	611	190	160	30	421
SIERRA LEONE	376	288	281	6	88	529	288	281	6	241	629	288	281	6	340
SUDAN	2410	504	367	136	1906	4379	504	367	136	3874	5399	504	367	136	4895
SWAZILAND	35	34	29	5	0	55	34	29	5	20	70	34	29	5	35
TANZANIA	1630	1217	1055	161	412	3095	1217	1055	161	1877	3594	1217	1055	161	2376
TOGO	159	252	246	6	-93	331	252	246	6	79	572	252	246	6	320
UGANDA	391	1129	1025	103	-737	832	1129	1025	103	-297	1272	1129	1025	103	143
UPPER VOLTA	337	343	300	42	-5	656	343	300	42	313	801	343	300	42	458
ZAIRE	9933	2229	2210	18	7704	20290	2229	2210	18	18060	21660	2229	2210	18	19431
ZAMBIA	2152	349	306	42	1803	4714	349	306	42	4365	5728	349	306	42	5378
TOTAL	35126	21464	19969	1495	13661	72010	21464	19969	1495	50545	89257	21464	19969	1495	67792

Table A16: Power required and supply for rainfed production in tsetse areas: By country: Results of maximum revenue runs for year 2000

	YEAR 1975					YEAR 2000				
	----- LIVESTOCK (1000) -----					----- LIVESTOCK (1000) -----				
COUNTRY NAME	Cattle	Sheep	Goats	LSU	Oxen	Cattle	Sheep	Goats	LSU	Oxen
ANGOLA	2470	191	773	1052	412	4812	377	1527	2050	803
BURUNDI	558	232	446	266	93	809	428	820	402	135
CAMEROON	2248	1879	1417	1092	375	4726	3670	2765	2267	789
CENT AFR EMP	603	92	692	294	100	987	178	1376	500	164
CHAD	733	659	672	373	122	1599	1808	1844	859	267
CONGO	51	46	91	29	8	83	157	313	62	13
BENIN	647	801	787	353	108	1268	2105	2067	757	211
EQ GUINEA	5	32	8	4	0	8	50	12	6	1
ETHIOPIA	11552	10579	7845	5699	1929	12928	11055	8199	6298	2159
GABON	5	44	47	7	0	7	70	75	11	1
GAMBIA	301	99	93	131	50	544	178	168	238	90
GHANA	942	1512	1822	579	157	1665	2483	2991	999	278
GUINEA	1493	404	375	643	249	2863	839	780	1241	478
IVORY COAST	550	978	979	337	91	968	1974	1976	624	161
KENYA	1992	739	732	885	332	3105	1292	1278	1396	518
LIBERIA	34	171	170	34	5	55	301	299	57	9
MALAWI	646	79	704	311	107	1384	146	1303	652	231
MALI	513	906	522	287	85	1022	1999	1152	589	170
MOZAMBIQUE	546	35	242	237	91	909	62	434	397	151
NIGERIA	5571	4654	16175	3593	930	9171	9562	33239	6473	1531
GUIN BISSAU	175	125	25	77	29	280	200	40	124	46
ZIMBABWE	2323	463	605	994	387	4209	889	1161	1809	702
RWANDA	464	188	477	228	77	718	307	780	357	119
SENEGAL	975	519	330	439	162	1740	1029	654	793	290
SIERRA LEONE	230	52	136	104	38	384	84	221	173	64
SUDAN	5277	2723	3312	2478	881	7885	6913	8407	4088	1316
SWAZILAND	172	9	59	73	28	309	16	111	132	51
TANZANIA	5407	1148	2616	2403	903	9319	1912	4361	4128	1556
TOGO	219	824	630	172	36	365	1415	1080	292	60
UGANDA	4274	904	1747	1877	713	5975	1992	3849	2759	997
UPPER VOLTA	1674	836	1445	812	279	2433	1665	2879	1257	406
ZAIRE	850	691	2536	552	141	1085	779	2861	673	181
ZAMBIA	1331	6	257	550	222	2463	12	535	1023	411
TOTAL	54836	32625	48772	26980	9157	86082	55951	89562	43499	14375

Table A17: Present and projected livestock population in tsetse areas: By country

	Year 1975	Pessimistic: Run A -- F E E D (1000 LSU)				Likely: Run B --- F E E D (1000 LSU)				Possible: Run C -------- F E E D (1000 LSU)				
	LSU	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd	Requd	Supply	%Range	%C.Res	%C.Bpd
ANGOLA	1052	14255	81.5	14.6	3.9	27030	64.2	28.5	7.3	1052	29793	58.9	33.2	8.0
BURUNDI	266	330	81.2	14.9	3.9	885	73.0	21.7	5.3	266	1011	64.9	26.7	8.4
CAMEROON	1092	8754	91.2	7.0	1.8	11343	74.9	20.4	4.7	1092	22750	49.9	40.8	9.3
CENT AFR EMP	294	12878	90.2	7.8	2.0	21095	79.6	16.6	3.8	294	31042	68.1	26.1	5.7
CHAD	373	2752	70.2	26.0	3.8	8054	46.5	45.3	8.3	373	10962	35.5	51.1	13.4
CONGO	29	4891	74.7	20.1	5.2	10190	59.3	32.5	8.2	29	12506	46.3	43.4	10.3
BENIN	353	2003	77.3	18.1	4.6	4745	56.6	35.1	8.3	353	5376	51.0	38.7	10.3
EQ GUINEA	4	302	77.7	17.2	5.2	1082	70.4	22.9	6.7	4	1388	45.9	43.5	10.6
ETHIOPIA	5699	5129	77.5	17.5	5.1	13728	65.9	27.2	6.9	5699	14789	64.0	27.4	8.5
GABON	7	3999	87.3	9.2	3.6	12403	75.9	18.3	5.8	7	15911	54.6	37.1	8.3
GAMBIA	131	145	68.7	26.2	5.0	310	30.7	57.5	11.9	131	514	19.6	67.7	12.7
GHIANA	579	3027	75.2	19.7	5.2	6920	58.5	33.5	8.0	579	11128	46.7	43.7	9.6
GUINEA	643	3026	78.8	16.8	4.4	5276	63.4	29.4	7.2	643	7609	60.8	32.4	6.8
IVORY COAST	337	5884	80.4	15.5	4.1	11266	68.6	24.8	6.6	337	15520	53.5	38.2	8.3
KENYA	885	611	85.4	11.4	3.2	1528	67.7	25.6	6.6	885	1632	68.3	24.8	6.9
LIBERIA	34	2849	78.1	17.4	4.5	3668	47.9	41.3	10.8	34	4953	50.3	40.3	9.4
MALAWI	311	1138	67.3	25.7	7.0	2445	53.0	37.3	9.7	311	2842	56.4	32.9	10.7
MALI	287	2022	80.2	16.5	3.3	5517	62.3	31.6	6.1	287	6531	56.5	33.9	9.6
MOZAMBIQUE	237	8079	71.0	22.9	6.1	18307	60.1	32.1	7.8	237	19340	58.0	33.2	8.8
NIGERIA	3593	9747	74.3	20.9	4.7	19025	53.3	38.8	7.9	3593	24783	42.7	45.5	11.8
GUIN BISSAU	77	262	37.6	50.4	12.0	893	25.5	59.7	14.7	77	1114	29.3	52.1	18.6
ZIMBABWE	994	1725	56.4	34.4	9.2	4972	29.4	56.1	14.5	994	5066	28.7	55.8	15.5
RWANDA	228	321	86.8	10.7	2.6	805	80.2	15.9	3.9	228	986	73.3	20.5	6.3
SENEGAL	439	1095	80.8	16.0	3.2	2480	54.3	37.8	7.9	439	3125	41.6	46.2	12.2
SIERRA LEONE	104	1980	84.0	12.8	3.2	2255	66.2	27.0	6.8	104	4174	64.1	29.9	6.1
SUDAN	2478	9721	71.5	24.3	4.3	24475	42.5	48.6	8.9	2478	30905	36.2	50.4	13.4
SWAZILAND	73	131	55.9	34.4	9.7	412	43.9	43.7	12.4	73	422	43.6	44.1	12.3
TANZANIA	2403	7018	71.0	23.0	5.9	17366	54.8	36.2	9.0	2403	16994	58.5	33.2	8.3
TOGO	172	785	75.0	19.8	5.2	1490	57.5	34.1	8.4	172	2455	38.9	50.9	10.2
UGANDA	1877	2851	89.5	8.6	1.9	5138	75.7	20.1	4.2	1877	6770	62.7	29.8	7.5
UPPER VOLTA	812	2585	85.6	12.4	2.1	6748	70.6	25.0	4.3	812	7448	62.2	29.7	8.2
ZAIRE	552	39990	81.5	14.6	3.8	69381	65.9	27.1	7.0	552	83176	42.6	45.8	11.6
ZAMBIA	550	11188	68.6	24.8	6.6	24594	45.3	43.3	11.4	550	20595	54.0	36.8	9.1
TOTAL	26980	171487	79.0	16.8	4.2	345844	60.9	31.6	7.5	26980	423624	50.7	39.4	9.8

Table A18: Present and potential livestock units, percentage contribution to feed supply of rangeland, crop residues and crop by-products in tsetse areas: By country: Results of potential population runs (year 1975)

	Year 2000	Pessimistic: Run A -- F E E D (1000 LSU)-------				Likely: Run B --- F E E D (1000 LSU)-------				Possible: Run C -- F E E D (1000 LSU)-------			
COUNTRY NAME	LSU	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd
ANGOLA	2050	14114	81.3	14.7	3.9	27216	64.2	28.5	7.3	29716	58.8	33.2	8.0
BURUNDI	402	302	81.1	15.0	3.9	807	73.0	21.7	5.3	922	65.0	26.7	8.4
CAMEROON	2267	8709	91.2	7.0	1.8	11315	74.6	20.6	4.7	22608	49.9	40.8	9.3
CENT AFR EMP	500	12674	90.0	8.0	2.0	20859	79.6	16.7	3.8	30996	68.1	26.1	5.7
CHAD	859	2737	70.2	25.9	3.8	8013	46.5	45.3	8.3	10899	35.5	51.1	13.4
CONGO	62	4839	75.0	19.8	5.1	10185	59.4	32.4	8.2	12476	46.3	43.4	10.3
BENIN	757	1969	77.2	18.2	4.6	4546	54.7	36.6	8.7	5285	51.0	38.7	10.3
EQ GUINEA	6	301	77.5	17.3	5.2	1077	70.4	22.9	6.7	1382	45.9	43.5	10.6
ETHIOPIA	6298	5181	77.9	17.1	4.9	13555	65.9	27.2	6.9	14594	64.0	27.4	8.5
GABON	11	3975	87.2	9.3	3.6	12399	75.9	18.3	5.8	15904	54.6	37.1	8.3
GAMBIA	238	138	69.0	26.0	5.0	298	31.6	56.7	11.7	484	20.0	67.3	12.7
GHANA	999	2971	75.6	19.3	5.1	6711	58.7	33.3	8.0	10798	46.8	43.7	9.5
GUINEA	1241	3001	78.7	16.9	4.4	5258	63.2	29.6	7.2	7560	60.7	32.4	6.9
IVORY COAST	624	5749	80.2	15.7	4.1	11118	68.6	24.8	6.6	15311	53.5	38.2	8.3
KENYA	1396	569	85.7	11.2	3.1	1422	67.7	25.6	6.7	1525	68.2	24.8	7.0
LIBERIA	57	2815	78.3	17.3	4.5	3616	48.1	41.1	10.8	4885	50.5	40.1	9.4
MALAWI	652	1065	67.6	25.5	6.9	2329	52.7	37.5	9.8	2680	56.6	32.8	10.6
MALI	589	1987	80.2	16.5	3.3	5453	62.5	31.5	6.0	6456	56.7	33.7	9.5
MOZAMBIQUE	397	8015	71.2	22.7	6.1	18596	58.8	33.0	8.2	19227	58.0	33.1	8.8
NIGERIA	6473	9132	74.3	21.0	4.7	18029	53.4	38.7	7.9	23378	43.1	45.2	11.7
GUIN BISSAU	124	261	37.6	50.4	12.0	934	27.8	57.8	14.4	1109	29.3	52.1	18.6
ZIMBABWE	1809	1687	56.7	34.3	9.1	4883	29.5	56.0	14.5	4946	28.9	55.6	15.5
RWANDA	357	290	86.5	10.9	2.6	723	79.9	16.1	4.0	889	73.0	20.6	6.3
SENEGAL	793	1083	80.8	16.0	3.2	2456	54.4	37.7	7.9	3093	41.6	46.2	12.2
SIERRA LEONE	173	1940	84.1	12.7	3.2	2020	63.3	29.3	7.3	4082	64.2	29.8	6.0
SUDAN	4088	9697	71.5	24.2	4.3	24412	42.5	48.6	8.9	30821	36.2	50.4	13.4
SWAZILAND	132	129	56.1	34.3	9.6	405	43.9	43.7	12.4	416	43.6	44.1	12.3
TANZANIA	4128	6964	70.8	23.2	6.0	17069	54.6	36.3	9.1	16807	58.6	33.2	8.2
TOGO	292	751	74.6	20.2	5.2	1431	57.5	34.2	8.3	2392	39.1	50.8	10.1
UGANDA	2759	2769	89.7	8.5	1.9	5059	74.4	21.1	4.5	6548	62.7	29.8	7.4
UPPER VOLTA	1257	2565	85.5	12.4	2.1	6675	70.7	25.0	4.3	7366	62.2	29.6	8.2
ZAIRE	673	39810	81.5	14.6	3.8	68561	65.8	27.2	7.0	82797	42.6	45.8	11.6
ZAMBIA	1023	11156	68.6	24.8	6.6	24532	45.3	43.3	11.4	20531	54.1	36.8	9.1
TOTAL	43499	169364	79.0	16.8	4.2	341977	60.7	31.7	7.6	418899	50.8	39.4	9.8

Table A 19: Present and potential livestock units, percentage contribution to feed supply of rangeland, crop residues and crop by-products in tsetse areas: By country: Results of potential population runs (year 2000)

	Year 1975	Pessimistic: Run D -- F E E D (1000 LSU)-------				Likely: Run E - F E E D (1000 LSU)-------				Possible: Run F - F E E D (1000 LSU)-------			
COUNTRY NAME	LSU	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd
ANGOLA	1052	13115	82.8	13.6	3.6	28272	66.4	27.1	6.5	30918	66.7	28.0	5.4
BURUNDI	268	306	82.9	13.8	3.4	812	82.4	14.8	2.7	859	85.1	11.6	3.4
CAMEROON	1092	4861	88.6	9.1	2.2	11544	75.7	20.0	4.3	13853	51.7	39.6	8.8
CENT AFR EMP	294	10387	90.1	7.9	1.9	21509	81.0	15.6	3.4	28503	69.6	25.6	4.8
CHAD	373	2919	70.9	24.9	4.2	7943	49.8	43.5	6.8	8882	46.2	45.4	8.4
CONGO	29	4461	77.2	17.8	5.0	8895	55.1	35.9	9.0	11527	45.9	43.9	10.2
BENIN	353	1933	77.9	17.7	4.3	4761	58.2	34.0	7.8	4744	61.4	32.3	6.3
EQ GUINEA	4	328	79.7	15.6	4.7	957	66.6	25.9	7.6	775	31.6	53.9	14.5
ETHIOPIA	5699	5267	81.6	14.6	3.8	13307	67.9	25.9	6.1	11310	82.5	14.3	3.2
GABON	7	3509	81.4	13.8	4.8	11706	73.4	20.1	6.5	13649	49.4	41.9	8.7
GAMBIA	131	141	67.7	26.9	5.4	299	31.8	57.0	11.2	478	21.1	67.4	11.5
GHANA	579	2754	77.9	17.7	4.4	6875	57.2	35.0	7.8	8662	42.0	48.6	9.3
GUINEA	643	2568	76.3	18.8	4.9	5611	63.2	29.7	7.1	7306	61.3	32.6	6.1
IVORY COAST	337	5121	81.0	15.0	3.9	11449	68.7	25.0	6.3	14300	55.7	37.5	6.8
KENYA	885	587	88.9	9.1	2.0	1493	72.8	22.3	4.9	1391	83.8	13.5	2.7
LIBERIA	34	2829	79.4	16.4	4.2	3712	48.8	40.7	10.6	2781	41.3	46.6	12.1
MALAWI	311	1122	70.4	23.6	6.0	2352	55.1	36.2	8.7	2227	61.0	29.4	9.6
MALI	287	2035	80.8	15.8	3.5	5365	64.8	29.9	5.3	5333	69.8	25.3	4.8
MOZAMBIQUE	237	7402	73.2	21.6	5.3	18297	63.8	29.6	6.5	17915	69.1	26.0	4.9
NIGERIA	3593	8313	70.9	23.9	5.2	19249	53.5	39.1	7.5	21625	47.1	43.5	9.5
GUIN BISSAU	77	291	45.0	44.4	10.5	794	28.8	58.3	12.9	846	40.4	44.8	14.8
ZIMBABWE	994	1680	57.7	33.5	8.8	4583	32.8	54.3	13.0	3535	43.0	48.0	9.0
RWANDA	228	289	89.3	8.7	2.0	805	84.9	12.6	2.5	984	78.7	17.3	4.0
SENEGAL	439	1106	80.2	16.4	3.4	2426	56.4	36.4	7.2	2571	51.2	40.5	8.3
SIERRA LEONE	104	2005	84.5	12.4	3.1	2299	66.2	27.1	6.7	3263	61.0	32.5	6.5
SUDAN	2478	8737	68.9	26.2	4.9	23821	47.3	45.9	6.8	25130	47.7	45.7	6.6
SWAZILAND	73	115	58.3	33.1	8.6	387	47.5	41.3	11.2	266	70.0	25.5	4.5
TANZANIA	2403	6819	74.3	20.7	5.0	17022	59.2	33.2	7.6	15616	66.9	27.4	5.7
TOGO	172	754	74.9	19.7	5.3	1687	52.0	39.4	8.6	2534	39.6	50.9	9.5
UGANDA	1877	2202	87.3	10.4	2.3	5128	76.0	20.1	4.0	6654	64.4	29.5	6.1
UPPER VOLTA	812	2742	85.4	12.3	2.3	6530	73.1	23.2	3.7	6214	73.9	22.3	3.8
ZAIRE	552	30986	79.3	16.4	4.3	68435	66.8	26.4	6.7	80236	57.5	34.1	8.4
ZAMBIA	550	11106	72.8	21.6	5.7	24409	48.5	41.1	10.3	18629	63.2	30.6	6.2
TOTAL	26980	148803	78.4	17.3	4.3	342750	62.6	30.6	6.8	373533	58.8	34.2	7.1

Table A20: Present and potential livestock units, percentage contribution to feed supply of rangeland, crop residues and crop by-products in tsetse areas: By country: Results of maximum revenue runs (year 1975)

	Year 2000	Pessimistic: Run D				Likely: Run E				Possible: Run F			
		--- F E E D (1000 LSU)-------				--- F E E D (1000 LSU)-------				-- F E E D (1000 LSU)-------			
COUNTRY NAME	LSU	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd	Supply	%Range	%C.Res	%C.Bpd
ANGOLA	2050	13081	82.8	13.6	3.6	27949	67.3	26.3	6.4	30840	66.7	28.0	5.4
BURUNDI	402	279	82.9	13.8	3.4	742	82.4	14.9	2.7	787	84.8	11.7	3.4
CAMEROON	2267	4830	88.6	9.1	2.2	11471	75.7	20.0	4.3	13767	51.7	39.5	8.8
CENT AFR EMP	500	10374	90.1	7.9	1.9	21481	80.9	15.6	3.4	28463	69.6	25.6	4.8
CHAD	859	2900	70.9	24.9	4.2	7894	49.8	43.4	6.8	8828	46.3	45.3	8.4
CONGO	62	4451	77.2	17.8	5.0	8876	55.1	35.9	9.0	11499	45.9	43.9	10.2
BENIN	757	1900	77.9	17.7	4.3	4680	58.2	34.0	7.8	4660	61.5	32.3	6.3
EQ GUINEA	6	326	79.7	15.6	4.7	953	66.6	25.9	7.6	772	31.6	53.9	14.5
ETHIOPIA	6298	5198	81.6	14.6	3.8	13133	67.9	25.9	6.1	11164	82.5	14.3	3.2
GABON	11	3508	81.4	13.8	4.8	11701	73.4	20.1	6.5	13644	49.4	41.9	8.7
GAMBIA	238	135	68.3	26.4	5.3	284	32.0	56.8	11.2	449	21.5	67.0	11.4
GHANA	999	2668	78.2	17.5	4.3	6662	57.4	34.8	7.8	8419	42.0	48.7	9.3
GUINEA	1241	2553	76.3	18.8	4.9	5577	63.1	29.7	7.1	7257	61.2	32.6	6.2
IVORY COAST	624	5061	81.1	15.0	3.9	11301	68.8	24.9	6.3	14121	55.8	37.4	6.8
KENYA	1396	544	89.0	9.0	2.0	1382	72.8	22.3	4.9	1287	84.3	13.0	2.7
LIBERIA	57	2795	79.6	16.2	4.2	3655	49.0	40.5	10.5	2731	41.6	46.4	12.0
MALAWI	652	1049	70.7	23.4	6.0	2208	55.5	35.9	8.6	2095	61.4	29.1	9.5
MALI	589	1995	80.7	15.8	3.5	5300	64.9	29.8	5.3	5266	70.2	25.0	4.8
MOZAMBIQUE	397	7357	73.2	21.5	5.2	18134	64.1	29.4	6.5	17822	69.2	25.9	4.9
NIGERIA	6473	7881	71.3	23.6	5.1	18247	53.8	38.8	7.4	20392	47.6	43.0	9.4
GUIN BISSAU	124	290	45.0	44.4	10.5	790	28.8	58.3	12.9	842	40.4	44.8	14.8
ZIMBABWE	1809	1649	57.8	33.4	8.8	4485	33.0	54.1	12.9	3464	43.2	47.8	9.0
RWANDA	357	259	89.2	8.8	2.0	724	84.8	12.7	2.5	886	78.7	17.4	3.9
SENEGAL	793	1095	80.2	16.4	3.4	2399	56.4	36.4	7.2	2544	51.3	40.4	8.3
SIERRA LEONE	173	1964	84.6	12.3	3.1	2271	66.7	26.7	6.6	3190	61.2	32.4	6.5
SUDAN	4088	8715	68.9	26.2	4.9	23761	47.3	45.9	6.8	25064	47.7	45.7	6.6
SWAZILAND	132	114	58.3	33.1	8.6	381	47.5	41.3	11.2	262	70.0	25.5	4.5
TANZANIA	4128	6739	74.4	20.6	5.0	16821	59.2	33.1	7.6	15447	67.0	27.4	5.6
TOGO	292	729	75.0	19.7	5.3	1624	51.9	39.6	8.5	2457	39.4	51.1	9.5
UGANDA	2759	2125	87.3	10.4	2.3	4953	76.0	20.0	4.0	6432	64.4	29.4	6.1
UPPER VOLTA	1257	2714	85.4	12.3	2.3	6461	73.1	23.2	3.7	6149	74.0	22.2	3.8
ZAIRE	673	30849	79.4	16.3	4.3	68093	66.9	26.4	6.7	79876	57.5	34.1	8.4
ZAMBIA	1023	11073	72.8	21.6	5.6	24334	48.5	41.1	10.3	18566	63.2	30.5	6.2
TOTAL	43499	147216	78.5	17.3	4.2	338744	62.8	30.4	6.8	369457	58.8	34.1	7.1

Table A21: Present and potential livestock units, percentage contribution to feed supply of rangeland, crop residues and crop by-products in tsetse areas: By country: Results of maximum revenue runs (year 2000)

	PRODUCTION (1000 mt)														
COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	188	297	6016	0	45	24	0	4231	4103	0	85	181	106	1143	417
BURUNDI	5	6	163	0	10	41	151	8	36	5	0	2	34	0	2
CAMEROON	151	356	1167	0	2	0	186	608	1032	0	0	468	8292	3676	2727
CENT AFR EMP	34	261	2017	0	0	0	0	1236	2034	0	0	1208	0	622	1487
CHAD	492	1323	0	0	0	0	0	0	965	0	0	1141	0	0	1
CONGO	2	1	605	0	1	0	112	436	6131	0	0	125	4895	744	1788
BENIN	19	206	1105	0	7	0	63	41	304	0	0	104	0	12	15
EQ GUINEA	0	0	0	5	0	0	0	0	355	0	0	7	52	405	655
ETHIOPIA	37	216	3202	0	0	0	0	0	122	626	5	1	0	302	29
GABON	0	0	166	0	0	0	0	698	1906	0	0	84	1378	11880	4644
GAMBIA	15	14	8	0	0	0	0	0	54	0	0	133	0	0	0
GHANA	131	0	1244	0	7	0	0	428	1657	0	0	346	4218	571	859
GUINEA	17	104	884	0	0	0	0	87	2043	0	0	44	0	5	230
IVORY COAST	26	16	1296	0	0	0	340	244	4534	0	0	0	3	71	3239
KENYA	2	17	226	0	5	378	34	1	35	33	1	6	2	174	4
LIBERIA	0	0	1	0	0	0	0	1	3683	0	0	0	0	742	282
MALAWI	57	1	925	0	0	17	0	5	303	0	0	171	0	66	194
MALI	1	530	547	0	0	0	0	0	301	0	0	296	0	0	14
MOZAMBIQUE	215	807	4883	0	113	0	431	1188	2347	0	0	735	0	8581	128
NIGERIA	1607	1	2263	0	129	0	0	432	6650	0	0	1635	0	0	851
GUIN BISSAU	23	20	32	0	1	0	0	0	737	0	0	95	0	120	0
ZIMBABWE	96	132	1858	0	0	0	0	0	715	0	0	157	0	42	13
RWANDA	4	14	93	0	5	22	218	8	43	1	0	1	30	5	0
SENEGAL	169	0	109	0	0	0	0	0	223	0	0	512	0	0	0
SIERRA LEONE	0	0	16	0	0	0	2	0	1850	0	0	7	75	0	34
SUDAN	54	4418	993	0	4	34	0	0	5089	0	0	2720	0	350	250
SWAZILAND	0	0	157	0	0	0	25	0	53	0	0	12	0	0	0
TANZANIA	184	338	3631	0	46	50	1424	315	4296	43	2	424	345	635	208
TOGO	5	61	456	0	3	0	0	38	224	0	0	33	0	12	104
UGANDA	52	112	267	0	27	0	396	226	792	0	0	192	1315	41	73
UPPER VOLTA	118	712	314	0	0	0	0	0	300	0	0	159	0	46	9
ZAIRE	21	28	5640	3	26	1	453	6862	32326	0	22	1139	49986	6753	13985
ZAMBIA	37	586	7840	0	0	0	5436	69	5196	0	1	730	0	1348	4
TOTAL	3775	10589	48138	8	441	571	9279	17171	90455	710	120	12883	70739	38358	32256

Table A12: Rainfed crop production in tsetse areas: By country: Results for "pessimistic" potential population (Run A) for year 1975

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	1192	941	20725	0	740	762	2894	49396	12986	36	0	3457	0	0	8754
BURUNDI	2	29	612	0	92	115	372	228	98	31	0	4	39	0	97
CAMEROON	858	1364	3007	0	171	1	2155	8519	5531	0	0	1874	19962	6788	19178
CENT AFR EMP	1115	1451	4719	0	0	0	25	29349	7837	0	0	4928	5	883	11384
CHAD	3383	4065	3085	0	0	0	681	0	6496	0	0	2874	0	0	42
CONGO	10	15	1012	0	52	0	278	15714	22166	0	0	500	18299	1358	6633
BENIN	183	1037	4189	0	206	0	999	967	2016	0	0	644	0	209	344
EQ GUINEA	0	0	0	25	0	0	586	0	1705	0	0	13	2	1728	790
ETHIOPIA	557	2886	10691	0	306	819	279	0	391	2714	0	47	0	0	92
GABON	0	0	237	0	0	0	106	17447	14757	0	0	203	2947	37721	6502
GAMBIA	77	42	80	0	11	0	0	1	464	0	0	411	0	0	0
GHANA	631	45	4393	0	182	0	95	9482	5810	0	0	1267	9875	1977	5313
GUINEA	404	614	2766	0	0	0	638	4816	5003	0	0	183	0	2	2506
IVORY COAST	164	135	4250	0	0	0	1155	11112	11975	0	0	196	7266	8093	10105
KENYA	25	94	1273	0	113	1241	210	92	214	76	0	14	2	387	65
LIBERIA	0	0	0	0	0	0	0	1021	11178	0	0	0	10958	3781	1716
MALAWI	353	5	2534	0	0	57	900	1366	1273	0	0	521	0	0	628
MALI	799	2610	2641	0	0	0	13	0	1500	0	0	1212	0	0	104
MOZAMBIQUE	1312	3241	14682	0	762	0	13617	16197	5726	0	0	2619	0	15180	3638
NIGERIA	5619	143	7107	0	2763	0	1158	8002	22288	0	0	5121	3312	471	7385
GUIN BISSAU	128	96	785	0	12	0	0	94	1888	0	0	299	0	274	0
ZIMBABWE	1201	540	8513	0	0	0	423	0	2573	0	0	860	0	0	112
RWANDA	2	33	370	0	34	36	386	336	163	11	0	5	46	0	110
SENEGAL	906	0	676	0	0	0	424	16	2284	0	0	1712	0	127	0
SIERRA LEONE	4	0	45	0	0	0	71	264	4404	0	0	49	171	0	1911
SUDAN	4073	19877	11288	0	62	81	347	0	19654	0	0	8593	0	694	2291
SWAZILAND	0	3	672	0	1	0	64	0	148	0	0	32	0	0	19
TANZANIA	1811	1968	14840	0	616	458	3735	12348	12550	145	4	1139	575	5352	1658
TOGO	47	301	1176	0	47	0	0	753	769	0	0	186	0	1473	1034
UGANDA	302	446	953	0	264	146	4109	2564	3549	0	0	515	2645	0	1550
UPPER VOLTA	939	3127	1891	0	0	0	792	0	1760	0	0	713	0	499	37
ZAIRE	82	121	10017	15	533	103	3611	122492	115637	0	0	4119	280577	26506	40079
ZAMBIA	1838	864	30006	0	0	595	14893	12045	17213	0	1	5236	0	0	732
TOTAL	28029	46107	169250	40	6977	4421	55028	324634	322021	3017	6	49562	356689	113510	134822

Table A23: Rainfed crop production in tsetse areas: By country: Results for "likely" potential population (Run B) for year 1975

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	2685	0	13952	1006	0	1258	33719	28151	22848	0	0	11548	0	4044	6651
BURUNDI	0	0	920	59	0	39	286	93	175	13	0	106	0	0	136
CAMEROON	0	0	4303	444	0	0	6342	1110	50155	0	0	749	33125	2186	2521
CENT AFR EMP	643	335	2957	1121	0	0	3684	26077	34393	0	0	2824	5936	11892	4634
CHAD	621	0	13527	4	0	0	2751	51	11841	0	0	98	0	28129	45
CONGO	0	0	0	535	0	0	0	5833	34450	0	0	218	48200	0	1880
BENIN	0	0	5949	31	0	0	2762	0	3017	0	0	1176	0	1938	351
EQ GUINEA	0	0	0	55	0	0	0	0	3998	0	0	16	1863	0	222
ETHIOPIA	0	0	14807	167	0	12945	7075	1777	1300	1427	405	213	0	19091	383
GABON	0	0	0	674	0	0	0	2621	34839	0	0	132	13668	0	3975
GAMBIA	0	0	241	0	0	0	47	0	1462	0	0	0	0	0	0
GHANA	0	47	3071	212	0	0	5810	1406	21987	0	0	1962	5287	1478	1759
GUINEA	0	0	1293	115	0	0	2330	6135	9505	0	0	2060	118	4022	1473
IVORY COAST	0	0	45	841	0	0	1623	3903	29032	0	0	2156	6023	9845	4498
KENYA	23	19	1074	10	0	3455	1308	99	394	361	34	118	0	138	62
LIBERIA	0	0	15	127	0	0	0	0	13002	0	0	0	17777	0	488
MALAWI	0	0	1326	48	0	260	2624	108	2221	0	0	1360	42	15979	208
MALI	0	0	8296	18	0	0	5876	1122	1737	0	0	181	0	261	98
MOZAMBIQUE	849	115	15236	521	0	0	55837	4073	8995	0	0	6038	0	10524	3713
NIGERIA	0	275	16972	391	0	0	15410	1345	40321	0	0	8328	3095	12425	3629
GUIN BISSAU	0	0	1794	0	0	0	0	0	755	0	0	0	0	11234	0
ZIMBABWE	312	0	10094	13	0	0	7534	0	2689	0	0	369	0	0	117
RWANDA	0	0	520	54	0	36	373	140	366	10	0	62	4	0	98
SENEGAL	0	0	3789	0	0	0	1361	0	3505	0	0	32	0	1505	0
SIERRA LEONE	0	0	0	82	0	0	21	0	6941	0	0	42	1264	0	430
SUDAN	0	0	39277	88	0	105	20949	5161	33946	0	0	3550	0	44084	2419
SWAZILAND	0	0	647	4	0	0	370	0	203	0	0	25	0	0	12
TANZANIA	1990	1378	9482	299	0	4595	32338	8598	11422	213	131	4947	243	15085	2218
TOGO	0	0	385	92	0	0	791	39	4964	0	0	605	0	3158	480
UGANDA	0	0	1418	406	0	921	5833	1148	8900	1	2	316	1134	1974	1481
UPPER VOLTA	0	0	7527	0	0	0	9339	0	2548	0	0	525	0	502	36
ZAIRE	0	0	1607	5340	0	413	9812	25354	246001	0	0	3511	300610	382	12296
ZAMBIA	644	0	12906	0	0	3546	100026	4	19761	4	1	6790	0	22039	747
TOTAL	7770	2172	193445	12769	0	27579	336245	124358	667687	2033	575	60072	438397	221923	57074

Table A24: Rainfed crop production in tsetse areas: By country: Results for "possible" potential population (Run C) for year 1975

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	292	190	3974	0	339	230	0	3257	3550	5	56	943	416	8528	2232
BURUNDI	0	0	132	0	20	73	147	0	36	2	1	2	42	0	14
CAMEROON	243	101	254	0	35	0	176	68	1261	0	10	665	8497	3833	8047
CENT AFR EMP	24	0	691	0	0	0	0	609	2309	0	0	2052	0	1302	4153
CHAD	815	603	0	0	0	0	0	0	1339	0	0	1475	0	0	17
CONGO	0	0	154	0	17	0	116	195	5140	0	0	233	5047	5672	3309
BENIN	49	48	854	0	64	0	64	0	474	0	0	264	0	45	116
EQ GUINEA	0	0	0	5	0	0	0	0	348	0	0	7	52	386	665
ETHIOPIA	52	0	2361	0	325	15	0	0	150	708	56	2	0	0	54
GABON	0	0	65	0	0	0	0	253	2947	0	0	119	1482	11200	6471
GAMBIA	4	0	3	0	5	0	0	0	83	0	0	141	0	0	0
GHANA	84	0	683	0	41	0	0	212	1555	0	0	536	4573	590	1707
GUINEA	3	59	724	0	0	0	0	43	2153	0	0	85	0	110	886
IVORY COAST	0	0	658	0	0	0	365	225	4605	0	0	5	30	335	5152
KENYA	1	11	95	0	45	435	38	1	45	42	12	11	4	179	33
LIBERIA	0	0	0	0	0	0	0	0	3435	0	0	0	0	731	591
MALAWI	17	1	581	0	0	34	0	32	455	0	1	398	1	16	257
MALI	236	57	473	0	0	0	0	0	476	0	0	524	0	0	68
MOZAMBIQUE	179	443	2821	0	576	0	451	1464	2857	0	0	1406	18	8510	1268
NIGERIA	383	0	1112	0	710	0	0	253	8299	0	3	2099	711	594	2820
GUIN BISSAU	23	16	17	0	2	0	0	0	731	0	0	107	0	110	0
ZIMBABWE	166	0	1615	0	0	0	0	0	720	0	0	386	0	0	33
RWANDA	0	0	58	0	12	29	218	7	45	3	5	2	43	0	24
SENEGAL	40	0	46	0	0	0	0	0	339	0	0	689	0	0	0
SIERRA LEONE	0	0	11	0	0	0	0	0	1823	0	0	11	93	0	67
SUDAN	1382	2483	927	0	4	34	0	0	5498	0	0	2994	0	1466	1270
SWAZILAND	0	0	102	0	2	0	43	0	53	0	0	40	0	0	19
TANZANIA	220	1	2030	0	359	191	1427	190	4590	40	16	997	369	1692	673
TOGO	4	0	383	0	16	0	0	34	314	0	0	70	28	307	215
UGANDA	23	37	134	0	75	6	381	81	905	0	3	246	1354	187	682
UPPER VOLTA	399	160	269	0	14	0	0	0	641	0	0	398	0	15	23
ZAIRE	0	1	1594	7	154	47	604	3561	31570	0	22	2004	53737	18514	30141
ZAMBIA	296	320	5085	0	0	73	5434	27	4372	0	5	2716	0	7306	152
TOTAL	4947	4538	27922	12	2825	1174	9469	10521	93137	802	197	21643	76507	71638	71176

Table A25: Rainfed crop production in tsetse areas: By country: Results for "pessimistic" maximum revenue run (Run D) for year 1975

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	1135	888	16358	0	1376	3045	1669	50231	13824	39	0	7553	0	0	7241
BURUNDI	1	15	236	0	140	773	372	149	98	26	0	37	60	0	91
CAMEROON	857	1292	1920	0	474	0	1628	7410	6267	0	0	2355	22565	6788	19364
CENT AFR EMP	1096	796	3058	0	0	0	22	29441	7922	0	0	7101	198	200	11521
CHAD	2936	3933	0	0	365	0	1673	0	8126	0	0	3908	0	0	13
CONGO	4	6	350	0	76	0	661	14687	22204	0	0	642	29125	1593	7775
BENIN	228	804	3432	0	367	0	936	957	2232	0	0	1194	0	1268	215
EQ GUINEA	0	0	0	23	0	0	548	0	1705	0	0	16	2	1727	1037
ETHIOPIA	839	1559	8895	0	1527	1461	228	0	375	2774	1	198	0	0	127
GABON	0	0	219	0	0	0	239	16930	15514	0	0	203	2947	39116	7736
GAMBIA	83	20	11	0	23	0	0	5	466	0	0	461	0	0	0
GHANA	603	0	3315	0	251	0	37	8616	6573	0	0	2218	10415	2002	5254
GUINEA	413	593	2586	0	0	0	127	2599	5150	0	0	1014	0	2	2379
IVORY COAST	167	117	4113	0	0	0	1193	11058	12558	0	0	282	9256	2112	10131
KENYA	11	57	834	0	271	1355	258	109	199	85	0	77	2	405	50
LIBERIA	0	0	0	0	0	0	0	942	11161	0	0	0	11237	3247	1688
MALAWI	360	4	1613	0	1	88	844	1088	1445	0	0	1232	2	0	628
MALI	1351	1994	1509	0	0	0	267	0	1595	0	0	1970	0	0	100
MOZAMBIQUE	925	2765	8155	0	1327	0	9823	17506	6076	0	0	8689	0	16022	3103
NIGERIA	4393	0	3451	0	4163	0	1003	7815	26380	0	0	7059	3622	109	7532
GUIN BISSAU	147	54	94	0	21	0	0	94	1894	0	0	825	0	227	0
ZIMBABWE	1297	409	5598	0	0	0	236	0	2700	0	0	2895	0	0	108
RWANDA	1	11	176	0	84	174	395	245	182	9	0	44	46	0	94
SENEGAL	814	0	150	0	0	0	269	16	2276	0	0	2215	0	80	0
SIERRA LEONE	3	0	33	0	0	0	89	227	4452	0	0	77	201	0	1985
SUDAN	4084	19673	1633	0	2929	92	1484	0	19858	0	0	11390	0	694	1920
SWAZILAND	0	3	525	0	6	0	194	0	160	0	0	85	0	0	19
TANZANIA	1197	1165	9897	0	1770	518	3887	13700	13512	144	1	2896	825	6332	1549
TOGO	59	260	1058	0	77	0	0	698	1593	0	0	256	0	1240	853
UGANDA	272	294	548	0	380	165	4115	2286	3659	0	0	996	2783	0	1926
UPPER VOLTA	1720	2119	763	0	0	0	1455	0	1934	0	0	1446	0	449	0
ZAIRE	28	42	7503	15	744	226	4245	121223	113117	0	0	5279	363338	22610	30989
ZAMBIA	1659	926	22305	0	1	687	12869	11441	18187	0	0	11375	0	0	220
TOTAL	26696	39811	110351	38	16382	8588	50781	319486	333414	3080	3	86002	456631	106231	125661

Table A28: Rainfed crop production in tsetse areas: By country: Results for "likely" maximum revenue run (Run E) for year 1975

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	0	0	468	31	196	12345	48608	31960	28212	0	0	19908	2437	4044	2403
BURUNDI	0	0	63	34	1	2549	711	34	328	0	0	59	20	794	29
CAMEROON	0	0	372	488	850	0	9724	469	29773	0	0	2296	80906	1166	836
CENT AFR EMP	0	0	0	160	40	0	9002	24679	32330	0	0	5896	27209	11892	1724
CHAD	0	0	0	0	2394	0	3929	137	12065	0	0	5704	0	28129	9
CONGO	0	0	0	311	0	0	1232	5338	32354	0	0	142	58992	1750	887
BENIN	0	0	0	0	88	0	3885	0	3650	0	0	5039	32	2164	186
EQ GUINEA	0	0	0	50	0	0	0	0	3007	0	0	0	5004	0	82
ETHIOPIA	0	0	1663	28	1943	32283	7343	0	2719	124	0	616	0	23100	112
GABON	0	0	0	178	0	0	160	2621	34012	0	0	114	27067	0	2373
GAMBIA	0	0	0	0	0	0	47	0	1462	0	0	174	0	0	0
GHANA	0	0	0	56	125	0	7712	417	19909	0	0	3629	18463	1478	740
GUINEA	0	0	0	3	1	0	3550	5215	9543	0	0	3248	2503	4022	953
IVORY COAST	0	0	0	132	0	0	5175	2790	25588	0	0	2382	33872	1141	1912
KENYA	0	0	226	0	61	5762	1822	39	485	0	0	181	0	138	23
LIBERIA	0	8	0	129	0	0	0	0	9158	0	0	0	30252	0	14
MALAWI	0	0	22	47	47	418	5951	79	1866	0	0	1570	1011	16273	113
MALI	0	0	0	0	58	0	6799	371	1860	0	0	5996	0	261	58
MOZAMBIQUE	0	0	0	19	863	0	85486	5740	11226	0	0	12952	523	14803	913
NIGERIA	0	0	271	82	535	0	19392	618	39419	0	0	18983	16022	12627	2040
GUIN BISSAU	0	0	0	0	0	0	495	0	730	0	0	1224	0	11234	0
ZIMBABWE	0	0	0	3	381	0	9183	473	2861	0	0	6786	0	0	83
RWANDA	0	0	268	3	7	604	765	99	499	0	0	100	67	20	10
SENEGAL	0	0	0	0	32	0	1366	0	3476	0	0	2710	0	1505	0
SIERRA LEONE	0	0	0	20	0	0	130	0	6024	0	0	133	4838	0	192
SUDAN	0	0	0	0	14863	518	28059	5142	34235	0	0	8206	300	45640	1398
SWAZILAND	0	0	0	0	0	0	1685	0	227	0	0	133	14	0	1
TANZANIA	0	0	42	205	1790	6233	41576	7327	14243	0	0	8171	1324	17095	1485
TOGO	0	0	0	0	17	0	1002	0	5358	0	0	775	658	6698	136
UGANDA	0	0	26	115	192	1131	7662	443	9574	0	0	1145	4021	3823	611
UPPER VOLTA	0	0	0	0	797	0	9788	0	2883	0	0	4211	0	502	0
ZAIRE	0	0	380	4515	71	1210	32688	25138	163733	0	0	6774	504005	1159	4165
ZAMBIA	0	0	2	0	1144	3698	118318	1727	21069	0	0	10336	0	22039	225
TOTAL	0	8	3809	6621	26506	66756	473260	120864	563896	124	0	139608	819551	233510	23728

Table A27: Rainfed crop production in tsetse areas: By country: Results for "possible" maximum revenue run (Run F) for year 1975

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	213	298	5927	0	78	24	0	4183	4096	0	83	206	111	1141	638
BURUNDI	4	5	150	0	9	33	141	8	34	4	0	2	32	0	1
CAMEROON	158	347	1173	0	3	0	185	598	1030	0	0	452	8237	3653	2733
CENT AFR EMP	39	265	2016	0	0	0	0	1210	2097	0	0	1194	0	621	1782
CHAD	486	1321	0	0	0	0	0	0	960	0	0	1131	0	0	1
CONGO	2	2	602	0	2	0	112	435	5947	0	0	123	4951	734	1826
BENIN	16	209	1085	0	8	0	61	28	305	0	0	103	0	11	14
EQ GUINEA	0	0	0	5	0	0	0	0	355	0	0	7	52	403	653
ETHIOPIA	37	210	3164	0	0	0	0	0	124	617	12	1	0	299	31
GABON	0	0	166	0	0	0	0	695	1909	0	0	84	1395	11648	4681
GAMBIA	13	13	8	0	0	0	0	0	52	0	0	125	0	0	0
GHANA	130	0	1203	0	9	0	0	401	1583	0	0	330	4178	549	801
GUINEA	14	106	880	0	0	0	0	86	2045	0	0	44	0	5	228
IVORY COAST	26	18	1274	0	0	0	367	223	4487	0	0	0	3	70	3167
KENYA	1	16	204	0	10	363	31	0	27	31	0	5	1	139	3
LIBERIA	0	0	1	0	0	0	0	0	3606	0	0	0	0	732	282
MALAWI	51	1	864	0	0	17	0	4	274	0	0	159	0	62	187
MALI	1	523	537	0	0	0	0	0	294	0	0	291	0	0	14
MOZAMBIQUE	221	804	4780	0	112	0	428	1342	2330	0	0	733	0	8686	127
NIGERIA	1535	0	2118	0	129	0	0	380	6161	0	0	1563	0	0	839
GUIN BISSAU	23	20	31	0	1	0	0	0	734	0	0	95	0	119	0
ZIMBABWE	92	130	1773	0	0	0	0	0	705	0	0	192	0	42	13
RWANDA	4	13	85	0	5	21	205	8	38	1	0	1	27	4	0
SENEGAL	164	0	104	0	0	0	0	0	223	0	0	511	0	0	0
SIERRA LEONE	0	0	15	0	0	0	1	0	1801	0	0	7	74	0	35
SUDAN	49	4408	977	0	4	34	0	0	5076	0	0	2723	0	349	250
SWAZILAND	0	0	151	0	0	0	25	0	52	0	0	15	0	0	0
TANZANIA	221	341	3610	0	51	49	1408	65	4250	43	0	415	332	1088	221
TOGO	5	64	440	0	2	0	0	19	217	0	0	32	0	12	98
UGANDA	55	105	252	0	24	0	384	215	763	0	0	186	1283	44	84
UPPER VOLTA	70	749	311	0	0	0	0	0	303	0	0	157	0	46	8
ZAIRE	21	28	5614	3	26	1	452	6844	32127	0	22	1134	49685	6727	13898
ZAMBIA	37	584	7817	0	0	0	5419	67	5170	0	1	728	0	1346	4
TOTAL	3701	10594	47347	8	482	546	9225	16824	89192	699	121	12765	70369	38543	32633

Table A28: Rainfed crop production in tsetse areas: By country: Results for "pessimistic" potential population (Run A) for year 2000

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	1190	940	20980	0	740	759	1601	49266	13016	36	0	3446	0	0	8733
BURUNDI	2	27	556	0	85	104	346	213	92	28	0	4	36	0	90
CAMEROON	852	1357	3133	0	170	1	1659	8458	5529	0	0	1863	19817	6831	19044
CENT AFR EMP	1114	1448	4584	0	0	0	25	29755	7827	0	0	4918	5	883	11516
CHAD	3359	4043	3079	0	0	0	678	0	6461	0	0	2858	0	0	42
CONGO	10	15	989	0	52	0	280	15721	22136	0	0	492	17696	1353	6711
BENIN	180	1026	4116	0	202	0	422	947	2216	0	0	631	0	205	334
EQ GUINEA	0	0	0	25	0	0	584	0	1698	0	0	13	2	1721	787
ETHIOPIA	532	2857	10560	0	298	785	258	0	393	2688	0	46	0	0	91
GABON	0	0	236	0	0	0	106	17440	14751	0	0	203	2946	37706	6499
GAMBIA	73	40	77	0	10	0	0	1	436	0	0	391	0	0	0
GHANA	610	39	4260	0	172	0	40	9230	5571	0	0	1231	9647	1910	5214
GUINEA	403	619	2799	0	0	0	493	4784	4980	0	0	183	0	2	2482
IVORY COAST	163	134	4204	0	0	0	1105	10995	11814	0	0	185	7190	8014	9930
KENYA	23	85	1197	0	105	1155	194	77	176	78	0	12	1	319	54
LIBERIA	0	0	0	0	0	0	0	940	10980	0	0	0	10835	3730	1684
MALAWI	329	5	2492	0	0	57	425	1290	1163	0	0	486	0	0	599
MALI	791	2575	2624	0	0	0	8	0	1431	0	0	1187	0	0	104
MOZAMBIQUE	1309	3196	15916	0	772	0	8900	15802	5669	0	0	2729	0	15085	3610
NIGERIA	5406	138	6725	0	2633	0	996	7387	20720	0	0	4922	3127	458	6720
GUIN BISSAU	127	95	868	0	12	0	0	94	1796	0	0	297	0	272	0
ZIMBABWE	1173	514	8375	0	0	0	251	0	2537	0	0	825	0	0	110
RWANDA	1	31	336	0	31	34	362	315	150	11	0	5	39	0	102
SENEGAL	897	0	679	0	0	0	420	16	2241	0	0	1689	0	126	0
SIERRA LEONE	4	0	44	0	0	0	73	249	4281	0	0	48	187	0	1957
SUDAN	4061	19823	11258	0	62	81	346	0	19600	0	0	8572	0	692	2286
SWAZILAND	0	3	661	0	1	0	63	0	145	0	0	33	0	0	19
TANZANIA	1794	1796	14668	0	611	386	3918	12152	12383	157	4	1205	554	5300	1626
TOGO	45	294	1135	0	45	0	0	712	737	0	0	186	0	872	1029
UGANDA	292	431	1242	0	251	127	2814	2486	3452	1	0	494	2597	0	1513
UPPER VOLTA	927	3085	1870	0	0	0	762	0	1747	0	0	706	0	495	37
ZAIRE	81	121	9974	15	531	102	3601	122017	114937	0	0	4105	282080	22518	39989
ZAMBIA	1833	861	29968	0	0	437	14854	12004	17135	0	1	5207	0	0	729
TOTAL	27596	45609	169618	40	6793	4034	45597	322363	318214	3003	6	49190	356769	108500	133653

Table A29: Rainfed crop production in tsetse areas: By country: Results for "likely" potential population (Run B) for year 2000

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	2681	0	13906	1003	0	1252	33641	28088	22801	0	0	11524	0	4039	6634
BURUNDI	0	0	834	55	0	35	267	86	160	12	0	99	0	0	127
CAMEROON	0	0	4274	442	0	0	6313	1104	49835	0	0	745	32902	2166	2508
CENT AFR EMP	643	335	2956	1119	0	0	3682	26042	34336	0	0	2821	5921	11889	4627
CHAD	619	0	13469	4	0	0	2741	50	11740	0	0	97	0	27965	45
CONGO	0	0	0	535	0	0	0	5817	34386	0	0	217	48176	0	1864
BENIN	0	0	5868	30	0	0	2723	0	2950	0	0	1150	0	1903	342
EQ GUINEA	0	0	0	55	0	0	0	0	3981	0	0	15	1855	0	221
ETHIOPIA	0	0	14609	165	0	12775	6984	1757	1284	1408	399	211	0	18872	379
GABON	0	0	0	674	0	0	0	2619	34824	0	0	132	13665	0	3974
GAMBIA	0	0	236	0	0	0	46	0	1363	0	0	0	0	0	0
GHANA	0	41	2920	209	0	0	5562	1357	21366	0	0	1943	5170	1062	1735
GUINEA	0	0	1313	114	0	0	2313	6087	9437	0	0	2043	117	4140	1461
IVORY COAST	0	0	45	831	0	0	1614	3877	28556	0	0	2137	5937	9747	4446
KENYA	22	18	1045	11	0	3323	1016	84	301	350	32	120	0	106	51
LIBERIA	0	0	15	126	0	0	0	0	12741	0	0	0	17582	0	483
MALAWI	0	0	1264	46	0	258	2313	105	2040	0	0	1298	42	14621	196
MALI	0	0	8240	18	0	0	5837	1115	1590	0	0	180	0	189	97
MOZAMBIQUE	845	115	15169	518	0	0	55560	4049	8870	0	0	5994	0	10363	3680
NIGERIA	0	268	16361	351	0	0	14964	1304	36950	0	0	7951	2800	11880	3359
GUIN BISSAU	0	0	1786	0	0	0	0	0	751	0	0	0	0	11184	0
ZIMBABWE	307	0	9795	20	0	0	7409	0	2651	0	0	354	0	0	115
RWANDA	0	0	467	50	0	34	354	133	335	9	0	59	4	0	90
SENEGAL	0	0	3756	0	0	0	1349	0	3457	0	0	32	0	1401	0
SIERRA LEONE	0	0	0	80	0	0	20	0	6760	0	0	41	1237	0	422
SUDAN	0	0	39166	87	0	105	20896	5152	33847	0	0	3546	0	43964	2415
SWAZILAND	0	0	637	3	0	0	364	0	200	0	0	24	0	0	12
TANZANIA	1971	1365	9391	283	0	4549	31990	8517	11209	211	130	4891	238	14881	2167
TOGO	0	0	369	85	0	0	771	39	4825	0	0	593	0	3034	456
UGANDA	0	0	1372	389	0	835	5591	1122	8598	1	2	317	1121	1884	1424
UPPER VOLTA	0	0	7425	0	0	0	9249	0	2521	0	0	521	0	498	36
ZAIRE	0	0	1601	5325	0	412	9790	25285	244583	0	0	3502	298771	381	12265
ZAMBIA	643	0	12882	0	0	3544	99720	4	19646	4	1	6773	0	21981	744
TOTAL	7736	2143	191187	12641	0	27127	333093	123802	658913	1999	566	59344	435546	218159	56389

Table A30: Rainfed crop production in tsetse areas: By country: Results for "possible" potential population (Run C) for year 2000

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	291	190	3962	0	338	229	0	3249	3542	5	56	941	415	8517	2227
BURUNDI	0	0	120	0	18	66	136	0	34	1	1	2	39	0	13
CAMEROON	242	100	252	0	35	0	175	68	1252	0	10	661	8440	3810	7998
CENT AFR EMP	24	0	691	0	0	0	0	608	2306	0	0	2050	0	1300	4145
CHAD	811	601	0	0	0	0	0	0	1330	0	0	1467	0	0	17
CONGO	0	0	153	0	17	0	116	195	5129	0	0	232	5040	5666	3305
BENIN	49	48	839	0	63	0	62	0	465	0	0	259	0	44	113
EQ GUINEA	0	0	0	5	0	0	0	0	347	0	0	7	52	385	662
ETHIOPIA	52	0	2330	0	321	15	0	0	148	697	55	2	0	0	54
GABON	0	0	65	0	0	0	0	253	2946	0	0	119	1482	11196	6469
GAMBIA	4	0	2	0	4	0	0	0	76	0	0	134	0	0	0
GHANA	82	0	665	0	39	0	0	206	1468	0	0	516	4468	572	1670
GUINEA	4	59	720	0	0	0	0	42	2139	0	0	86	0	126	877
IVORY COAST	0	0	653	0	0	0	362	222	4519	0	0	5	30	330	5073
KENYA	0	10	89	0	42	418	34	1	37	40	11	10	3	137	27
LIBERIA	0	0	0	0	0	0	0	0	3360	0	0	0	0	720	585
MALAWI	15	1	538	0	0	34	0	31	417	0	1	372	1	15	245
MALI	236	53	468	0	0	0	0	0	460	0	0	517	0	0	67
MOZAMBIQUE	178	441	2804	0	572	0	448	1456	2822	0	0	1399	18	8409	1260
NIGERIA	368	0	1041	0	679	0	0	238	7635	0	3	2010	668	556	2557
GUIN BISSAU	23	16	17	0	2	0	0	0	728	0	0	107	0	109	0
ZIMBABWE	161	0	1581	0	0	0	0	0	710	0	0	378	0	0	32
RWANDA	0	0	53	0	11	28	205	6	40	2	4	2	38	0	22
SENEGAL	39	0	46	0	0	0	0	0	333	0	0	681	0	0	0
SIERRA LEONE	0	0	11	0	0	0	0	0	1775	0	0	11	91	0	65
SUDAN	1378	2476	924	0	4	34	0	0	5484	0	0	2987	0	1462	1267
SWAZILAND	0	0	101	0	2	0	42	0	53	0	0	40	0	0	19
TANZANIA	218	1	2010	0	355	189	1411	188	4510	40	16	986	357	1655	661
TOGO	4	0	372	0	16	0	0	33	301	0	0	68	23	266	210
UGANDA	22	36	129	0	72	6	364	78	877	0	2	236	1321	181	661
UPPER VOLTA	394	158	266	0	13	0	0	0	635	0	0	393	0	13	22
ZAIRE	0	1	1589	7	153	47	603	3552	31378	0	22	1996	53414	18420	29969
ZAMBIA	295	319	5069	0	0	73	5416	27	4347	0	5	2709	0	7294	152
TOTAL	4900	4519	27576	12	2767	1144	9381	10462	91617	789	193	21398	75910	71194	70460

Table A31: Rainfed crop production in tsetse areas: By country: Results for "pessimistic" maximum revenue run (Run D) for year 2000

PRODUCTION (1000 mt)

COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	1133	887	16310	0	1373	3025	1666	51851	13798	38	0	5819	0	0	7674
BURUNDI	1	13	216	0	128	699	346	138	92	24	0	34	56	0	85
CAMEROON	853	1285	1905	0	472	0	1620	7367	6224	0	0	2342	22397	6745	19428
CENT AFR EMP	1095	795	3054	0	0	0	22	29392	7912	0	0	7095	197	199	11500
CHAD	2920	3912	0	0	368	0	1667	0	8046	0	0	3888	0	0	13
CONGO	4	6	348	0	76	0	658	14639	22173	0	0	640	29104	1587	7762
BENIN	226	795	3369	0	362	0	924	938	2192	0	0	1174	0	1231	209
EQ GUINEA	0	0	0	23	0	0	546	0	1698	0	0	15	2	1719	1032
ETHIOPIA	828	1539	8783	0	1507	1439	225	0	371	2733	1	195	0	0	125
GABON	0	0	219	0	0	0	239	16923	15509	0	0	203	2946	39100	7734
GAMBIA	79	17	10	0	22	0	0	5	444	0	0	436	0	0	0
GHANA	582	0	3208	0	239	0	32	8418	6292	0	0	2157	10167	1935	5135
GUINEA	417	591	2571	0	0	0	122	2577	5128	0	0	1016	0	2	2356
IVORY COAST	166	117	4055	0	0	0	1184	10902	12338	0	0	282	9159	2096	9970
KENYA	11	51	779	0	252	1302	239	93	165	82	0	70	1	337	41
LIBERIA	0	0	0	0	0	0	0	928	10933	0	0	0	11111	3202	1666
MALAWI	334	4	1519	0	1	87	817	1034	1317	0	0	1143	2	0	600
MALI	1333	1969	1490	0	0	0	265	0	1523	0	0	1947	0	0	100
MOZAMBIQUE	920	2742	8095	0	1318	0	9743	17950	6014	0	0	8370	0	15916	3083
NIGERIA	4197	0	3262	0	3981	0	973	7190	24414	0	0	6792	3420	106	6823
GUIN BISSAU	146	54	93	0	20	0	0	93	1885	0	0	821	0	226	0
ZIMBABWE	1267	400	5446	0	0	0	233	0	2662	0	0	2821	0	0	106
RWANDA	1	10	156	0	78	166	370	230	167	9	0	42	39	0	87
SENEGAL	805	0	148	0	0	0	266	16	2252	0	0	2188	0	79	0
SIERRA LEONE	3	0	32	0	0	0	87	221	4337	0	0	75	196	0	1928
SUDAN	4072	19619	1629	0	2921	92	1480	0	19803	0	0	11362	0	692	1915
SWAZILAND	0	3	517	0	6	0	191	0	157	0	0	84	0	0	19
TANZANIA	1183	1152	9777	0	1742	512	3841	13556	13295	143	1	2867	792	6272	1535
TOGO	57	254	1022	0	74	0	0	676	1546	0	0	249	0	644	850
UGANDA	263	284	527	0	364	149	3961	2219	3535	0	0	963	2727	0	1864
UPPER VOLTA	1700	2085	755	0	0	0	1438	0	1912	0	0	1431	0	445	0
ZAIRE	28	42	7466	15	741	226	4234	120758	112435	0	0	5262	361070	22476	30911
ZAMBIA	1654	923	22232	0	1	687	12819	11403	18104	0	0	11347	0	0	219
TOTAL	26292	39562	109009	38	16057	8388	50225	319529	328689	3031	3	83145	453394	105021	124784

Table A.32: Rainfed crop production in tsetse areas: By country: Results for "likely" maximum revenue run (Run E) for year 2000

	PRODUCTION (1000 mt)														
COUNTRY NAME	Millet	Sorgh.	Maize	Soybean	Beans	W.Pot.	S.Pot.	Cassava	Rice	Wheat	Barley	GrndNut	Banana	SugCane	Oil P.
ANGOLA	0	0	464	31	195	12259	48507	31894	28152	0	0	19867	2433	4039	2397
BURUNDI	0	0	59	31	1	2305	662	32	303	0	0	54	19	747	27
CAMEROON	0	0	364	485	846	0	9679	466	29583	0	0	2285	80379	1161	833
CENT AFR EMP	0	0	0	160	40	0	8996	24645	32280	0	0	5892	27151	11889	1722
CHAD	0	0	0	0	2385	0	3914	136	11963	0	0	5679	0	27965	9
CONGO	0	0	0	311	0	0	1226	5322	32293	0	0	141	58954	1749	872
BENIN	0	0	0	0	87	0	3826	0	3566	0	0	4962	31	2123	182
EQ GUINEA	0	0	0	50	0	0	0	0	2995	0	0	0	4983	0	82
ETHIOPIA	0	0	1646	28	1921	31811	7249	0	2686	122	0	608	0	22834	111
GABON	0	0	0	178	0	0	160	2619	33999	0	0	114	27059	0	2372
GAMBIA	0	0	0	0	0	0	46	0	1363	0	0	170	0	0	0
GHANA	0	0	0	55	119	0	7402	407	19359	0	0	3526	18021	1062	735
GUINEA	0	0	0	3	14	0	3525	5173	9478	0	0	3223	2477	4140	945
IVORY COAST	0	0	0	130	0	0	5139	2772	25177	0	0	2365	33352	1135	1895
KENYA	0	0	215	0	56	5530	1615	32	404	0	0	171	0	106	12
LIBERIA	0	8	0	127	0	0	0	0	8932	0	0	0	29945	0	13
MALAWI	0	0	22	49	45	414	5486	77	1705	0	0	1493	963	14802	110
MALI	0	0	0	0	57	0	6754	369	1713	0	0	5956	0	189	58
MOZAMBIQUE	0	0	0	19	859	0	85055	5709	11112	0	0	12870	519	14617	893
NIGERIA	0	0	246	73	465	0	18780	598	36188	0	0	18334	14413	12070	1912
GUIN BISSAU	0	0	0	0	0	0	493	0	727	0	0	1219	0	11184	0
ZIMBABWE	0	0	0	1	303	0	8988	466	2817	0	0	6702	0	0	82
RWANDA	0	0	231	3	6	574	717	94	459	0	0	95	61	0	10
SENEGAL	0	0	0	0	32	0	1354	0	3428	0	0	2686	0	1401	0
SIERRA LEONE	0	0	0	20	0	0	126	0	5862	0	0	129	4734	0	190
SUDAN	0	0	0	0	14821	518	28000	5133	34134	0	0	8187	299	45518	1396
SWAZILAND	0	0	0	0	0	0	1659	0	224	0	0	131	14	0	1
TANZANIA	0	0	42	188	1772	6169	41146	7256	14031	0	0	8081	1300	16817	1439
TOGO	0	0	0	0	16	0	972	0	5223	0	0	754	646	5977	139
UGANDA	0	0	25	109	185	1017	7384	433	9251	0	0	1114	3946	3693	578
UPPER VOLTA	0	0	0	0	778	0	9695	0	2852	0	0	4170	0	498	0
ZAIRE	0	0	378	4487	71	1207	32614	25064	162899	0	0	6758	500877	1156	4155
ZAMBIA	0	0	2	0	1141	3696	117999	1724	20949	0	0	10308	0	21981	224
TOTAL	0	8	3701	6551	26223	65505	469183	120431	556124	122	0	138060	812586	228863	23406

Table A33: Rainfed crop production in tsetse areas: By country: Results for "possible" maximum revenue run (Run F) for year 2000

ANNEX 2

Estimation of Livestock Supporting Potential

ANNEX 2

Estimation of Livestock Supporting Potential

In each length of growing period zone the livestock population potential has been estimated from the potential roughage and crop production (residues and byproducts) as determined by the crop choice algorithms (maximizing food production or maximizing net revenues from crop production), Fig.A2.1. The potentially available feed supply, SFD in a particular length of growing period zone from crop production, has been calculated as

$$SFD = \sum_{j \in Z} \sum_{i=1}^{N} Q_{ij} \, (CR_i \cdot CRE_i \cdot CRU_i + CB_i \cdot CBE_i \cdot CBU_i) \cdot MJPMC$$

where

SFD... potentially available feed supply from rainfed crops and grassland in length of growing period Z (measured in MJ)

Q_{ij} ··· production of crop i = 1, ..., N in land cell j ∈ Z

CR_i ··· crop specific multiplier converting crop yields into fibrous dry matter yields of their respective crop residues

CRE_i ··· metabolizable energy from crop residues (Mcal/kg dry matter)

CRU_i ··· crop residue recovery rate. This rate is a crude estimate of the likely fraction of a particular crop residue actually used for feeding. It has to be noted that this utilization rate depends on a large number of factors, such as farm management practices, storage facilities, intake rates, etc.

CB_i ··· crop specific multiplier relating crop production to output of respective crop byproducts

CBE_i ··· metabolizable energy from crop byproducts (Mcal/kg dry matter)

CBU_i ··· crop byproduct utilization rate

MJPHC... conversion factor relating M Joule to Mcal (1Mcal = 4.187 M Joule)

Table A2.1. Feed Conversion Factors for Crop Residues and Crop Byproducts

		Residues			Byproducts		
		CR	CRE	CRU	CB	CBE	CBU
1	Millet	5.00	1.71	0.2	.08	2.40	0.9
2	Sorghum	5.00	1.88	0.2	.08	2.63	0.8
3	Maize	3.00	2.15	0.3	.20	3.16	0.9
4	Soybeans	4.00	1.65	0.3	.80	2.61	0.9
5	Beans	4.00	1.90	0.3	-	-	-
6	Sweet Potatoes	0.20	2.00	0.1	-	-	-
7	Cassava	1.00	2.00	-	-	-	-
8	Rice	1.80	1.58	0.4	.08	3.97	0.9
9	Spring Wheat	2.00	1.60	0.4	.20	2.57	0.9
10	White Potatoes	0.20	2.00	-	-	-	-
11	Winter Wheat	2.00	1.60	0.4	.20	2.57	0.9
12	Barley	1.50	1.72	0.3	-	-	-
13	Upland Rice	3.00	1.58	0.4	.08	3.97	0.9
14	Groundnuts	2.00	1.80	0.4	.38	3.63	0.2
15	Banana/Plantain	0.40	2.30	-	-	-	-
16	Sugarcane	0.25	1.70	0.1	.04	2.32	0.5
17	Oil Palm	4.00	1.35	-	-	-	-
18	Grassland	1.00	1.00	1.0	-	-	-

Source: Gartner and Hallam (1983); Kossila (1983).

The crop multipliers and conversion factors used in this study are listed in Table A2.1. The potentially available feed supply from rainfed crop origin SFD has been converted into a particular reference livestock unit (LSU) represented by a modern European-type dairy cow with an annual ME (metabolizable energy) requirement of 35600 MJ (Gartner and Hallam, 1983). Thus, the potential livestock supporting capacity LVPOT (measured in LSU's) is given as

LVPOT = SFD/35600

The potential livestock population has been compared to the estimated

year 1975 and projected year 2000 livestock populations at the LGP zone level. For this purpose the three livestock systems considered in this study, cattle, sheep and goats, had to be converted to the reference LSU. Conversion factors used to arrive at the reference unit of measurement were 0.4 for cattle, 0.05 for sheep, and 0.09 for goats. The large number of countries considered in the study did not allow for a distinction among different livestock systems within or between countries. The estimated livestock population in 1975 for a particular zone K was therefore calculated as

$$LVA_{K,1975} = CFC*CATTLE_{K,1975}+CFS*SHEEP_{K,1975}+CFG\cdot GOATS_{K,1975}$$

where

$LVA_{K,1975}$ ··· estimated 1975 livestock population in zone K measured in reference LSU

$CATTLE_{K,1975}$ ··· estimated 1975 cattle population in zone K (head)

$SHEEP_{K,1975}$ ··· estimated 1975 sheep population in zone K (head)

$GOATS_{K,1975}$ ··· estimated 1975 goat population in zone K (head)

CFC, CFS, CFG... conversion factors relating reference livestock units to number of heads (ref.LSU/head)

A similar calculation has been carried out for the projected livestock numbers in the year 2000. Projected country totals have been taken from the FAO AT2000 study (Scenario B, moderate economic growth). Livestock numbers for 2000 have been allocated to the LGP zones according to the estimated 1975 distribution. Even though this may be unrealistic in some cases the lack of additional information did not justify a more sophisticated approach. Finally, the potential livestock population has been compared to the estimated 1975 and projected 2000 livestock numbers (Annex 1, Tables A17-A21).

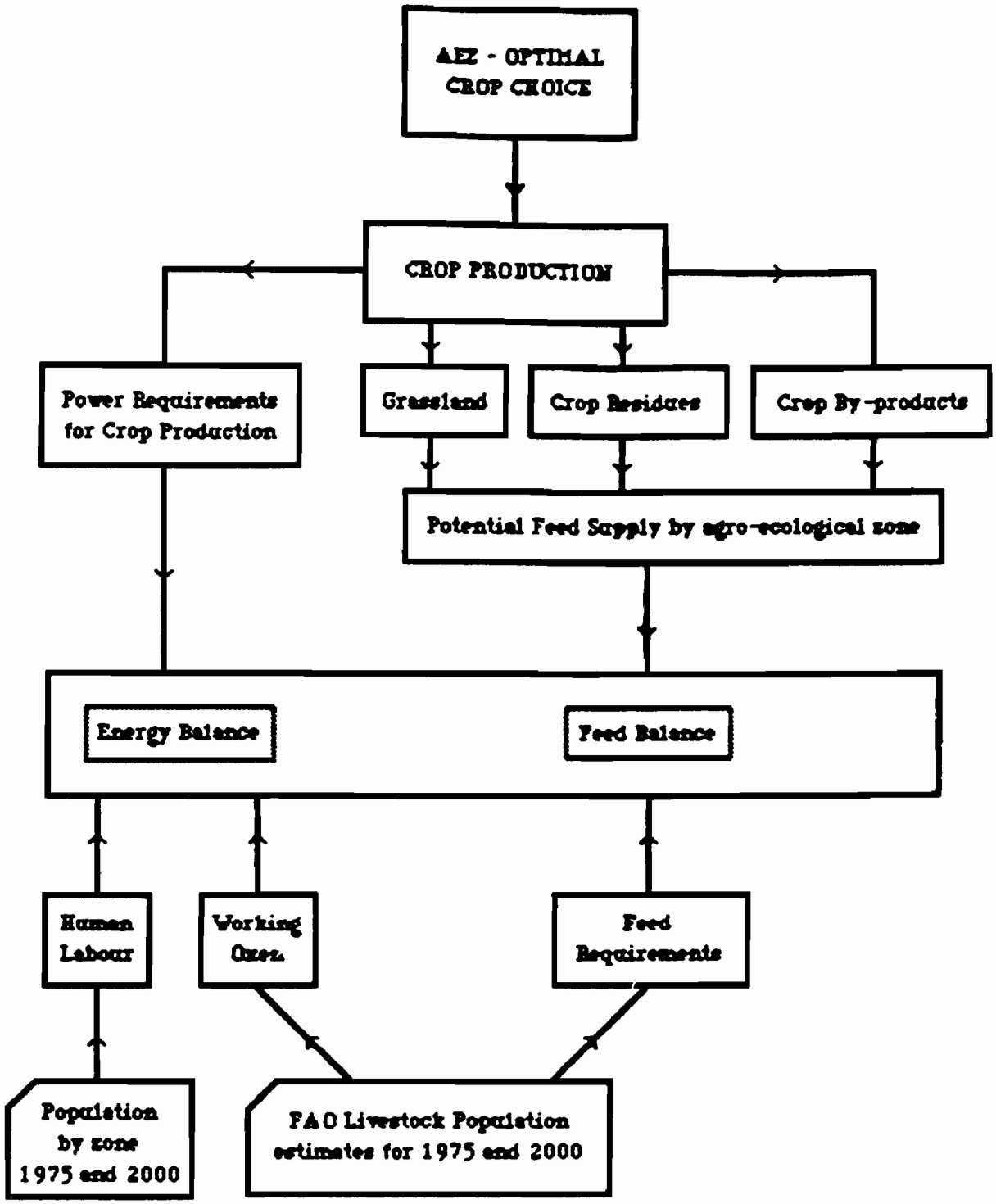

Fig. A 2.1: Feed and Energy Balance: Estimation of Livestock Supporting Potential