AGRICULTURAL UNIVERSITY OF NORWAY

Department of Vegetable Crops
P.O.B. 22, 1432 Ås-NLH, Norway

Mimeograph No. 89

ISBN 82-576-5548-1

Background notes to the proposed project:

THE LOCAL PRODUCTION OF VEGETABLES IN TANZANIA WITH THE AIMS OF IMPROVING THE NUTRITIONAL STANDARDS OF FAMILIES AND FOR SUPPLYING TO THE URBAN AREAS.

By

Trevor Remedios and A.R. Persson

AGRICULTURAL UNIVERSITY OF NORWAY
Department of Vegetable Crops
P.O.B. 22, 1432 Ås-NLH, Norway

Mimeograph No. 89
ISBN 82-576-5548-1

Background notes to the proposed project:

THE LOCAL PRODUCTION OF VEGETABLES IN TANZANIA WITH THE AIMS OF IMPROVING THE NUTRITIONAL STANDARDS OF FAMILIES AND FOR SUPPLYING TO THE URBAN AREAS.

By Trevor Remedios and A.R. Persson

Background notes to the proposed project.

THE LOCAL PRODUCTION OF VEGETABLES IN TANZANIA WITH THE AIMS OF IMPROVING THE NUTRITIONAL STANDARDS OF FAMILIES AND FOR SUPPLYING TO THE URBAN AREAS.

By Trevor Remedios and A.R. Persson

I. INTRODUCTION

Since agriculture started, man has lived on cereals, starchy roots and fruit, and foods of animal origin as a rare addition to the diet. In a variety of cultures and regions, people who exist on this diet eat, in addition, a quantity of legumes which is usually within the range of 30-70 grams daily.

The human body requires approximately 40 different types of nutrients ranging from water, vitamins, minerals, special fatty acids, and eight different essential amino acids, and enough of calorie-producing foods such as carbohydrates.

However, not all human beings have been fortunate enough to have all these suppliants in their diets and this can be clearly seen from the Food and Agricultural Organisation (FAO) statistics and from the outcome of the World Food Conferance in Rome, November 1974 (Tables 1, 2). Table 1 (see next page) shows by regions for 1961 and 1969-71 the per caput availability of energy (in kilo-calories), of proteins (in grams per day) and of energy as a per-centage of requirements. Table 2 (page 3) shows the numbers of countries with surpluses and deficits of energy supplies in 1961 and the 1969-71 average. As can be seen from these figures, the developing countries lag far behind the developed countries as far as food consumption is concerned, although they make up a far greater proportion of the world's population.

FAO statistics show that in almost all economically under-developed regions, calorie intake has surpassed 1937-39 levels, but protein levels are lower than 20 years ago. Recent figures show that energy intake in developed countries has risen from 2960 kcalories per caput per day in 1961 to 3160 kcalories in 1971, an increase of 200 calories. Daily protein intake has risen from 87 to 96 grams. During the same period, energy intake in the developing countries as a whole, rose from 2100 to 2200 kcal and the protein intake from 55 to 57 grams. This is a dangerous situation, and can give

Table 1. - AVERAGE ENERGY AND PROTEIN SUPPLY, BY REGION[1] (FAO)

	Energy		Protein		Energy as percent of requirement	
	1961	1969-71 average	1961	1969-71 average	1961	1969-71 average
	Kcals per caput		Grams per caput		Percent	
Developed market economies	2950	3090	87.5	95.1	115	121
Western Europe	3020	3130	89.3	93.7	118	123
North America	3110	3320	92.3	105.2	118	126
Oceania	3210	3260	92.7	108.1	121	123
Other devel. market economies	2420	2550	73.3	79.1	102	108
Eastern Europe and U.S.S.R.	2990	3260	85.8	99.3	116	127
Total developed countries	2960	3150	87.o	96.4	116	123
Developed market economies	2130	2210	55.o	56.o	93	97
Africa	2120	2190	55.7	58.4	91	94
Far East	2050	2080	51.3	50.7	92	94
Latin America	2410	2530	63.7	65.o	100	105
Near East	2200	2500	62.3	69.3	89	102
Asian centrally planned economies	2020	2170	54.7	60.4	86	92
Total developing countries	2100	2200	54.9	57.4	91	95
World	2380	2480	65.2	69.o	100	104

[1] The figures relate to protein and energy content of the food available at the retail level after allowance for storage and marketing losses and waste.

TABLE 2. - COUNTRIES WITH SURPLUS AND DEFICIT ENERGY SUPPLY BY REGION (FAO)

	1961				1969-71 average			
	Surplus		Deficit		Surplus		Deficit	
	More than 10%	Less than 10%	More than 10%	Less than 10%	More than 10%	Less than 10%	More than 10%	Less than 10%
Western Europe	14	5	-	-	17	2	-	-
North America	2	-	-	-	2	-	-	-
Oceania	2	-	-	-	2	-	-	-
Eastern Europe and U.S.S.R.	4	3	-	1	7	-	-	1
Other developed countries	1	2	-	-	2	1	-	-
Total developed regions	23	10	-	1	30	3	-	1
Latin America	5	4	8	8	8	6	4	7
Far East	-	4	7	5	4	4	3	5
Near East	1	1	10	2	1	3	4	6
Africa	-	5	18	14	3	8	12	14
Asian centrally planned economies	-	2	2	-	1	1	1	1
Total developing regions	6	16	45	29	18	22	24	33
World	29	26	45	30	48	25	24	34

serious repercussions on health in the future. The problem is in fact enormous in the light of the population explosion in many parts of the developing world.

Malnutrition is one of the major characteristics prevalent in developing countries (see table 3, p. 5). Nutritional diseases have a higher incidence in children than in grown-ups due to several socio-economic factors. Clinical examination of children and anthropometric data point to a cautious estimate that, of the children less than 5 years of age in the developing countries, 10 millions suffer from severe malnutrition, 80 mill. from moderate malnutrition, and 120 mill. from the milder (and less obvious) forms of malnutrition. In other words, 50 per cent of young children in the developing world may be inadequately undernourished! Among the countries named where malnutrition may well be particularly acute was Tanzania.

Without going deeper into the problem of age characteristic of the undernourished, one should only mention that insufficient feeding of the young ones has a great negative effect on the human capital which in the long run is the greatest asset of the third world.

In the world perspective, nutritional deficiences are mainly represented by protein and energy malnutrition generally referred to as "Protein-Calorie Malnutrition" (PCM). There are other specific malnutritions like vitamin and mineral deficiences, and these may often combine with PCM. Tables 4 and 5 (p. 6 and 7) give the required energy/protein intake and the actual consumption in reality per person per day respectively. PCM can be said to lie between the two broad spectrums:

1) Complete protein deficiency on one side, to
2) General calorie deficiency on the other.

The advanced form of the first is called 'Kwashiorkor' and of the second 'Marasmus'. Between these two spectra, there are several intercombinations of the two. (Refer to diagram below):

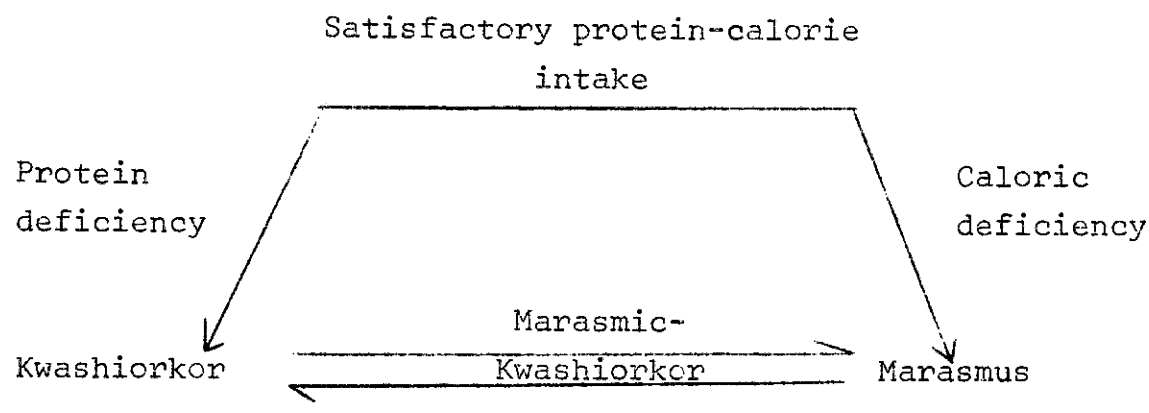


TABLE 3. - ESTIMATED NUMBER OF PEOPLE WITH INSUFFICIENT PROTEIN/ ENERGY SUPPLY, BY REGIONS, 1970 (FAO)

Region	Population	Percentage below lower limit	Number below lower limit
	Thousand million	Percent	Millions
Developed regions	1.o7	3	28
Developing regions (excluding Asian centrally planned economies)	1.75	25	434
Latin America	0.28	13	36
Far East	1.o2	30	301
Near East	0.17	18	30
Africa	0.28	25	67
World (excluding Asian centrally planned economies)	2.83	16	462

TABLE 4. - RECOMMENDED IN THE DAILY DIET

Age and sex	Body weight	Height in	Protein in grams	Kcal
Male:				
25 years	70	175	70	3200
45 "	70	175	70	3000
65 "	70	175	70	2550
Female:				
25 years	58	163	58	2300
45 "	58	163	58	2200
65 "	58	163	58	1800
Pregnant			78	2600
Lactating			98	3300
Children:				
2- 6 mnths	6	60		kgx120
7-12 "	9	70		kgx100
1- 3 years	12	87	40	1300
4- 6 "	18	109	50	1700
7- 9 "	27	129	60	2100
10-12 "	36	144	70	2500
Boys:				
13-15 "	49	163	85	3100
16-19 "	63	175	100	3600
Girls:				
13-15 "	49	160	80	2600
16-19 "	54	162	75	2400

Babies have according to body weight 3-4 x the protein requirement of grown ups.

From Food and Nutrition Board, National Research Council, 1958.

TABLE 5. - SURVEY OF FOOD INTAKE IN VARIOUS PARTS OF THE WORLD

	Per person and day				
		Available			
Areas	Requirement Kcal	Kcal	Animal protein grams	Total protein grams	Fat grams
U.S.A.	2640	3220	66	97	149
West Europe	2635	3040	48	81	120
Mediterranian	2430	2660	25	75	74
U.S.S.R.	2710	2985	26	92	70
East Europe	2635	2925	28	78	83
Latin America	2500	2640	23	66	60
(Peru)		(2040)	(13)	(52)	(34)
Africa	2375	2455	11	64	44
(Tunis)		(2170)	(15)	(67)	(28)
(Congo)		(2650)	(4)	(49)	(37)
West Asia	2400	2365	15	75	39
East Asia	2300	2100	8	56	32
China	2300	2200	6	65	32

Foreign Agricultural Service, U.S.D.A. 1961

TABLE 6. - THE CONTENTS OF ESSENTIAL AMINO ACIDS IN VEGETABLES, INCLUDING BEEF FOR COMPARISON (DUCKWORTH, 1966)

Amino acids in g/16 g N (100 g protein)	Leguminous seeds (fresh and dry)	Leafy vegetables	Other vegetables	Beef
Lysine	1.4- 9.2	3.1- 7.5	1.5- 5.8	7.o-10.o
Methionine	0.5- 3.9	0.9- 2.o	0.5- 2.6	1.9- 4.1
Tryptophan	0.2- 1.6	0.9- 2.1	0.6- 1.6	0.9- 2.o
Leucine	3.8-13.2	3.7- 9.3	2.7-11.9	7.2-10.o
Isoleucine	0.3- 6.3	2.4- 6.3	1.5- 5.1	3.o- 6.5
Phenylalanine	2.4- 9.1	1.9- 6.4	1.4- 4.5	3.5- 4.9
Threonine	1.9- 5.o	2.2- 5.5	1.5- 5.o	3.6- 5.8
Valine	1.9- 6.6	1.8- 7.1	2.2- 6.4	3.5- 6.5

The average figures on the food supply of a country or an area may in a very insufficient way describe the relevant food situation. The food distribution and income distribution play a major role qua incidence of hunger and malnutrition.

The causes of inadequate nutrition are many and closely interrelated, including ecological, sanitary and cultural constraints, but the principal cause is poverty. Progressive eradication of poverty together with an improvement in the physical and cultural environment would be a major step in eliminating protein/energy malnutritions. This would mean breaking the vicious circle of unemployment - low food production - low productivity and low incomes which strangle a large part of mankind today.

II. THE PLACE OF VEGETABLES IN NUTRITION TO-DAY, ESPECIALLY IN THE THIRD WORLD.

The nutritional role of horticultural crops has long been realized, and vegetables in particular have been known to be a very important source of carbohydrates, proteins, vitamins and minerals. As for species of the Leguminose family, historical findings have shown that they have been used for human consumption for about 8000 years. Legumes are grown throughout the world, having a protein content ranging from 17 to 25 per cent in dry grains (soya ca. 38 per cent), and contribute to 8 per cent of world protein supplies. In comparison, grain cereals have 6-14 per cent protein.

Textbooks on nutrition often refer to grain legumes as "poor man's meat", but surveys in Eastern Asian countries show that there is a tendency for consumption of legumes to be greater in the higher than in the lower income groups. In well-developed countries where there is an aboundance of milk, milk products, meat, fish and eggs, the consumption of legumes does not conform to this pattern. In U.S.A., intake falls with income where pork and beans are accepted staple food when the dollars are not readily available.

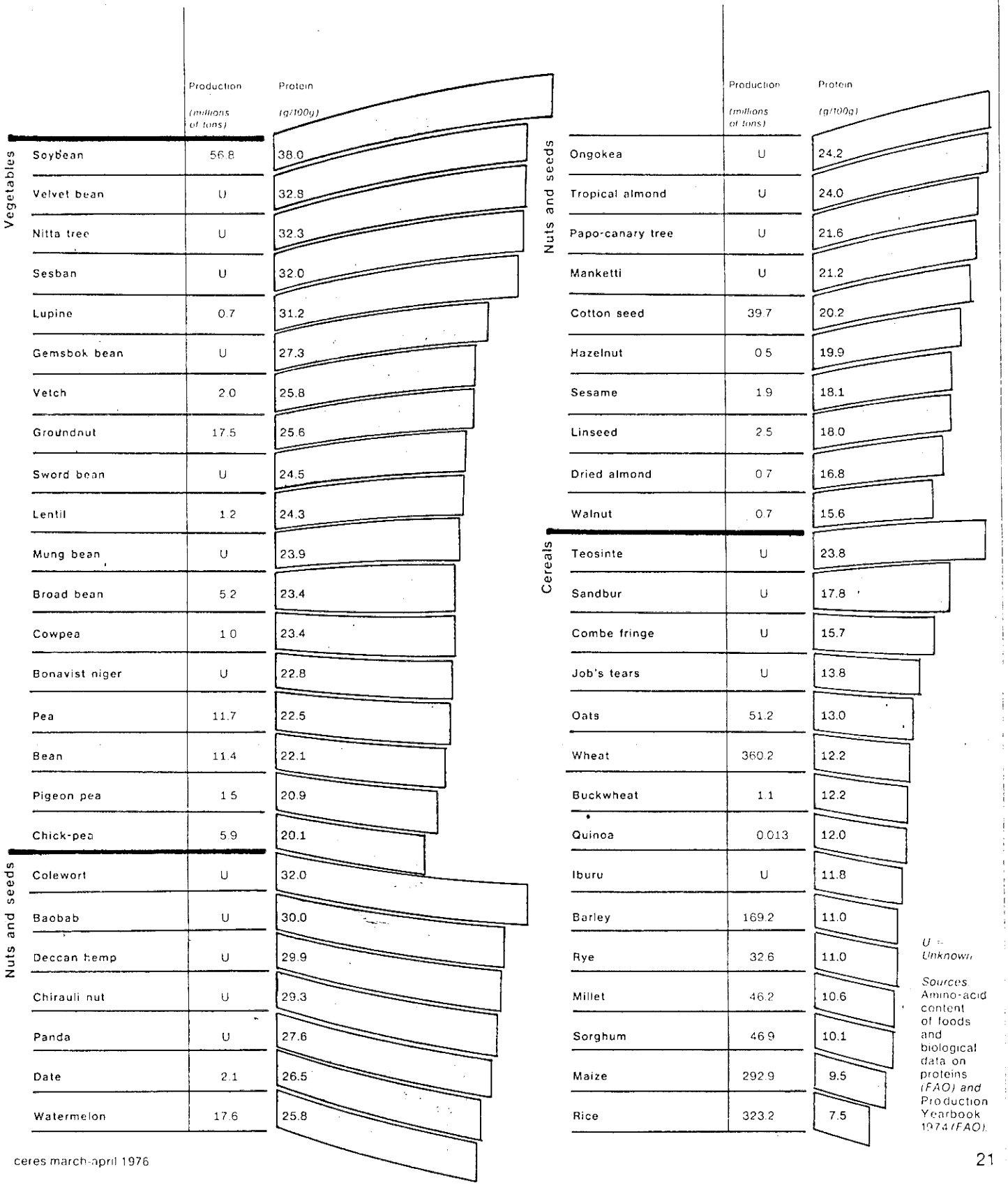
A partial solution to the problem of increasing world protein supplies may be to increase grain legumes, and this can be achieved quickly, in fact almost immediately, without serious difficulty.

Plant proteins are considered inferior to animal proteins as far as the Biological Value of proteins is concerned (see table 6, p. 7). Legume proteins are poor sources of sulphur-containing amino acids - methionine and cystine; many are also deficient in tryptophan and isoleucine. On the other hand, they have a higher content of lysine in which cereals are relatively deficient.

Fig. 1

A greater diversification

World production (1974) of 50 plants chosen for their protein content



U = Unknown

Sources: Amino-acid content of foods and biological data on proteins *(FAO)* and Production Yearbook 1974 *(FAO)*.

Trials have shown that the combination of legume proteins together with cereal and animal protein greatly correct deficiences in protein-malnutrited children.

In the tropics, 80 per cent of man's energy comes from carbohydrates. Cereals, vegetables and fruits are the major sources of carbohydrates, e.g. bread, potatoes, cassava and legumes. Vegetables which are basically starchy in nature may be low in proteins.

Fruits and vegetables contain only minor traces of fats with a few exceptions, such as nuts.

Vitamins: Major sources can be found in green vegetables and carrots. Dark green vegetables are richer in carotene (pro vitamin A).

In general, plants have a broader spectrum of minor elements and substances than animal products. This is supposedly an advantage of this food material.

Considering the value of vegetables in the daily diet one has to count on that there is wide group of plants with a great diversity in growth requirements. Some can give very valuable food within a very short period, for instance some leafy vegetables. The variability and the flexibility of this group of food plants make them highly desireable to meet the food requirements by people in the low income brackets in the third world, especially in periods when food traditionally is short in supply.

III. VEGETABLES GROWN IN TANZANIA TODAY

Horticulture has received more attention in the 2nd Five-Year plan (1969-74). Horticultural crops are grown in the north around Mt. Kilimanjaro and Meru where it is densely populated. The people here receive high incomes from arabica coffee, and the land is fertile. Food crops like maize and beans are also found in the north-east in Sukumaland where 80 per cent of the cotton crop of Tanzania is produced. In the south, i.e. the southern highlands, Iringa and Mbeya regions, besides the major cash crops, Irish potatoes, cassava and a variety of other vegetables and fruits are grown.

Due to the high urbanisation tendencies, farming systems have been adjusted to cater for this new demand, and in this respect, vegetables are beginning to receive more emphasis. Food habits are changing,and in this process the rate of vegetable consumption rises in the rural areas.

A very wide range of fruits and vegetables are grown in Tanzania, but only on a small scale. The country is fortunate in having a temperate type of climate in the high lands, a sub-tropical climate as in parts of the northern highlands, and a tropical climate. Table 7 gives a list of the most important horticultural crops currently grown in Tanzania. The most important vegetables grown are cabbage, potatoes, onions, beans and tomatoes. A wide range of other vegetables are grown to a smaller extent.

TABLE 7. - SELECTED EXAMPLES OF HORTICULTURAL CROPS CURRENTLY GROWN IN TANZANIA IN VARIOUS AREAS

English name	Botanical name	Climatic area concerned
Apple	Malus domestica	Temperate
Banana	Musa spp.	Tropical
Grapefruit	Citrus paradisi	Tropical & sub-tropical
Guava	Psidium guajava	" " "
Lemon	Citrus limon	" " "
Lime	Citrus aurantifolia	Tropical
Mango	Mangifera indica	"
Mandarin	Citrus reticulata	Tropical & sub-tropical
Orange	Citrus sinensis	" " "
Pawpaw	Carica papaya	Tropical
Peach	Prunus persica	Temperate
Pears	Prunus domestica	"
Beans	Phaseolus spp.	Tropical & sub-tropical
Cabbage	Brassica oleracea var. capitata	Sub-tropical & temperate
Carrot	Daucus carota	" " "
Egg plant	Solanum melongena	" " "
Lettuce	Lactuca sativa	" " "
Onion	Allium cepa	" " "
Pepper	Capsicum spp.	Tropical & sub-tropical
Spinach	Spinicia oleracea	Sub-tropical
Tomato	Solanum lycopersicum	"

(Manang)

IV. YIELD AND QUALITY OF THE DIFFERENT VEGETABLES AND PRODUCTION POSSIBILITIES IN TANZANIA

Research work carried out on horticultural crops in Tanzania is rather limited. One of the main reasons has been the lack of resources, qualified manpower, and the absence of a concentrated horticultural development policy. In general, the horticultural industry has never received great attention up to now. As for the export it was a higher volume in the past.

With the present decentralised system of government, however, regional crop priority lists have mentioned horticultural crops in one form or another. Effort in this field would be concentrated on "Ujamaa" villages. It was further realised that not all the Ujamaa villages could concentrate on horticultural crops, and therefore, it was hoped that the industry would spread in the districts.

At present there are hardly any literature references on horticultural statistics in Tanzania, and in FAO statistics, monthly and annual reports from the ministry, only general terms are used. These observations further point out the juvenile stage of the industry.

Results given below have been derived from the present research work carried out at the Horticultural Section at A.R.T.I., Mbeya. The main aim at present, was to find out methods and means to produce horticultural crops all the year round. Such a continuous supply was required, both for the processing industry, and the cool chain to various fresh vegetable markets, and for the local consumption by peasants. Another object was to introduce valuable species and cultivars suited to the different growing corditions. A lot of research has been carried out in the neighbouring East African countries, Kenya and Uganda, and much of the results and experience obtained are most likely relevant to Tanzania.

Beans: Previous research programmes on beans were carried out at Tengeru from 1959-65, with the main aim of developing the seed bean industry in Tanzania. White harricot cultivars were selected and recommendations for fertilizer applications, spacing and chemical weed control measures published.

Work at ARTI, Mbeya, started in 1971. The programme here has been more diversified with regards to cultivars, yielding abilities of seed beans, french beans and green leaves, quality and tolerance to diseases. Trials with 9-15 french bean cultivars were planted

at 10 day intervals from June to November, 1973, which is in the dry season. Results in table 8 (see p. 14) indicate that 'Sabo' (='Processor'), 'Prince' and 'Fin de Bagnol', cultivars from Europe, were better yielders than the other cultivars. A yield of 2300 kg/ha was almost double the yield of 'Saxa' which is one of the main cultivars in Lushoto. 'Sabo' also gave a higher yield per plan, and a higher number of pods per plant (table 9, p. 14). 'Fin de Bagnol', 'Triomphe de Farcy' and 'Prince' produced significantly longer pods than 'Saxa' and 'Tendergreen', two of the most widely used french beans in Tanzania.

Disease represents a main problem when beans are grown in the rainy season. Rust (Uromyces appendiculatus), angular leaf spot (Phaeoisariopsis griseola) and virus are the main problems. There are some local lines that are resistant to disease attacks, and these are being screened at the moment. The resistant lines that have been bred at Makerere, Uganda, namely 'Diacol Nima', 'Kabanyolo 129', and 'Kabanima' proved successful in the trials and gave high yields (table 10, p. 15). The 'Masusu' and 'Canadian Wonder' types are the most popular types in the Uyole region, but unfortunately rather susceptible to the two main diseases. 'Kabanyolo 129' showed signs of virus infection.

With leaf-picking trials, the cultivars 'Masusu' was least affected, followed by 'Canadian Wonder'.

Fertilizer trials have shown that the responses to phosphates at an economical level have not been obtained. No significant effect of nitrogen was recorded.

Cabbage: Cabbage is a major vegetable in the Highlands, and commercial production in large areas is found, e.g. in Umalila. The main cultivar is 'Drumhead'. One major problem in the wet season is the severe attack of Xanthomonas campestre, a bacteria which causes black spots and the shedding of leaves, and in severe cases wilting of the head. Insect pests have been a problem mostly in the dry season. Here we can name the diamond-back moth (Plutella maculipennis), cabbage saw fly (Athalia spp) and aphids (Brevicoryne brassicae).

In the trials conducted at ARTI, the main considerations were to select cultivars that were early and more disease resistant, to find better spacings and correct use of fertilizers to improve yields, and better methods of storage and transport.

Table 11 (see p. 15) illustrates the variations between hybrid

TABLE 8. - YIELD OF FRENCH BEANS UNDER IRRIGATION

Cultivar	kg/ha	Relative yield	Yield per plant	Relative
Sabo	2300	166	105	147
Bagnol	1700	125	69	97
Prince	1600	120	74	104
Prelude	1600	119	64	90
Tendergreen	1400	100	60	84
Farcy	1300	93	52	73
Brittlewax	1200	91	83	116
Saxa	1200	86	47	66
Sprite	900	69	72	101

TABLE 9. - POD CHARACTERISTICS OF THE DIFFERENT CULTIVARS

Cultivar	Length of pods (mm)	Pods/ plant	Relative	Grams/ pod	Relative
Sabo	113	32	136	3.28	110
Brittlewax	129	27	112	3.13	105
Prince	136	22	94	3.3o	110
Sprite	112	23	97	3.14	105
Bagnol	135	20	86	3.39	113
Prelude	108	23	96	2.83	95
Tendergreen	124	19	81	3.1o	104
Farcy	134	18	76	2.91	97
Saxa	102	18	76	2.65	89

TABLE 10. - YIELD AND DISEASE INDEX FOR PHASEOLUS SPP. GROWN IN THE WET SEASON

Cultivar	kg/ha	g/plant	100 kernel weight	Plants/ sq.m	Rust-mean scoring index
Canadian Wonder	526	2.1	37	25	49
Diacol Nima	910	3.6	44	25	-
Harricot	245	1.8	30	13	-
Kabanyolo 129	1308	6.2	57	21	5
Kabanima 74	906	3.6	48	25	32
Masusu (local)	386	1.6	44	25	-
Mikonge (local)	708	3.2	58	22	-
Triomphe de Farcy	165	0.7	23	25	52
Wade	429	2.2	28	19	-

TABLE 11. - YIELDS, QUALITY AND EARLINESS OF HYBRID CABBAGE CULTIVARS

Cultivars of reference	Yield tons/ha	Index	Mean wt. of heads g/head	Index	Disease Index	Days from sowing to 50% harvest
Drumhead	22	92	1047	108	100	129
Early Jersey Wakefield	26	108	892	92	109	94
Hybrids:						
A-S Cross	37	156	1420	146	100	126
B-A Cross	37	157	1464	151	135	141
C-G Cross	36	150	1271	131	78	101
Emerald Cross	28	119	1066	110	134	99
K-K Cross	50	210	1630	174	79	120
K-Y Cross	42	175	1552	165	125	120
N-S Cross	37	143	1398	126	81	140
R-I Cross	25	129	1214	109	102	146
S-D Cross	48	187	2068	186	84	141
Y-R Cross	34	201	1200	155	78	126

cultivars and the reference cultivars 'Early Jersey Wakefield' (early maturing) and 'Drumhead' (late maturing). All the cultivars in this group were superior to the reference cultivars in yield. The values for yield index and index for weight of heads are the most relevant yield criteria in this table. As far as yields are concerned, it is obvious that the cultivars 'K-K Cross' (Takii, Japan) and 'Y-R Cross' gave the highest relative yields.

In regard to quality, the intensity of disease incidence on the leaves was taken into account. The obtained figures were compared to 'Drumhead' which had a disease index of 100. Note that 'K-K Cross' and 'Y-R Cross' which were the highest yielders also had a low disease index.

Earliness plays an important part because, if the extra work and expenses (weeding, spraying, irrigation, etc.) do not pay in the form of higher yields or better quality, then it is better to choose an early-maturing cultivar. Table 11 (p. 15) shows that 'Emerald Cross' and 'C-G Cross' were the earliest hybrids. 'Y-R Cross' and 'K-K Cross' were also earlier than 'Drumhead'.

Trials were also carried out with "ordinary" cultivars and notable differences in yield, quality and time to maturity were recorded within this group. In table 12 (see p. 17) are figures describing the variations in the different cultivars as compared to the reference varieties. The best cultivar was 'Fukamidori' followed by 'Glory of Enkhuizen' and 'Brunswick'. The slight variations in the disease index did not signify any differences between the varieties. With regard to earliness, 'Golden Acre Special' was the earliest in the trial, being two weeks earlier than 'Early Jersey Wakefield', and 8 weeks earlier than 'Drumhead'.

Storage observations on the hybrid cultivars produced no significant differences, but with the "ordinary" cultivars, 'Golden Acre Special' withstood rottening better than all the other cultivars.

Results from red cabbage and savoy cabbage trials showed that they were inferior in yield and later than the reference varieties.

Fertilizer trials with P and N gave significant responses to N, but an almost lack of response to P at Uyole.

All the trials referred to her were carried out at Uyole which is 1800 m above sea level. Further trials are planned at other experiment stations at higher and lower altitudes.

TABLE 12. - YIELD, QUALITY AND EARLINESS OF NON-HYBRID CABBAGE CULTIVARS

Cultivars of reference	Yield tons/ha	Index	Mean wt. of heads g/head	Index	Disease Index	Days from sowing to 50% harvest
Drumhead	22	92	1047	108	100	129
Early Jersey Wakefield	26	108	892	92	109	94
Cultivars:						
Amager	21	88	1071	110	108	122
Brunswick	29	123	1263	130	104	118
Copenhagen Market	26	110	1082	112	115	104
Nostra	24	99	995	106	104	103
Fukamidori	34	141	1251	133	119	130
Glory of Enkhuizen	31	130	1210	129	102	127
Golden Acre Special	19	81	802	86	100	85
Premium Late Flat Dutch	26	102	1149	103	90	127
Rossebø	16	63	1225	110	89	145
Toten Amager	11	63	704	91	103	152

Peas: Peas are an important crop in the Southern Highlands in humid areas above 1800 m above sea level. There was a demand for both green peas and dried peas. In addition there was also an interest for the crop as fodder.

Presently, trials are being carried out at ARTI, Mbeya, with the aim of identifying the most pressing problems and future possibilities in pea production, and to build up a collection of a wide range of cultivars from which selections could be made for the Southern Highlands. The collection in 1974 included 106 cultivars of various origin, and data on earliness, growth habit and disease susceptibility was obtained for all cultivars.

Fungal diseases are quite common. The most important one was powdery mildew (Erysiphe polygoni D.C.). None of the cultivars tested were resistant to mildew, though some cultivars showed less susceptibility.

C.B. Jespersen found in his survey ('Pyrethrum in the Southern Highlands') mean yields of 432 kg/ha (mean of 34 farmers). The yielding potential in peas is 5-10 times that figure. Better yields were hoped to be obtained by improved crop husbandry methods, improved cultivars, the use of fertilizers, and inoculation with good strains of Rhizobium.

Onions: Cultivar and storage trials on onions were conducted at Uyole in the dry season. The aim was to select varieties tolerant to the main diseases, and, at the same time, produce a high yield of good quality onions.

Table 13 (p. 19) gives the yields, bolting effects and earliness of the different cultivars. Observations for bolting and maturity were taken 3 weeks before harvesting. The low temperatures during June to August could well have increased the incidence of bolting.

From the results, it will be seen that the yellow and white varieties gave much higher yields than the common red/purplish cultivars 'Red Creole' and 'Bombay Red'. The white/yellow cultivars were also larger in size and the incidence of bolting comparatively less. In this context, 'Bombay Red' was not recommended for growing above 1500 m due to the high bolting incidence.

With regards to storage, the red cultivars proved much better and showed no signs of fungal attack (Botrytis spp.) after 49 days in storage. There was no reason not to introduce the yellow and white cultivars, but more trials would have to be undertaken. Pre- and post-harvest factors would also have to be taken into consideration in future trials.

TABLE 13. - EFFECT OF CULTIVARS ON YIELD, BOLTING AND EARLINESS. MEAN OF 4 REPLICATIONS

Cultivar	Seed company	Tons/ ha	g/ bulb	% bolting	% mature [1]
Texas Grano	Asgrow	61	257	15	33
Tropic Ace	Takii	55	226	0	2
Amber Express	"	53	225	0	33
Crystal Wax	Asgrow	47	191	17	6
XP 413	"	34	147	3	2
Red Creole	K	29	120	15	26
Bombay Red	"	20	85	85	5

[1] Maturity is defined as the physiological stage when the leaf neck softens and the leaves bend down.

TABLE 14. - GERMINATION IN FIELD TRIALS OF BEANS AND CABBAGE FROM VARIOUS SEED FIRMS IN TANZANIA

Bean cultivar	% germ.	Cabbage cultivar	% germ.
Farcy	92	Drumhead	83
Saxa	87	Glory of Enkhuizen	83
Bagnol	86	Jersey Wakefield	79
Prince	78	Vertus Drumhead	75
Tendergreen	77	Golden Acre	66
Prelude	64	Holland Export (red)	51
Wade	63		
Sprite	20		
Brittlewax	16		

Tomatoes: Tomatoes are one of the major vegetables in Tanzania. Unfortunately, they are very susceptible to fungal and virus diseases in humid climates. Late blight (Phytophthora infestans), early blight (Alternaria solani) and tomato mosaic virus (TMV) were the most dominant. The aims of the trials at ARTI are to look for more disease-resistant cultivars other than the commonly grown cultivar 'Moneymaker'. The trials were also aimed at screening cultivars suitable for canning. Of the 29 cultivars grown for observation in 1974, none were found to be better than 'Moneymaker'.

Trials on fertilizer application showed a good response to phosphates and a positive interaction between nitrogen and phosphorous. Plant protection measures had also been tried and some success had been achieved with mancozeb and copperoxychloride compounds. Trials had also been carried out on improved crop husbandry practices and preliminary results were satisfactory.

Irish potatoes: Research work on potatoes have been carried out in Tengeru, Northern Tanzania and at Kitulo in the Southern Highlands. Work at ARTI started in 1973 with the overall aim of increasing potato production in areas suitable for the crop. One of the main setbacks was the severe attacks of late blight (Phytophthora infestans) in the various potato areas. The first step, therefore, was to attain new blight-resistant cultivars, and to screen local clones for resistance to blight, virus, quality and storage abilities.
In Tanzania, potatoes are grown in high areas like in Iringa, Mbeya, Tanga, Arusha, and Kilimanjaro areas. In 1961, 2950 tons were marketed, in 1962 6329 tons and in 1963 12758 tons. The estimated total production for 1963 was 19660 tons. Yields of 15-20 tons/ha were average, but 37-50 tons could be achieved.

An observation trial carried out at Uyole with cultivars originating from Tengeru, indicated that the choice of cultivar was a major factor for good yields. Not enough data was obtained to give full recommendations. Blight resistant cultivars were also obtained from the National Agricultural Laboratories, Nairobi, and six cultivars showed resistance, both at Kitulo (2700 m a.s.l.) and at Uyole (1800 m a.s.l.). At the "Seed Foundation Farm", Kitulo, local material has been screened and information on quality and yields gathered. Various screenings and trials have also been planned and it was hoped that from these trials it would be possible to give some recommendations.

V. EXAMPLES OF VEGETABLES GROWN AS FOOD FOR THE HOUSEHOLD

Most of the population of Tanzania are peasant farmers, and each farming unit, as such, is a self-supporting enterprise. Besides the cash crops, the farmer also supports a home garden where he grows enough of his staple food for the family. These basic foods are usually cooking bananas (Musa spp.), cassava (Manihot esculenta), maize and sweet potatoes (Ipomea batatas).

To many people in Tanzania, the production of horticultural crops still remains a supplementary activity using unallocated resources, if any, including labour, that he has left. Traditional taboos have, in addition, tended to slow down consumption of fruits and vegetables. Recently, however, increased use of vegetables in the daily food has been stressed on several occasions, e.g. "Chakula ni Uhai" campaign.

It is quite common, therefore, to see various fruits and vegetables being grown in addition to the staple foods. Beans, peas, cauliflower, egg plant, spinach, pepper, carrots and lettuce are grown in small quantities. Fruit trees like bananas, guavas, mangoes and citrus fruits can also be seen in gardens.

Regional differences and tribal preferences have also a bearing on the crops grown. For example, in the fertile areas of the Northern Highlands, around Mt. Kilimanjaro and Meru, the main staple food is cooking bananas (Musa spp.), more often than not interplanted with coffee. Maize and beans and other vegetables are also grown here. In the North-east, around Lake Victoria and Mwanza food crops include cassava, maize and beans. Pawpaws are also found here. In the Southern Highlands, maize, Irish potatoes, cassava, beans and a wide variety of vegetables are grown. Temperate fruits are also found here like apples, plums and peaches.

Traditionally people would eat what they were used to, but this tendency is breaking down slowly. Thus where the staple food was bananas, maize has entered the diet together with vegetables. This has been due to many factors, one of which is urbanisation.

VI. DISTRIBUTION OF SEEDS AND THE ACCESS TO OTHER PRODUCTION INPUTS

The majority of the horticultural seed material in Tanzania comes from foreign companies like Kirchoffs Co. based in Nairobi, Kenya, and Sluis Bros. Ltd. based at Arusha. In most cases, variety

recommendations are based on local trials. But the availability of different kinds of seeds and varieties is very uncertain. The distribution system is not well developed. Farmers have to wait a long time for the seed to arrive, or have to travel long distances for purchasing.

Another problem connected with seeds sold in Tanzania is relative poor germination percentages. A trial carried out at ARTI with the different cultivars from different companies (Table 14, page 19) showed that the seeds sold in Tanzania had quite a variable germination percentage. Packets were neither marked with the year of production nor germination percentages.

The range of cultivars which could be obtained from the seed companies has been limited. Results from variety trials showed that there were cultivars in the world collection of vegetables which preferably should replace those sold locally.

Recently established in Tanzania was the Tanzania Seed Co. that was expected to handle the production and distribution of seed, but the company was still in its infancy. But it has to be realized that a reliable and available source of high quality seed and plant propaguls is a basic factor in all areas of plant production.

The only fertilizer factory in Tanzania is situated in Tanga, but the distribution system has yet to be improved. Access to buying of plant protection chemicals and spraying equipment is more easier. They are usually obtained from local trading centres.

VII. PRODUCTION METHODS FOR THE PROPOSED PROJECTS

There are two basic requirements for good plant growth. The first is a growing medium allowing normal root growth, and having a diluted solution of balanced nutrients. The second requirement is optimal temperature and light conditions. Favourable natural climatic conditions are a starting point for vegetable production, but if maximal yield is to be obtained, some means of improving the micro-climate have to be applied.

Vegetable production in technically advanced countries has enjoyed various revolutionary steps in recent decades through rationalisation and mechanisation. Without anticipating a replication of this development, vegetable farmers can make use of an improved appropriate technology to improve quality, yields, timing and reduce production costs.

The gap between scientific research is often tremendous in the fields of agriculture and horticulture. By dedicated specialized extension services, the farmer would benefit directly if the aims of this service was to bring well proved technical news to the farmers and vice versa to take problems back to the researchers.

One can recommend several means and ways of helping the peasant farmer, but one has to always to keep in mind that resources are limiting and that the farmer is not always eager to change suddenly to new methods. On the other hand one has to realize that in general, the farmer is an intelligent person, and he is not different from others in the habit of adapting his way of profession if his economy improves by doing so. Problems vary from place to place, and therefore it is necessary to build up a good extension service first. With fully trained staff, effective use of publicity mediums and most important of all, strong government backing, one cannot go wrong.

We can take a general look at the different stages in production:

Choice of varieties: From research results and recommendations, it should be possible to choose varieties that are high-yielding, disease-resistant, and locally adapted to the climatic and edaphic conditions. It is also very necessary to obtain seeds that are fresh, viable and disease-free. Seed dressings should be applied as far as possible.

Propagation: Traditional methods of propagation may be rather hard on vegetable crops. Transplants should be physically fit for growth after transplanting. Seeds should be sown in seedbeds containing virgin or disinfected soil and have a free-draining composition. In permanent nurseries, the soil has to be disinfected between crops by sterilisation with steam or chemicals. One alternative to growing transplants in beds is the use of peat- or soil-blocks. This makes sterilisation more easier and doesn't disturb the soil around the roots during transplanting. For the improvement of the micro-climate in the seed-beds, for instance straw mats or plastic tunnels may be used.

There is no need to stress the importance of the 'hardening-off' process before transplanting. Gradual decreasing of shade and wind protection in the nursery until the plants are exposed to the real elements of nature that they would meet in the field, just before transplanting, would prepare the plants for the

'shock' they met in the transition to a new environment. On the other hand the hard 'beating' of young seedlings before transplanting practised some places should be avoided.

In the field: Horticultural crops, as such, require more attention in the field than other crops. Vegetables are rather sensitive to water-logging, weed competition, insufficient water and severe changes in climate. It is therefore necessary to understand beforehand the climatic response of the plants with reference to growth and development. Cultivation and water requirements in the different growing seasons should be known.

Correct timing qua seeding and planting is very important, especially if one is going to make use of the seasonal rains. Trials carried out before have shown that earlier planting than traditional gives higher yields and reduces the disease incidence. If irrigation is to be used, it is highly imperative that a continuous and secure source of water is available. Before a vegetable programme is initiated, this question has to be given high priority.

In tropical conditions, water-logging and erosion can be a big problem if not checked in time. Drainage channels and soil conservation measures are a must. In many cases, the use of mulch made from local materials like elephant grass and other grasses, banana leaves or papyrus have been found very beneficial.

Fungal diseases and insect pests play an important role in humid climates, and efficient plant-protection programmes together with the use of disease resistant cultivars must be taken into account. Using the correct chemicals and proper spraying equipment at the right time and in the right concentration should be taught to the farmer. Destroying diseased plants in the field and after harvesting is recommendable. In some cases, forecast system for disease and pest control may be considered, e.g. armyworm and locust forecast organized by the East African Agricultural and Forestry Research Organisation in Kenya.

Lastly, it is essential that great emphasis is given to the handling of the produce during harvesting, transporting, packing and marketing. Vegetables are a highly perishable crop, and the high temperatures and humidity and the presence of a large number of disease organisms combined with crude handling, create large losses. Proper containers possibly made from local materials, could be used to protect the produce which very often should be

brought to a cold store or processing factory as soon as possible.

VIII. PROPOSALS FOR A PILOT-PROGRAMME EMPHASIZING THE ROLE OF VEGETABLES IN NUTRITION

The proposed programme aims at an improved production and use of vegetables for the benefit of the farming families and of citizens of the urbanized centers. The nutritional values of vegetables are stressed, and also additional food supplies in periods when food usually is scarce.

Before one can propose any applied nutritional programme, there is one important question that must be answered first:"Is this programme going to be effective in improving nutritional standards?" Several nutritional programmes have been launched in different regions of the world during the late 1950's by several international agencies. A broadscale evaluation of these programmes by HUNDLEY (1966), pointed out that there were several shortcomings in each programme.

Dr. Margaret McArthur, FAO consultant, visited Tanzania, Malawi, Zambia and Swaziland to study the nutritional programmes there. Like Hundley,she too critized the stereo-type plans of operation, and proposed the need to tailor the plan of operations to the needs and resources of each individual country. She also proposed that a pre-project feasibility study be made to decide at an early stage whether the country's resources of manpower and other inputs were adequate, and to establish achievable targets for food production.

From these reports and experiences, it is obvious that there should be a more flexible and innovative approach to nutritional programmes. The whole complex of factors affecting food supply, demand and utilization, have to be considered. Too often than not, programmes are set up to solve less urgent problems while other more immediate problems are ignored.

Encouraging families to grow more food and teaching them how to make the best use of their food supply would contribute to better nutrition.

A home-garden system as set up in Nigeria (FAO reports 39, 75, 90) combined with the proposed Vegetable Observation Plot (VOP) project by ARTI, Mbeya, could be built into a worthwhile horticultural/nutritional programme. The VOP could be used as demonstration plots for farmers in the area it is located. It could be

used to demonstrate proper crop husbandry practices such as correct weeding, fertilizing, spacing, mulching, etc., in addition to pest and disease control. Improved cultivars with better yields and quality could be demonstrated. With the VOP as a basis, farmers could then be encouraged to start their own home gardens with the help of extension workers attached to the VOP.

In the first phase of the scheme, farmers would be made acquainted with the different types of vegetables, methods of production, cultivation, crop protection together with nutritional aspects. The last mentioned could be done in co-operation with nutritional extension workers. Farmers and schools would then be encouraged to begin their own gardens with the aim of supplementing their diets and perhaps to meet the local demand. Seeds and seedlings, chemicals, fertilizers, etc., could be made available through the VOP.

In the second phase, depending on the interest, demand and production potentials, production could be increased or specialized to fewer crops. If nearby urban centres or markets are in focus, these could be investigated further, and a rational plan worked out after having taken all the limiting factors into consideration. Here again, feasibility studies must be carried out beforehand.

Information and research material collected in the first and second phases could be used by planners at regional and national level. Information necessary for realistic planning and allocation of projects, e.g. canning and export, would then be used in the third phase. In the third phase, more specialized crops may be grown especially for processing, export to foreign markets or other needs. This third phase can only be possible after sufficient material on factors of production, transport, packing etc., for the various crops have been documented. The establishment of processing factories or dehydrating plants require careful analysis and appraisal. A reliable serial production of a large volume of produce has to be secured first.

If the export market is to be considered, a series of details have to be considered concerning quality, timing, containers, packing, labelling and transport. One very important detail is the contact with foreign markets and the rapidity with which information can be enchanged between seller and buyer. Since so many of the third world programmes on processing and export of

vegetables have been disappointing from the point of immediate economical return, such projects have to be very carefully evaluated before being eventually set in action. As for export markets one should consider the possibilities of the nearby countries in the first place.

At this juncture, we would like to emphasize that the considerations given above are only for the pilot projects set up in one area, e.g. Ujamaa village. If the first two phases have been successful, then consideration could be given to starting similar projects elsewhere. Phase three is only possible when several such projects have been established or else if there is enough support for this scheme.

Evaluation of the project activities: Again: To what extent will the project achieve its aims? The answer to this question is very important if one wants to evaluate the effectiveness of the methods and efforts used. Therefore, it is imperative that accurate records are kept. Information regarding the degree of understanding, and assimilation of advice given to peasants, and the actual application of the new techniques learnt are also very important in evaluation.

Questions on whether the approach to extension work used in the project is most appropriate, whether a more "self-help" approach was needed, or whether a more "penetrating force" is required, could then be answered.

IX. CONCLUSIONS

Mixed traditional farming systems will remain to a great extent in developing countries. In the shadow of the world food shortages, any policy interested in rapid economic development would definitely effect the existing structure of farming systems. The extent to which these systems can be disturbed must be carefully considered. However, within the established farming systems, many improvements can be made, as only a gradual change can be contemplated in improvements of the infrastructure and the socio-economic set-ups.

The main farming system with self-sufficiency as the basic aim is not able to cope with the demand for food crops for rapidly growing urban areas. Production is usually very low because of the small farms, impoverished soils, low crop yields, and the relatively low prices offered for the produce. Therefore, more and more

food is imported to the new countries. There is no reason why, with proper research and extension and the selection of suitable areas for intensive food production around urban areas, the local food supply cannot be vastly improved.

In conclusion, one can say that there lies a great potential for the production of vegetables in Tanzania. This potential can best be exploited with well co-ordinated research, educational and extension programmes designed to encourage variety in traditional diets and to a certain extent untraditional ones. The nutritional and economic gains are enough incentive towards these goals. Perhaps these is also a basis for rational production for processing and export.

X. REFERENCES

ARTHEY, V.D.: Quality of horticultural Products. London 1975. ISBN 0408 70645 7.

AYKROYD, W.R. & J. DOUGHTY: Legumes in Human Nutrition. FAO, Rome 1964.

DEMA, I.S.: Nutrition in Relation to Agricultural Production. FAO, Rome 1965.

FAO 1973: Report to the government of Nigeria on Home Gardens for Improved Human Nutrition, 1970-71 (Third Phase). FFHC/FAO Report 90, Rome.

FAO 1974: Handbook of plant introduction in tropical crops. FAO agricultural Studies, No. 93, Rome.

FAO 1975: Food and Nutrition, Vol. 1, No. 1, Rome.

FAO 1975: " " " , " ", " 2, " .

HÖNNINGDALSNES, O.K.: Protein mangelsjukdom og bekjempelsen av denne i U-land. Særoppgave ved eksamen for kurset "Landbruk i U-land", NLH 1971.

JAKOBSEN, H. & E. HANSEN: Research Reports and project schedules at ARTI, Mbeya, Tanzania 1974-75.

LAWRIE, R.A.: Proteins as Human food. London, Butterworths 1970. ISBN 0408 32000 1.

LOFTHAUG, O.: Descriptions and growing of different vegetables in the tropics. Kibaha Farmers Training Centre, 1966-67. Mimeographed.

MANANG, E.Z.: Horticulture in Tanzania. NLH, Norway. Mimeograph No. 67, ISBN 82-576-5502-3.

NYSTRÖM, K.: Tanzania - En länderbeskrivning. SIDA/Nordiska Afrikainstitutet 1970.

PERSSON, A.R.: Intensive Vegetable Production with special Reference to Export. NLH, Norway. Mimeograph No. 76, ISBN 82-576-5522-8, 1975.

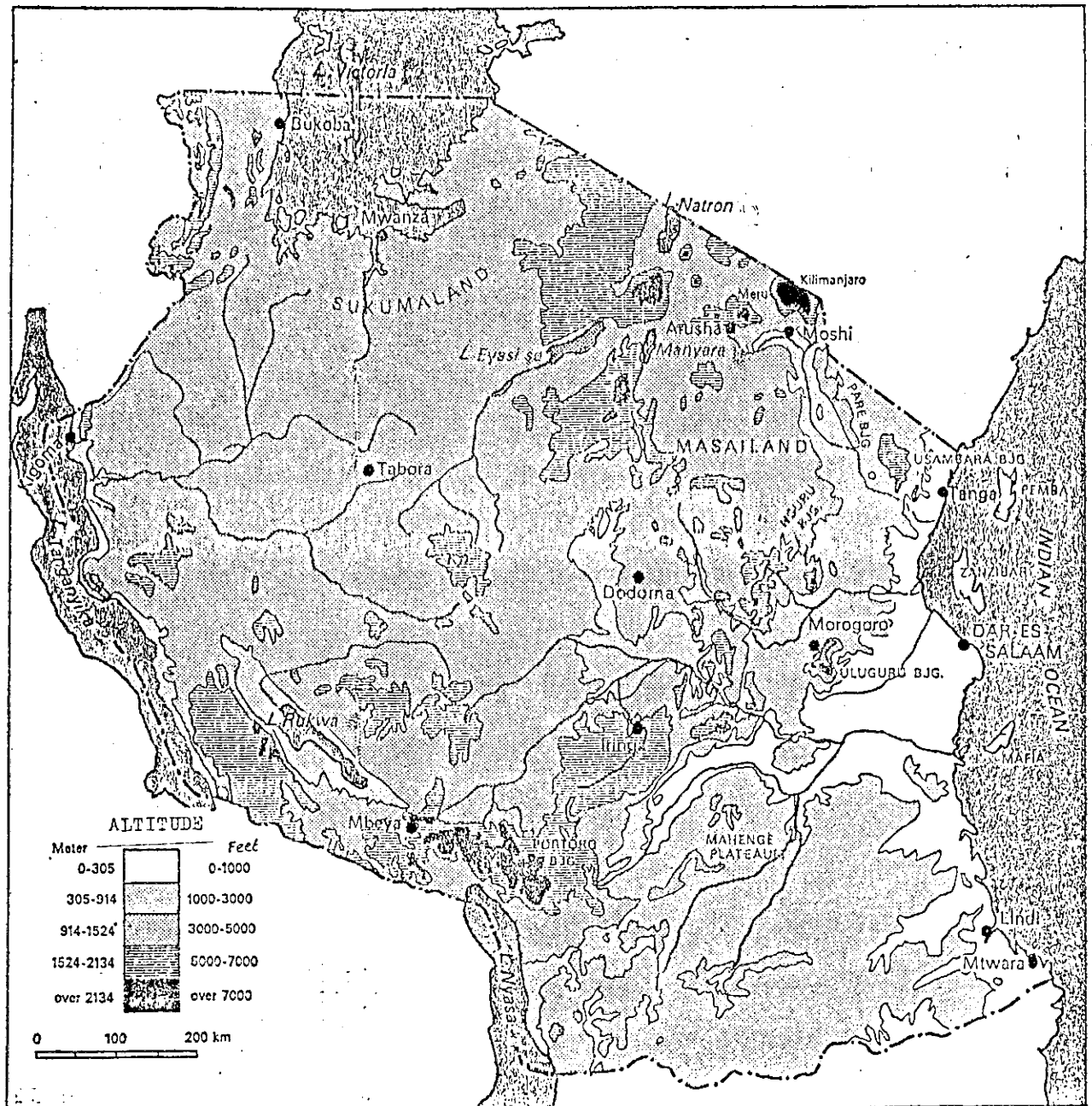
RUTHENBERG, H.: Smallholder Farming and Smallholder Development in Tanzania. Afrika-Studien series, Munich 1968.

SCHUPAN, W.: Nutritional values in crops and plants. Faber & Faber, London 1965.

STANTON, W.R.: Grain legumes in Africa. FAO, Rome 1966.

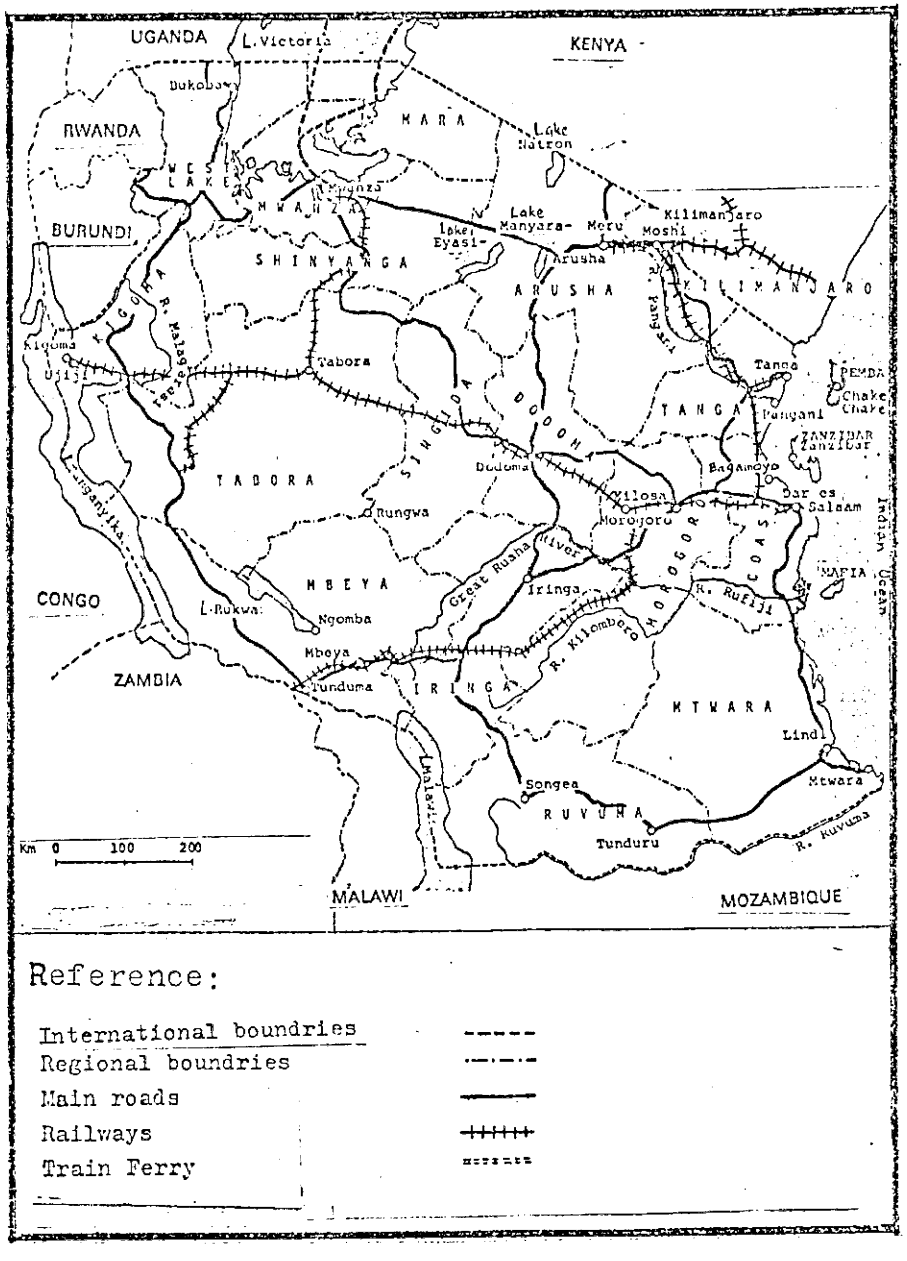
SVENDSEN, K.E. & M. TEISEN: Tanzania vil selv. 2. udg., Skive 1969.

Tanzania - Physical



Source: Tanzania vil selv.

Tanzania - Communications and Regions

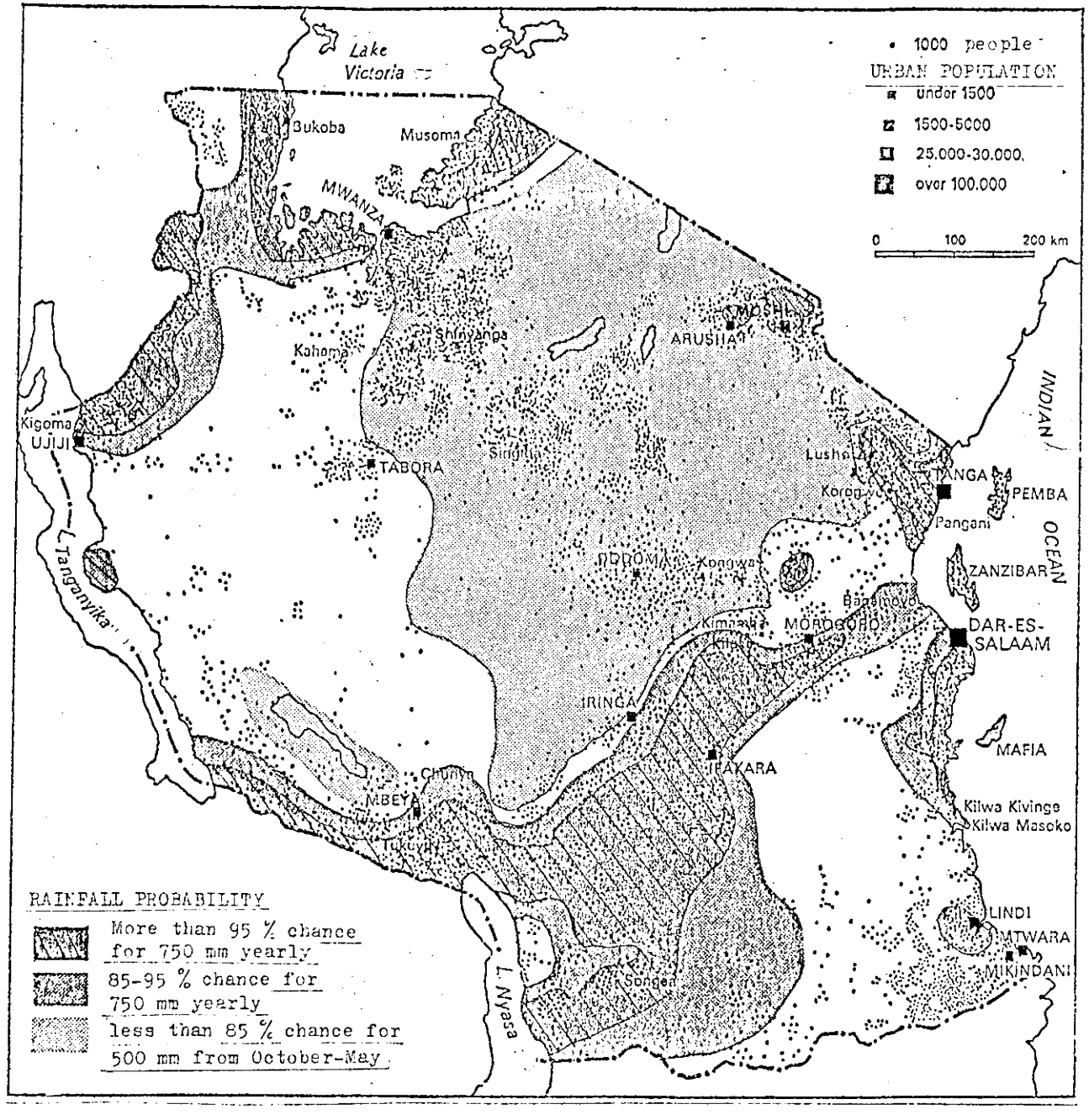


Reference:

International boundries	------
Regional boundries	-·-·-·-
Main roads	———
Railways	+++++
Train Ferry	≈≈≈≈≈

Source: Tanzania - En länderbeskrivning.

Tanzania - Rainfall Probability and Population Density



Source: Tanzania vil selv.