CADU

CHILALO AGRICULTURAL DEVELOPMENT UNIT

CA-13

B. 13.

CROP SAMPLING IN THE CHILALO AWRAJA, ARUSSI PROVINCE 1967

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1. PREFACE

Starting in 1966 the crop production staff of the Chilalo Agricultural Development Unit (CADU) has undertaken surveys in the Chilalo awraja on the yields of the most frequent crops. The purpose of the surveys carried out during the harvesting season in the months of November - December, has been to get an objective estimation of the average levels of yields of different crops in the area.

The investigation in 1966 primarily had the character of an introductory survey to gather experience in the field and consequently was carried out on a limited scale, whereas the survey in 1967 was more comprehensive.

Because of the small number of samples taken in 1966 and 1967 and the fact that they were not statistical samples, the results obtained here can not be used to estimate accurate crop yield of Chilalo awraja or the different localities, where the samples were taken.

2. AMOUNT AND DISTRIBUTION OF ANNUAL RAINFALL

If the two crop samplings are compared, the 1967 yields turn out to be inferior to those of the preceding year in all crops, mainly due to attacks by fungus diseases, favoured by the wet weather prevailing during the growing season of 1967 (Table 1).

Table 1. The precipitation in Asella and on the Kulumsa farm in 1966 - 67.

Month	Total rainfall, mm.			
	Asella+)		Kulumsa++)	
	1966	1967	1966	1967
January	17.0	2.5		1.3
February	112.5	0.0		0.5
March	52.5	139.5		85.3
April	111.5	71.5		45.5
May	27.5	180.5		87.5
June	138.5	112.5		69.7
July	231.5	367.0		172.9
August	221.5	281.5	70.0	149.8
September	139.0	211.5	111.7	140.3
October	82.5	191.0	22.3	66.8
November	1.5	90.5	0.3	65.3
December	0.0	0.0	0.0	0.0
Total	1.135.5	1.648.0	-	884.9

+) Swedish Mission

++) Observations started August 5th, 1966.

3. AREA OF CROP SAMPLING

The crop sampling represents an area extending from Huruta and Etaya in the north to Sagure and Dighellu in the south. The field work was carried out mainly by the extension agents in the following localities:

1. Huruta
2. Etaya
3. Gondhi
4. Asella
5. Sagure
6. Dighellu

4. SAMPLING METHOD

Two random samples of 1 square meter each were taken from each field. No statistical sampling method was, however, used to select the fields. From the fields chosen the samples were harvested with a sickle and collected in a sack for drying.

After drying in the open air the harvested samples were threshed with a small threshing machine for experimental work. The threshed crop was cleaned and weighed. The moisture content was estimated by means of a drying cabinet. Some estimations concerning purity, hectoliter weight and 1000 seed weight were also carried out.

The yield figures, hectoliter weights and 1000 seed weights have been corrected to 90% of dry matter.

5. AVERAGE YIELD OF DIFFERENT CROPS WITHIN THE CHILALO AWRAJA IN 1967

5.1. Wheat

The average wheat yield has been found to be 1160 Kg per hectare (Table 2). There are variations, however, and wheat is particularily high yielding in the Huruta area where the average is 1600 kg per hectare. The difference in altitude is of importance and the yield is decreasing at higher altitudes. In Sagure and Dighellu, where the acreage of wheat is small, the yields are very poor.

As an average, 12.9% of the total yield consists of weed seeds. The percentage also varies according to locality and is broadly speaking inversely proportional to the wheat yield. Besides the weeds harvested, there are of course a lot that remain in the field since many weeds have shed their seeds at harvest time. The figures give some idea about the weed occurence.

Table 2. Average yield of wheat at various localities.

Location	Average grain yield		Average amount of weed seeds		
	No. of samples	10% moisture Kg/ha	No. of samples	Kg/ha	%
Huruta	37	1600	37	170	9.6
Etaya	32	910	31	250	20.9
Gondhi	50	1250	48	140	10.2
Asella	25	1080	25	200	15.4
Sagure	20	760	11	250	25.2
Dighellu	2	630	2	90	12.9
Average and total	167	1160	154	190	12.9

An attempt has been made to classify the samples into different local and introduced varieties as far as information on this subject has been available (Table 3). There might be some errors in the classification, but still the information thus obtained will give an idea of the characteristics of the varieties. It must be born in mind, however, that the number of observations in some cases is very small and consequently the figures uncertain. The listing according to yield is not to be taken as a definite evaluation of the varieties.

In this sampling the best yielding variety seems to be "Yaktana 54", which yields about 2200 Kg per hectare and very little weed seeds (1.3%). Varieties such as "Ayebo", "Nech" and "Bokeke" yield about 1500 - 1600 Kg per hectare with a weed seed frequency of around 10%. "Kenya 1" is low yielding, giving about 1200 Kg per hectare and could be compared to "Sett akuri" and "Shalo". The amount of weed seeds constitutes about 11% in "Shalo". Among the very low yielding varieties are "Tikur sinde" (black wheat) and "Bawnde" which are mainly grown in the areas of Gondhi, Asella and Sagure. The yield varies between 700 - 900 Kg per hectare and the amount of weed seeds in the total yield amounts to about 13% in "Bawnde" and 18% in "Tikur sinde".

The varieties "Neck sinde" and "Agebo sinde" have particularly large seeds, whereas the seeds of Tikur sinde" are very small. Kenya 1 shows a high 1000 seed weight compared to the other varieties.

Table 3. Average yield of local wheat varieties.

Variety	No. of samples	Average grain yield 10% moisture	Weight of 1000 seeds 1 hl.		Average amount of weed seeds	
		Kg/ha	g	kg	Kg/ha	%
"Yaktana 54	2	2220	33.2	75.1	30	1.3
"Bokeke"	5	1660	36.4	76.7	170	9.0
"Ayebo sinde"	8	1640	38.9	76.9	160	8.9
"Neck sinde"	16	1580	39.9	78.0	200	10.4
"Sett akuri"	9	1270	34.3	77.2	230	15.4
Kenya 1	39	1190	32.5	81.0	130	9.8
"Shalo"	6	1150	33.8	76.6	140	10.9
"Bawnde"	6	900	33.7	79.4	160	12.8
" Tikur sinde"	13	700	25.8	76.3	200	17.7
Average and total	104	1250	33.8	78.5	160	11.3

5.2. Barley

There is a tendency also in barley to decreasing yields with increasing altitude, even though it is not so pronounced as in wheat. The average yield is 1.390 Kg per hectare, and the variations between the different areas are more moderate than in wheat. The moisture content is about 9% and the weed content 12.5% (Table 4) Whereas wheat is more frequently cultivated at lower altitudes, barley is the predominant crop in the higher, southern part of the area.

Table 4. Average yield of barley at various localities .

Location	Average grain yield		Average amount of weed seeds		
	No. of samples	10% moisture Kg/ha	No. of samples	Kg/ha	%
Huruta	22	1640	22	230	12.4
Etaya	30	1810	30	210	10.2
Gondhi	6	1310	6	330	19.9
Asella	37	1120	37	230	17.0
Sagure	38	1570	38	210	11.8
Dighellu	75	1200	77	150	11.4
Average & total	208	1390	208	200	12.5
Average 1966	29	1600			
Min. of Agr. 1966	348	884			

As for the following listing by variety (Table 5), the same comments as were given for wheat are valid. It is true that Workeye has proved to yield very well, but it is only represented by 3 samples. Arusso and Netela also average more than 1500 Kg/ha, whereas Gojjamie and Kessele - the most frequent variety - are to be found at the bottom of the list. However, most samples of Kessele have been obtained from Asella and Dighellu, where the yields were generally poor. The frequency of weed seeds is not correlated to the yields of the varieties in the same way as in wheat. Senafe Kollo has turned out to have large seeds compared to the other varieties. The hectoliter weight is rather uniform.

Table 5. Average yield of local barley varieties.

Variety	No. of samples	Average grain yield, 10% moisture, Kg/ha	Weight of:		Average amount of weed seeds,	
			1000 seeds gm.	1 hl, kg	Kg/ha	%
Workeye	3	2370	40.1	66.9	80	3.2
Arusso	5	1620	43.4	65.5	220	11.9
Netela	12	1520	44.1	65.8	290	15.8
Senafe Kollo	11	1400	49.4	65.7	160	10.3
Nech gebs	36	1400	42.0	66.3	160	10.2
Muga	13	1390	42.8	66.5	110	7.4
Sergenja	3	1250	40.4	66.9	250	16.5
Tikur gebs	14	1200	38.3	66.0	260	18.0
Kessele	39	1070	38.3	65.8	160	13.2
Gojjamie	3	1060	39.7	64.9	210	16.1
Average	139	1310	41.3	66.0	180	12.1

5.3. Teff

Teff is not extensively grown in the Chilalo area, but some fields have been found in each of the sub-areas. The yield has been found to decrease with increasing altitude.

As an average, teff yields 1210 Kg per hectare. (Table 6)

Table 6. Average yield of teff at various localities.

Location	No. of samples	Average grain yield, 10% moisture Kg/ha.	Weight of: g 1000 seeds	hl., Kg
Huruta	5	1430	0.34	87.5
Etaya	2	1260	0.36	85.4
Gondhi	5	1060	0.35	87.3
Asella	1	1430	0.27	85.0
Sagure	3	980	0.29	86.6
Average and total	16	1210	0.32	86.9
" 1966	3	1250		
Min. of Agr. 1966	10	676		

5.4. Maize.

Maize is commonly cultivated at altitudes below 2.200 meters, where its yielding capacity under favourable conditions is very high. In several plots yields exceeding 5000 Kg per hectare have been recorded, the highest yield being 8.500 Kg/ha. There are great variations, however, and most of the very high yielding plots have been found at lower altitudes. It is obvious that if proper cultivation was introduced, e.g. the use of hybrid seed, better weeding and fertilizing, yields might still be raised considerably and maize would be a very profitable crop. As yet, hybrid seed has not been introduced into the area (with exception for the Kulumsa farm), and the varieties cultivated are different local ones.

There is a definite trend towards a decrease in 1000 seed weight and hectoliter weight with increasing altitude.

Table 7. Average yield of maize at various localities.

Location	No. of samples	Average grain yield, 10% moisture, Kg/ha	Weight of: 1000 seeds g	1HL, kg	Thousands of plants/ha	No. of cobs /plant
Huruta	10	4180	199	79.7	86	1.00
Etaya	12	2960	168	78.3	87	1.00
Gondhi	6	1790	151	77.7	88	1.02
Asella	2	2450	134	76.8	(73)	(1.37)
Average and total	30	3110	172	78.6	84	1.03
" 1966	3	3250				
Min. of Agr. 1966	28	1653				

5.5. Sorghum.

The average hectare yield of sorghum in the sampled area was about 1280 Kg per hectare. Sorghum is not commonly cultivated, and the number of samples is relatively small. Similar to most other crops, also sorghum has proved to yield better at the lower altitudes this year.

Table 8. Average yield of sorghum at various localities.

Location	No. of samples	Average grain yield 10% m. Kg/ha	Weight of: 1000 seeds gm.	1 hl, kg	Thousands of plants/ ha	No. of heads/plant
Huruta	4	1660	14.8	69.1	123	0.87
Gondhi	12	1280	14.5	69.1	129	1.02
Asella	2	470	10.8	-	(213)	0.84
Average and total	18	1280	14.3	69.1	138	0.93

5.6. Field peas.

Field peas is a rather common crop in the area investigated. The average yield has been found to be 1090 Kg/ha., but there are particularly great variations in this crop from one yield to the other. The variations do not seem to be correlated with the altitude, however.

Table 9. Average yield of field peas of various localities.

Location	No. of samples	Average yield, 10% moisture Kg/ha.	Weight of: 1000 seeds gm.	1 hl, kg.
Etaya	7	1180	153	79.5
Gondhi	3	1320	160	78.4
Asella	11	1050	180	78.4
Sagure	6	920	177	78.3
Dighellu	11	1120	164	78.9
Average and total	38	1090	168	78.8
" 1966	6	1310		
Min. of Agr. 1966	8	1048		

5.7. Horse beans.

Among leguminous crops horse beans are particularly high yielding. Horse beans are cultivated in all the sub-areas investigated. As an average of the crop samples the yield was 1610 Kg/ha. The yield seems to be increasing with the altitude.

Table 10. Average yield of horse beans at various localities.

Location	No. of samples	Average yield 10% moisture Kg/ha	Weight of: 1000 seeds gm.	1 hl, kg.
Huruta	3	1750	374	80.1
Etaya	9	1380	483	77.2
Gondhi	6	1360	506	77.1
Asella	11	1670	398	78.4
Sagure	5	1860	495	75.4
Dighellu	12	1730	436	77.3
Average and total	46	1610	446	77.4
" 1966	7	2710		
Min. of Agr. 1966	12	1166		

5.8. Lentils.

Only 3 samples of lentils have been taken from the area around Gondhi. The average yield of the samples was 200 Kg/ha, and the 1000 seed weight 25.7 gm.

5.9. Flax.

According to the "Report on a survey of Arussi province" published by the Central Statistical Office of the Imperial Ethiopian Government in 1966, 15% of the cultivated area in the Chilalo awraja is occupied by flax. Consequently flax is by far the most important oil crop within the area. Particularly south of Asella the cultivation is widespread. The yield is poor, however, partly due to a heavy weed infestation. There is a tendency to decreasing yield with increasing altitude.

Table 11. Average yield of flax at various localities.

Location	Average grain yield No. of samples	10% moisture Kg/ha	Weight of: 1000 seeds gm.	Average amount of weed seeds No. of samples	kg/ha	%
Huruta	1	520	4.2	1	20	4.4
Etaya	15	650	4.4	7	30	4.3
Gondhi	4	600	4.3	4	160	20.4
Asella	23	390	4.0	9	20	4.5
Sagure	29	400	4.6	13	90	15.6
Dighellu	10	380	4.7	7	40	8.0
Average and total	82	450	4.4	41	60	10.5
" 1966	19	630				
Min. of Agr. 1966	70	408				

6. FREQUENCY OF WEED SEEDS IN THE CROP SAMPLES.

As far as wheat, barley and flax samples are concerned, the amount of weed seeds has been determined and the percentages are given in the preceding tables. The figures in question give no accurate idea of the weed frequency in the crops concerned, especially when the harvest is delayed, since many or perhaps most weeds have shed their seeds at that time. In judging the value of the harvest as a seed the estimations are interesting, however, since no further cleaning is carried out before sowing.

In order to determine what species of weeds are spread by seed, not only the total amount of weed seeds in the samples has been determined, but also the different species of seeds.

As can be seen from the figures (Tables 12 - 16), a small proportion (about 1%) of the seeds in the grain crops are non-gramineous. The seed cleaning is essential in these crops, since no chemical control of gramineous weeds in grain in possible except for the control of Avena sp., which is very expensive, however. Also in flax the proportion of gramineous weeds is dominant, and the same statement is relevant. Guizotia villosa seems to be significantly more abundant in flax than in grain crops.

The frequency of different weeds seems to be somewhat depending upon the crop concerned. Thus, Lolium temulentum constitutes the majority of seeds in wheat, followed by the Avena species. In barley, Avena sp. predominate, and Lolium comes second. Other grass species, such as Phalaris paradoxa and Bromus sp., probably B. adoensis, also occurr on a considerable scale. The difference in frequency between weed species in wheat and barley might partly be due to the fact that most investigated wheat samples derive their origin from lower altitudes, most barley samples on the other hand from higher altitudes.

Also in the flax samples (mostly from higher altitudes) Avena sp. are abundant, followed by Lolium, Bromus and Phalaris and, to a greater extent than in the grain samples, broad-leaved weed seeds.

Table 12. Proportion of different weed seeds in wheat crop samples in 1967.

	L O C A T I O N						
	Huruta	Etaya	Gondhi	Asella	Sagure	Dighellu	Average
No. of samples:	6	6	6	7	6	2	33
Weeds:							
Lolium temulentum	78.5	64.2	42.7	59.6	40.7	0.2	55.0
Avena sp.							
strigosa	7.2	23.8	9.8	22.1	23.5	34.8	18.0
abessinica	4.8	4.7	42.4	15.1	19.7		17.6
ludoviciana	0.6						0.1
Phalaris paradoxa	3.5	X	X	0.1	13.6	1.6	3.3
Festuca adoensis (?)				X			X
Galium spurium	0.9		0.1	X	X	X	0.2
Bromus adoensis (?)	2.4	0.2	0.6	1.3	1.8	0.1	1.2
Guizotia villosa	X	0.3	0.4	0.2	0.4	1.7	0.3
Torilis arvensis	0.2	X	0.4	X	X	X	0.1
Polygonum nepalense	0.4		X	X	X		0.1
Setaria acromelana	0.2	X	0.1	X	X	X	0.1
Commelina imberbis		1.4	X	X			0.3
Rumex sp.				X	X	0.6	X
Cruciferae	X		0.2				X
Miscellaneous weed seeds	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Crop seeds	1.1	5.2	3.1	1.4	0.2	0.9	3.6

X) indicates that the weed has been observed.

Table 13. Proportion of weed seeds in barley crop samples in 1967.

	L O C A T I O N						
	Huruta	Etaya	Gondhi	Asella	Sagure	Dighellu	Ave-rage
No. samples:	6	6	2	9	6	6	35
Weeds:							
Lolium temulentum	43.6	43.6	12.4	24.0	35.0	22.5	29.9
Avena sp.							
strigosa	47.7	26.2	18.2	40.2	16.4	59.8	36.5
abyssinica	0.1	0.9	0.5	5.0	6.5	11.1	4.3
ludoviciana				X	1.0	1.0	0.3
Phalaris paradoxa	X	1.6	37.1	23.8	35.2	1.6	16.9
Bromus adoensis (?)	0.4	20.4	29.7	5.1	4.7	0.6	8.3
Festuca adoensis (?)	X			X		0.6	0.1
Galium spurium			X	0.1	X	0.4	0.1
Guizotia villosa	0.1	0.1	X	0.3	X	0.9	0.3
Torilis arvensis	0.4	0.4	X	X		X	0.1
Polygonum nepalense	X	0.1	0.2	0.1		X	0.1
Setaria acromelana	2.7	0.9		0.5			0.7
Commelina imberbis	0.3						0.1
Rumex sp.				X	0.1	0.6	0.1
Cerastium sp.				0.1		X	X
Miscellaneous weed seeds	0.3	0.4	0.2	0.4	0.1	0.6	0.2
Crop seeds	4.4	5.6	1.7	0.4	1.0	0.3	2.0

Table 14. Proportion of different weed seeds in flax crop samples in 1967.

	L O C A T I O N						
	Huruta	Etaya	Gondhi	Asella	Sagure	Dighellu	Ave-rage
No. of samples:	1	6	3	9	12	5	36
Weeds:							
Lolium temulentum	16.1	46.3	21.6	40.1	21.7	16.1	25.0
Avena sp.							
strigosa	36.6	9.0	11.6	13.7	8.5	21.2	11.1
abyssinica		7.8	1.4	15.8	38.2	21.5	23.2
Phalaris paradoxa		1.7	43.2	0.4	2.0	5.6	11.9
Festuca adoensis (?)			1.6	6.0	X	4.8	1.4
Galium spurium		1.3	2.0	2.1	0.5	1.5	1.1
Bromus adoensis (?)	2.5	21.4	9.1	10.9	17.3	11.9	14.3
Guizotia villosa	39.3	9.9	0.2	0.4	4.9	7.2	4.2
Torilis arvensis	0.5	0.7	0.2	0.2	0.1	X	0.2
Polygonum nepalense		X	0.7	X	0.1	0.3	0.1
Setaria acromelana	1.8	X	0.1	X	X		X
Plantago lanceolata				2.2	0.4		0.4
Cerastium sp.				X		1.4	0.1
Rumex sp.			X		X	0.2	X
Cruciferae	2.5				1.0		0.5
Miscellaneous weed seeds	0.7	1.9	1.0	1.0	2.9	2.2	2.3
Crop seeds			7.3	7.2	2.4	6.1	4.2

X) indicates that the weed has been observed.

Table 15. Proportion of different weeds in some areas in Chilalo awraja in 1967.

	L O C A T I O N						
	Huruta	Etaya	Gondhi	Asella	Sagure	Dighellu	Average
No. of samples:	13	18	11	25	24	13	104
Weeds:							
Lolium temulentum	53.1	43.1	44.0	39.8	33.6	19.4	40.0
Avena strigosa	36.3	15.4	12.1	31.1	17.1	53.4	25.7
Avena abyssinica	2.3	26.2	2.6	9.9	20.0	10.8	12.1
Avena ludoviciana				0.3	0.3	0.8	0.2
Phalaris paradoxa	X	0.7	22.9	12.5	18.0	2.0	10.6
Bromus adoensis (?)	0.3	8.6	13.7	3.9	7.0	1.6	6.0
Guizotia villosa	0.5	0.8	X	0.3	1.5	1.6	0.7
Setaria acromelana	1.5	0.4	X	0.3	X	X	0.4
Galium spurium		X	0.8	0.2	0.2	0.4	0.3
Festuca adoensis (?)	X		0.3	0.4	X	0.9	0.2
Torilis arvensis	0.3	0.4	0.2	X	X	X	0.1
Polygonum nepalense	X	X	0.4	X	X	X	0.1
Plantago lanceolata				0.1	0.1	0.1	0.1
Commelina imberbis	0.8	X		X			0.1
Rumex sp.			X	X	0.1	0.6	0.1
Cruciferae	X	X	X	X	0.3	0.4	0.1
Cerastium				X		0.1	
Miscellaneous weed seeds:							
among others Andropogon	X	X		X	X	X	
Chenopodium			X				
Amaranthus		X	X				
Salvia	X	X		X			
Vicia	X						
Pennisetum		X			X		
Bidens	X			X	X		
Sorghum	X						
Euphorbia		X					
Brassica		X					
Reichardia		X					
Geranium			X				
Stellaria					X		
Cynoglossum					X		
Trifolium						X	
Crop seeds	4.7	3.8	2.4	1.2	1.0	7.5	2.9

X) indicates that the weed has been observed.

7. SUMMARY AND CONCLUSIONS

The number and yield figures of the crop samplings, carried out by the Chilalo Agricultural Development Unit in 1966 and 1967, are compiled in table 16.

Table 16. Number and yield of crop samples in 1966 - 67.

Crop	No. of samples		Yield	
	1966	1967	1966	1967
Wheat	38	167	1330	1160
Barley	29	208	1600	1390
Teff	3	16	1250	1210
Maize	3	30	3250	3110
Sorghum	-	18	-	1280
Field peas	6	38	1310	1090
Horse beans	7	46	2710	1610
Lentils	-	3	-	200
Flax	19	82	630	450
Total	105	607		

The 1967 yields are on all hands inferior to those of 1966, probably due to the wet weather during the growing season of 1967.

Maize differs markedly from the other crops with regard to yield level. Although the weather was exceptionally wet in 1967, the yield figures of that year ought to be more reliable than those of 1966, especially in the low-frequent crops. Lentils, which are rarely cultivated in the area, seem to yield very poorly.

As a general conclusion, it can be stated that the yields are poor and most likely could be raised considerably. The following steps should be taken to achieve desirable improvements:

1. Better soil preparation practices. The plow used for the present does not eradicate the weeds satisfactorily. Specially this is the case with vegetatively propagated weeds such as many grass species. Mouldboard plows should be introduced.

2. Better weeding practices, implying primarily more frequent weedings and in some cases, where broad-leaved weeds and wild oats predominate, chemical weed control as well.

3. Row planting of big grained species, such as maize and beans, which will facilitate a more efficient weeding and make possible the introduction of some simple implement for weed control.

4. Seed improvement, implying better cleaning of the seed, cultivation of uniform, high yielding varieties, adapted to the area, seed dressing if necessary and introduction of hybrid seed maize and sorghum. The crop sampling visualizes the fact that the seed is an important means of spread for novious gramineous weeds such as Avena sp., Lolium temulentum, Phalaris paradoxa and Bromus adoensis.

5. Control of insects and fungus diseases.

LIST OF CADU PUBLICATIONS

A. Project Preparation Period

1. Report No. I on the establishment of a Regional development project in Ethiopia, October 1966.
   Part I General Background.
   Part II Project Outline.
   Part III Appendices.
   (A reprint of the Summary is also available).
2. Report No. II on the establishment of a regional development programme in Ethiopia, May 1967. (The building programme appears under separate cover.)
3. Trials and demonstration plots at Kulumsa in 1966, July 1966
4. Reconnoitering survey of the water resources in Chilalo awraja, March 1967.
5. Creation of a forestry adminstration in Arussi province, March 1967.
6. Crop sampling in the Chilalo Awraja 1966, May 1967.
7. Results of trials and observation plots at Kulumsa 1966/67, May 1967.
8. Sagure, a market village, June 1967.
9. Forest nursery and planting techniques, June 1967.
10. Trials and demonstration plots at Kulumsa and Swedish Mission Asella in 1967, July 1967.
11. Grain Marketing experiments 1967, August 1967.

B. Implementation Period

1. Government Agreement and Plan of operation.
2. Some reflextions on water erosion in Chilao Awraja, October 1967.
3. The Taungya afforestation method, November 1967.
4. Grow better Bahr-Zaaf in Ethiopia, January 1968.
5. CADU Semi-annual report 1967/68, January 1968.
6. Census in Sagure-Yeloma 1967, February 1968.
7. The changing rural society in Arussiland.
   Some findings from a field study 1966-67, March 1968.
8. CADU (pamphlet in English and Amharic)
9. CADU plan of work and budget 1968/69 (with preliminary estimates for 1969/70).
10. Cultivation practices and the weed, pest and disease situation in some parts of the Chilalo awraja, March 1968.
11. Introductory Agro-Botanical Investigations in Grazed areas in the Chilalo Awraja, Ethiopia.
12. Results of trials and observations on field and forage crops at the Kulumsa Farm and in Asella, 1967/68, June 1968
13. Crop sampling in the Chilalo Awraja, Arussi Province 1967, June 1968