

Cultivation Trial of Various Vegetables in Gambella District, Ethiopia

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A study to obtain basic information on the potential of cultivating various vegetables on a site in the Gambella district of Ethiopia was undertaken in 1987. The results indicate that the vegetable crops studied (6 fruit vegetables, 5 beans, 8 leafy vegetables and 10 root vegetables) could be divided into four groups according to their suitability in the district as follows.

1: Very suitable and promising — tomatoes (cvs. 'UC204-Select', 'Money Maker', 'Roma', 'Peto 94-C'), hot pepper, egg plant, water melon, beans (mung bean, cowpea, groundnut, pole bean), kale, Chinese cabbage, taro, yam and sweet potato. 2: Suitable for growing, but not appreciated by the locals — cucumber and cassava. 3: Possible to grow, but cropping system should be carefully planned — melon, Swiss chard, cabbage, carrot, radish, Japanese radish, and beetroot. 4: Very difficult to grow in this area — lettuce, spinach, pea, broccoli, cauliflower, onion and turnip.

General comments and expectations were also made for the future development of vegetable crop production in the area.

Key words : cultivation trial, vegetables, Gambella district, Ethiopia

Introduction

Gambella is one of the most under-developed districts and is on unusually lowland in mountainous Ethiopia. The majority of the population consists of the 'Anyok' and 'Noel' tribes who are Bantus and had lived in this area long before the 'Amhara' and other highland tribes moved in. These people enjoy a simple life, keeping their traditional life style, where agriculture is the main industry. The main crops are maize, sorghum, and some varieties of beans and cucurbits which are mostly grown in the rainy season. Vegetable crops are not commonly grown except for okra, beans and cucurbits, which are grown around the homesteads. Until a few years ago, the growing and consumption of vegetables (except for pumpkins, young leaves of beans and some herbs) was not popular among these people.

Their staple food is mainly maize and sorghum and major protein sources are river fish, meat and milk.

Recently the traditional eating habits of people in this district have begun to change gradually because of the influence of highlanders who have moved into the district either for business or in accordance with government policies. As a result, the demand for vegetables has greatly increased, resulting in an improved nutritional status for the community.

In order to achieve this, the Ministry of Agriculture started demonstration farms for horticultural crops and began trials and research in the 1970s. However, no data from such trials is available as no regular planting had been established with regard to vegetable crop production. This

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present study, therefore, was designed to carry out a trial on the production of various kinds of vegetable, using the demonstration farms which had been established previously. The main objective of this trial was to evaluate their growing potential and yield and the local people's willingness to accept the vegetables for inclusion in their diets. Basic parameters were used to screen the vegetables which had the potential to grow in this area.

Agrometeorological data of the site, materials and methods

Gambella district is located in the western part of Ethiopia at latitude 8°N and longitude 34°E, about eight hundred kilometers from the capital city of Addis Ababa. It is about 450 meters above sea level, which places it in the lowlands and the climate is typically tropical. Table 1 shows the temperature, rainfall and rainy days for 1987. The means of the maximum and minimum temperatures were 35.7°C and 22.9°C, respectively. Total rainfall was 1093.2mm and there were 75 rainy days in total. The dry season lasts from January to March.

The demonstration farm is on the banks of the Balo River which flows through Gambella and the eastern part of Sudan into the White Nile.

Table 1 The annual temperature, rainfall and days of rain in Gambella, Ethiopia for 1987

	Temperature (°C)		Rainfall (mm)	Rain (days)
	Max. (AVG.)	Min. (AVG.)		
January	38.8	19.6	2.5	1
February	40.1	21.1	2.0	1
March	40.3	23.3	23.2	4
April	39.1	26.3	68.8	7
May	35.4	27.0	417.2	11
June	31.6	22.7	166.6	10
July	32.5	23.3	120.5	11
August	33.4	24.8	114.0	7
September	33.8	26.9	50.5	9
October	32.3	20.0	107.5	12
November	33.3	20.1	20.4	2
December	37.3	19.1	0	0
AVG./Total	35.7	22.9	1,093.2	75

The soil is a fertile loam.

The cultivation and land preparation was done by hand or by tractor (60 horse power, from the Ministry of Agriculture). Seeding, transplanting, weeding and harvesting were all done by hand according to local practices and general recommendations^{1,2)}. Weed growth was rapid because of the high temperature, hence weeding was done frequently, in most cases once every week. The grasses weeded were used for mulching. Irrigation water was pumped from the Balo River using a motor pump. Irrigation was done twice or three times a week in the dry season and once a week in the rainy season.

Pesticides and fungicides were applied only when plants were attacked by insects or disease. The main insect pests were aphid, armyworm and cucurbit leaf beetle. The most serious diseases were early and late blight which affected tomato plants. Nematodes were also encountered.

All farm tools were obtained locally. A kind of sickle called "gajara", which looks like a sword, was a very useful tool for weeding, harvesting and other related work.

Most of the vegetable seeds used were imported from Europe or the U.S.A., and were obtained from the Agricultural Development Department (ADD) of the Ministry of Agriculture. Some of them were purchased at seed shops in Addis Ababa. Included in the trial were six kinds of fruit vegetables, five kinds of beans, eight kinds of leafy vegetables and ten kinds of root vegetables. An effort was made to use as many types of vegetables as possible in the trial so as to obtain data on their growth characteristics as well as to evaluate their acceptability for inclusion in the local people's diet.

Results

Fruit vegetables

Table 2 shows the yield, growth, quality and suitability of fruit vegetables. With tomatoes, the

Table 2 Yield, growth, quality and suitability of fruit vegetables

Type	Cultivar	Area (m ²)	Yield (kg)	Yield (kg/a)	Growth ^{a)}	Quality ^{a)}		Suitability for the region ^{a)}	Sowing date	Harvest date
						Appearance	Taste ^{b)}			
Tomato	Money Maker	114.75	174.9	152	3	4	4	3	Jul. 7, 1987	Oct. 10, 1987
	UC204-Select	45.90	139.1	303	4	4	4	4	"	"
	Admiral	45.90	91.3	199	3	4	4	3	"	"
	Marglobe	45.90	90.8	198	3	3	3	3	"	"
	Beefsteak	22.95	83.6	364	3	4	3	4	"	"
	Roma VFN	45.90	155.0	338	5	4	4	5	"	"
	Roma VF	45.90	112.6	245	5	4	4	4	"	"
	Chico III	45.90	156.2	340	4	4	3	4	"	"
	Peto 94-C	45.90	100.8	220	4	5	5	4	"	"
	Better Boy	22.95	17.5	76	1	2	3	1	"	"
	Hosowo 80	45.90	115.9	253	5	3	3	3	"	"
	Money Maker	58.65	202.4	345	4	4	4	4	Oct. 28, 1987	Feb. 2, 1988
	UC204-Select	48.88	141.1	289	3	4	4	4	"	"
	Admiral	48.88	134.9	276	3	5	3	3	"	"
	Marglobe	29.33	71.6	244	3	3	3	3	"	"
	Beefsteak	29.33	59.4	203	2	4	3	3	"	"
	Roma VFN	58.65	299.3	510	5	5	4	5	"	"
	Roma VF	58.65	264.5	451	5	5	4	5	"	"
	Chico III	48.88	155.6	318	4	4	3	3	"	"
	Peto 94-C	48.88	195.9	401	4	5	5	5	"	"
	Hosowo 80	39.10	136.1	349	4	3	2	3	"	"
Hot pepper	Ghana 2	22.95	36.3	158	5	5	2	2	May 26, 1987	Sept. 15, 1987
	Goav pepper (KPAKPO SHITO)	68.85	65.8	96	5	5	2	2	"	"
	Chili	10.20	18.8	157	5	5	5	5	Jan. 4, 1988	May 10, 1988
	Caynne Long	10.20	5.3	52	3	5	5	5	"	May 20, 1988
	Slim De-Caynney	5.10	4.7	92	4	5	5	5	"	"
Egg plant	Local Garden	53.50	163.7	306	5	2	3	2	Jul. 6, 1987	Oct. 1, 1987
	Local Gambella	40.80	139.1	341	5	5	5	4	Jan. 4, 1988	May 8, 1988
Cucumber	New Tokiwa	91.80	498.4	543	5	5	5	2	Jul. 1, 1982	Aug. 19, 1987
	Table Treat	30.60	50.4	165	4	4	4	2	"	"
	Marketer	45.90	105.0	229	4	4	4	2	"	"
Water melon	Crimson Sweet	75.00	132.7	177	4	4	4	4	Jan. 5, 1987	May 3, 1987
	Charleston Gray 133	100.00	132.3	132	4	4	4	4	"	"
	Kodama	50.00	61.1	122	4	4	4	4	"	"
Melon	Charrentais	100.0	7.4	7.4	2	3	4	2	Jan. 5, 1987	May 10, 1987

a) Scores were based on the following scale; 1: Very poor, 2: Poor, 3: Moderate, 4: Good, 5: Very good

b) Scored by the staff of Ministry of Agriculture and the authors based on interviews to the local people.

trials were carried out during the rainy and dry seasons. In the rainy season (July, 1987 - October, 1987), 'Roma VFN' had high score in terms of growth, quality and suitability. 'Roma VFN', 'UC204-Select'. 'Peto 94-C' and 'Chico III' also demonstrated good performance, however, their growth, quality, yield and/or suitability were slightly inferior to those of 'Roma VFN'. The other cultivars had medium scores except for

'Better Boy', which showed a very low yield and poor growth. In the dry season (October, 1987 - February, 1988), 'Roma VFN', 'Roma VF', and 'Peto 94-C' were the best, followed by 'Money Maker' and 'UC204-Select', while the rest were medium. 'Better Boy' was excluded from this trial since the growth and yield had been very poor in the rainy season.

'Ghana 2' and 'Goav pepper' are both Ghanaian

cultivars of hot peppers which have both high yield and a very hot taste. Although Ethiopian people use hot pepper very frequently in their meals, they said the taste of Ghanaian cultivars was a little different from that of the local cultivars, such as 'Caynne Slim' or 'De-Caynne'. This was the main reason why the Ghanaian cultivars were not highly appreciated by the people. 'Chili', 'Caynne Long Slim' and 'De-Caynne' had very good quality and suitability; 'Chili' was particularly excellent in spite of the fact that it was new in this area. On the other hand, 'Caynne Long Slim' had the lowest yield among the three cultivars as a result of devastation by wild animals, mainly deer.

In cucumbers, 'New Tokiwa' (Japanese cultivar) showed vigorous growth and high yield, but acceptability by the people was very low since the crop was new and the local people had no knowledge of how to use it in cooking.

The egg-plant fruits of 'Local Garden', one of the Ghanaian cultivars become orange when they ripen, and this resulted in low acceptability among the people. On the other hand, 'Local Gambella', which was very similar to the cultivar 'Black Beauty', had vigorous growth, and was

appreciated by the people because it was already popularly known in the society.

Three cultivars of water melon all grew well and were readily accepted by the people. It seems that water melon is one of the very important crops in this area because of its high water content, probably substituting for poor quality drinking water. On the other hand, 'Charentais' melon had poor growth mainly due to attacks by cucumber leaf beetle. More trials would be necessary to establish Charentais' growth characteristics using proper methods of crop protection.

Beans

The results from the bean trial are shown in Table 3. All cowpea cultivars showed good growth, quality and suitability except for 'IT84-1-108', in which germination rate and growth were poor. Mung bean and pole bean had excellent scores although the yield of mung bean was not so high. In groundnuts, 'Boma' was very good, and 'B.V.' and 'N.C.2' were good. The quality of the local cultivar was not so good in spite of its high yield.

Leafy vegetables

Among the leafy vegetables (Table 4), kale showed the best results both in the rainy season

Table 3 Yield, growth, quality and suitability of beans

Type	Cultivar	Area (m ²)	Yield ^{b)} (kg)	Yield ^{b)} (kg/a)	Growth ^{a)}	Quality ^{a)}		Suitability for the region ^{a)}	Sowing date	Harvest date
						Appearance	Taste ^{c)}			
Cowpea	IT82D-789	39.95	2.05	5.13	3	4	4	4	Jul. 14, 1987	Oct. 10, 1987
	IT84-1-108	39.95	1.40	3.50	2	3	4	3	"	"
	IT82E-32	39.95	4.58	11.45	5	5	4	5	"	"
	IT84E-124	39.95	3.85	9.64	4	4	4	4	"	"
	IT83D-442	39.95	3.45	8.64	4	4	4	4	"	"
	IT82E-16	39.95	5.88	14.71	5	5	4	5	"	"
	IT82E-18	39.95	2.60	6.51	3	4	4	4	"	"
Mung bean	Local	306.00	31.50	10.29	5	5	4	5	Jun. 29, 1987	Aug. 25, 1987
Groundnut	Boma	178.50	25.70	14.40	5	5	5	5	Jun. 29, 1987	Oct. 25, 1987
	B. V.	178.50	20.20	11.32	5	5	4	4	"	Nov. 13, 1987
	N. C. 2	178.50	20.50	11.48	5	5	4	4	"	"
	Local	178.50	24.00	13.45	5	3	3	3	"	"
Pole bean	Florida Butter Lima	22.95	11.30	49.24	5	5	4	5	Jul. 7, 1987	Oct. 9, 1987

a) Scores were based on the following scale; 1: Very poor, 2: Poor, 3: Moderate, 4: Good, 5: Very good

b) Without pod, seed only

c) Scored by the staff of Ministry of Agriculture and the authors based on interviews to the local people.

Table 4 Yield, growth, quality and suitability of leafy vegetables

Type	Cultivar	Area (m ²)	Yield (kg)	Yield (kg/a)	Growth ^{a)}	Quality ^{a)}		Suitability for the region ^{a)}	Sowing date	Harvest date
						Appearance	Taste ^{b)}			
Swiss chard	Fordhook Giant	45.90	69.4	151	3	4	4	3	Jul. 3, 1987	Aug. 25, 1987
	Long White Ribbed	45.90	69.6	152	3	4	4	3	"	"
	Smooth Leaf									
	Lucullus	10.20	14.5	142	3	4	4	3	Feb. 8, 1988	Apr. 15, 1988
	Fordhook Giant	10.20	16.2	158	4	4	4	4	"	"
Kale	Long White Ribbed	10.20	14.4	141	4	4	4	4	"	"
	Smooth Leaf									
	Local	12.75	32.5	255	4	4	4	4	Jul. 7, 1987	Aug. 25, 1987
	Local	15.30	23.2	152	3	4	4	4	Feb. 8, 1988	Apr. 30, 1988
Chinese cabbage	Disease Resistant-60 days	8.70	45.4	522	4	3	4	4	Jul. 7, 1987	Sept. 20, 1987
Cabbage	Copenhagen Market	9.78	27.9	285	4	4	4	3	Oct. 28, 1987	Feb. 20, 1988
	Early Drum Head	9.78	17.3	177	4	3	4	3	"	Feb. 28, 1988

a) Scores were based on the following scale; 1: Very poor, 2: Poor, 3: Moderate, 4: Good, 5: Very good

b) Scored by the staff of Ministry of Agriculture and the authors based on interviews to the local people.

and in the dry season. Moreover, this vegetable was the most familiar to the people, followed by Swiss chard. Although Swiss chard showed fairly good growth, quality and suitability, people seemed to prefer kale. They appear to consume Swiss chard as an alternative to kale when kale is not available in the market.

We observed that head cabbage does not perform well in this area because of the hot weather. However, we demonstrated that heads did form if cabbage was grown in the rainy season when the temperatures were somewhat lower than in the dry season, although its cultivation in the dry season was not tested. In the two cultivars grown, 'Copenhagen Market' appeared to perform better than 'Early Drumhead'.

Chinese cabbage also grew well and was accepted by the people in spite of its unfamiliarity in the country as whole. This is probably due to the lack of fresh leafy vegetables in the market.

Root vegetables

Among the root vegetables (Table 5), taro showed the best results in all aspects. Its cultivation was very applicable to the weather cycle in this area, because it was possible for taro to be grown regularly; planting just at the beginning of

the rainy season (May), harvesting at the beginning of the dry season (October) then storing of the daughter tubers under shade in a hole covered with soil until the beginning of the next rainy season. It was strange that taro was not widely grown in spite of the fact that it was familiar to the people and well suited to the natural conditions. Yam was also fairly good from the same point of view.

Sweet potato was the only root vegetable which was overproduced here since it was well suited to this area and the farmers were well supplied with planting materials. In this trial, 'Koka 6' and 'Koka 12' performed very well. However, they should be distributed widely in this area for comparison of the yield and acceptability with the other existing cultivars.

Most of the cassava cultivars grew very well. Cassava was well suited to this area, but few people were familiar with cassava and its utilization. They say that some people have died after eating cassava. It may be that these people had eaten the raw toxic cassava and this tragedy could be the main reason why cassava is not popular. The cultivars tested in this study included both toxic and non-toxic ones. It seemed that a demonstration to the people was necessary to

Table 5 Yield, growth, quality and suitability of root vegetables

Type	Cultivar	Area (m ²)	Yield (kg)	Yield (kg/a)	Growth ^{a)}	Quality ^{a)}		Suitability for the region ^{a)}	Sowing date	Harvest date
						Appearance	Taste ^{b)}			
Radish Japanese radish	Early Scarlet Globe	45.90	20.8	45.3	2	2	3	2	Jul. 7, 1987	Aug. 26, 1987
	Disease Resistant	3.00	4.3	141	3	3	4	2	Jul. 7, 1987	Sept. 15, 1987
	All-fat Tokinashi	3.00	2.2	73	2	3	3	2	"	"
Carrot	Nantes Forto RS	59.60	16.1	27	3	2	3	3	Jul. 3, 1987	Sept. 10, 1987
	Chanteney Red	22.95	4.2	18	2	2	3	2	"	"
	Top Weight	22.95	3.7	16	2	2	2	2	"	"
	New Kuroda Gosun	22.95	2.4	11	1	2	2	2	"	"
	Mikado Gosun N	22.95	2.1	9	1	2	2	2	"	"
Beetroot	Crosby Egyptian	45.90	20.0	44	3	2	3	3	Jul. 3, 1987	Aug. 28, 1987
	Detroit Dark Red Short Top	45.90	22.5	49	3	2	3	3	"	"
Taro	34/79 Rosheb (Cuba)	176.50	250.0	142	5	5	5	5	Jan. 5, 1987	Oct. 20, 1987
	Local	1,342	428.0	32	4	5	5	5	Jun. 30, 1987	Jan. 15, 1988
Yam	Non Variat	47.50	113.0	238	5	4	3	4	Jan. 5, 1987	Oct. 21, 1987
Sweet potato	Abol	272.00	163	62	3	3	4	4	Jun. 30, 1987	Dec. 12, 1987
	Gambella	97.75	89	91	4	3	3	4	"	"
	Koka 6	234.60	313	133	5	5	4	5	"	"
	Koka 12	156.40	232	148	5	5	4	5	"	"
Cassava	Wollayta	66.85	129	192	4	4	3	2	May 5, 1987	Dec. 17, 1987
	Jimma	25.50	39	153	4	4	3	2	"	"
	Nigeria White	42.00	68	162	4	4	3	2	"	"
	45-72	49.42	128	259	5	5	4	2	"	"
	44-72	24.00	66	275	5	5	4	2	"	"
	Isonia Nigeria	113.71	224	197	4	4	4	2	"	"
	White Oybania	40.63	39	96	2	3	3	2	"	"
	Nigeria White Isona	52.29	57	109	3	4	3	2	"	"
	Nigeria Red Oybania	—	—	—	—	—	—	—	"	"
	Nigeria Red 04/72	33.00	9	27	1	2	3	2	"	"
	Red Nigeria 44 Isonia	3.00	14	467	5	5	4	2	"	"
	Nigeria Red 104/72	15.00	47	313	5	5	4	2	"	"
	White Nigeria	25.44	29	114	3	4	3	2	"	"

a) Scores were based on the following scale; 1: Very poor, 2: Poor, 3: Moderate, 4: Good, 5: Very good

b) Scored by the staff of Ministry of Agriculture and the authors based on interviews to the local people.

differentiate between the toxic and non-toxic cultivars or to give them the means to eliminate the toxic compounds. Alternatively, cultivars which are low in cyanide content or without any cyanide may have to be introduced. Cassava is drought resistant and has a wide soil adaptability, thus it is well suited to the area.

Radish and Japanese radish were of poor suitability because the climatic conditions are too harsh for them and they were unknown vegetables in the region. It was possible to grow carrot and beetroot although the planting season must

be chosen carefully. Among the carrot cultivars, 'Nantes Forto RS' performed better than the others.

Discussion

In Gambella, hot weather is a serious problem, especially in the dry season. During this time it is quite uncomfortable to work in the fields during daytime but it is also during this time that irrigation is absolutely necessary. Heat-resistant or drought-resistant vegetables need therefore to be introduced, and at the same time the methods of

cultivation should be simple for quick adaptation by the local farmers. It is also necessary to give incentives to the farmers and have them realize the importance of vegetable crop production not only from the financial but also from the nutritional point of view.

From the results of this trial, the vegetables studied can be divided into four major groups according to their suitability for Gambella district, as follows:

1. Very suitable and hopeful

Tomato (cvs. 'UC204-Select', 'Money Maker', 'Roma', 'Peto 94-C'), Hot pepper, Egg plant, Water melon, Beans (Mung bean, Cowpea, Groundnut, Polebean), Kale, Chinese cabbage, Taro, Yam, Sweet potato.

2. Suitable for growing, but not highly appreciated (demonstrations on how to prepare or cook are required.)

Cassava, Cucumber.

3. Possible to grow, but cropping system should be carefully planned (e.g. should be grown in cool season)

Melon, Cabbage, Swiss chard, Carrot, Radish, Japanese radish, Beetroot.

4. Very difficult to grow in this area

Lettuce, Spinach, Pea, Broccoli, Cauliflower, Onion, Turnip. (In this study, useful data could not be obtained due to very poor growth.)

Considering the present situation whereby most vegetables are in short supply in this region, the growing of vegetables ranked 1 to 3 above should be emphasized. Limiting factors in the widespread cultivation of these vegetables are, among others, the hot weather which makes it difficult or uncomfortable to work in the fields, and the difficulties the farmers undergo to acquire the necessary vegetable seeds and equipment for both irrigation and cultivation.

Although some fertilizers, chemicals and plant-

ing materials such as seeds of tomato, hot pepper, egg plant, cabbage, okra and beans, cuttings of sweet potato and cassava, and tubers of taro, are distributed to the farmers, the supply is not enough. It is therefore important for the Ministry of Agriculture to continue the distribution of the planting materials at least and provide some extension services. In addition, some of the tools or equipment such as watering cans, irrigation pumps and planting pots for seedlings should be available to the farmers more freely.

From this study, it is suggested that more trials should be carried out in order to accumulate data over a longer period of time. Since there appeared to be a high demand for vegetables, production of those vegetables which performed well should be increased. This can be done in cooperative farms or farms belonging to individual farmers who showed interest during the preliminary trial. In so doing, this may in the long run improve not only the economic status of the people of Gambella but also improve their nutritional status through increasingly diversified production of vegetables, which is in line with Government policies.

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エチオピア国ガンベラ県における数種野菜の栽培試験

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エチオピアのガンベラ県において、野菜栽培の可能性に関する基礎的知見を得るために1987年に数種野菜栽培試験を行った。試験に用いた野菜（果菜類6種類、豆類5種類、葉菜類8種類、根菜類10種類）はその地域での適合性により以下の4つのグループに分類できた。

1：非常によく適合している、または可能性が高いもの。

トマト（‘UC 204-Select’、‘Money Maker’、‘Roma’、‘Peto 94-C’）、トウガラシ、ナス、スイカ、豆類（リョクトウ、ササゲ、ラッカセイ、ポールピーン）、ケール、ハクサイ、サトイモ、ヤマイモ、サツマイモ

2：栽培には適合しているが、地域で知られていないもの。

キュウリ、キャッサバ

3：栽培可能であるが、注意深い栽培計画を要するもの。

メロン、キャベツ、フダンソウ、ニンジン、ハツカダイコン、ダイコン、テーブルビート

4：栽培がほとんど不可能なもの

レタス、ハウレンソウ、エンドウ、ブロッコリー、カリフラワー、タマネギ、カブ

更に、結果を踏まえた上で、将来に向けてガンベラ地域で野菜生産を発展させるための方策について提案し、その可能性・重要性について検討を加えた。