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ASSISTANCE TO SETTLEMENT

ETHIOPIA

LAND USE PLANNING AND SOIL AND WATER CONSERVATION DEVELOPMENT PLANNING OF ASOSA



PROVISIONAL MILITARY GOVERNMENT OF SOCIALIST ETHIOPIA RELIEF AND REHABILITATION COMMISSION



UNITED NATIONS DEVELOPMENT PROGRAMME



FOOD AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ADDIS ABABA 1986

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> by S.K. Choi

THE PROVISIONAL MILITARY GOVERNMENT OF

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This field document is one of a series of reports prepared during the course of the UNDP/VAC project ETH/SD/Cl2 preparing the Assistance to Settlement Project, Phase TV, identified on the title page. The conclusions and recommendations given in the report are those considered appropriate at the time of its preparation. They may be codified in the light of further knowledge gained at subsequent stages of the project.

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ALSTPACT

This report describes the result of detailed survey of Land Use Planning and Soil and Water Conservation of Asosa Settlement Project 18,824 ha in western Welegaadministrative region. The Land Resources map, present Land Use/cover, slope and erosion classes map and Land suitability classification map are in scale of 1:50,000 and Soil and Water Conservation Development plan at a scale of 1:20,000 (consisting of 7 mapsheets and legends) accompanies the report.

The natural resources data and development plan information presented here is based on data collected during field work and the analysis of soil samples and reference of the Technical report 1.2.3.10. Assistance to Land Use Planning Project (ETM/78/003). Aerial Photointerpretation played an important role in locating land resources boundaries and basic studies.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

1.1 General

This document with its relevant maps is one of a series of documents prepared during the course of the FAC/UNDP Assistance to Settlement Project ETH/82/012 while preparing land use planning and soil and water conservation development planning and implementation for three large-scale settlements. namely Asosa, Tedele/Harole and Harawa of the Relief and Rehabilitation Commission (RRC) of Ethiopia.

This document has been presented with the aim of transf rming and promoting the selected settlement into sustainable self-reliant through the development of land suitability classification and Soil and Water Conservation Development plan based on the FAO methodology for land use planning and soil and water conservation.

With respect to the planning exercise the fundamental requirement and an essential component has been the compilation of a comprehensive land resources of each selected settlement site (please, refer the location map of Asosa Settlement Site.presented in figure 1).

1.2 Methods and Results

The methodology for the study of land use planning to prepare and explain the land suitability classification was based on the (FAO 1976) "Framework for Land Evaluation, (FAO 1983) "Land Evaluation in Rainfed Agriculture and (FAO 1986) "Guidelines for Land Use Planning" third draft The Soil and Water Conservation plan for the settlement is based on (FAO 1977) Soil Conservation and Management in Daveloping Countries" and (FAO 1979) Watershed Development with special reference to Soil and Water Conservation".

Analysis of land resources as a basis for land evaluation was based on combination of a land resources map at a scale of 1:50,000 with basic

information on Agroelimatology, Geomorphology and Soils.

As has been pointed out earlier, the land rescurce map focuses on the land resources inventory. This is because it provides the necessary assemblage and integration of resources data to carryout a land suitability evaluation.

A well formulated Soil and Water Conservation Development plan at a scale of 1:20,000 determines the methodology and technique to be used and to understand the physical and social conditions. This is important to formulate the needs and priorities of the settlers and also to indicate the most suited development options for the settlements.

2. BACKGROUND DATA

2.1 General description

2.1.1 Location

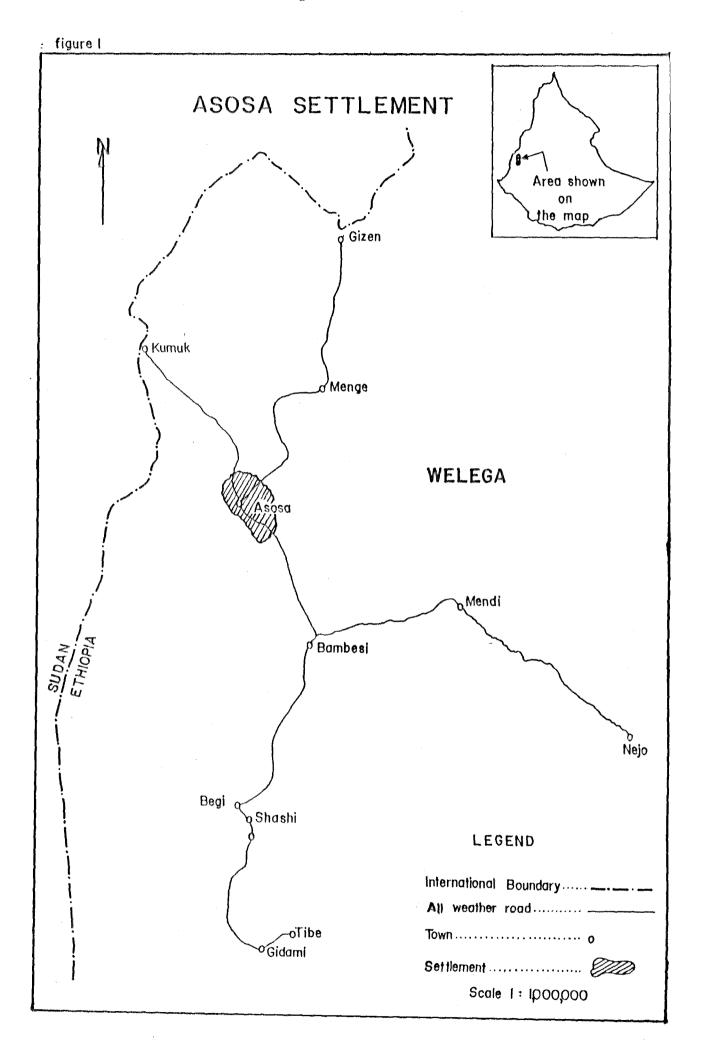
The Asosa settlement project is located adjacent to the Asosa Awraja capital in Welega Administrative region. The distance from Addis Ababa is 730 km west via Addis-Kumruk road.

The project area situated at an altitude range of 1300 to 1666 m.a.s.l and between south west of the Dabus River and Asosa mountain extends between latitude 10^{0} N to 13^{0} N and longitudes 38^{0} E to 41^{0} E. It therefore covers an area of 18.824 hectares.

2.1.2 Physiography

The area is gently undulating with interfluves of between one to two kilometers, the maximum reaching four kilometers.

The top of the interfluves is generally flat with slope percentages of 1 to 2% with a sharp increase as one reaches the river valleys. The soils in the area is highly uniform and is mainly deep red clays, i.e. "latesols"



Parent material and climate do not vary much within the project area, consequently, soil formation and differentiation have primarily been influenced by slope, aspect and drainage. The soil on top of the undulations and on the gentle slopes is well developed, deep and well structured. The seasonally flooded areas generally have a clayey texture and are very compact when dry. In places of weathered parent material layers of gravel are found at variable depths. The texture of the soil is predominantly clay, but the granulating effect of iron oxide on the clay particles permits this dark red soils to behave as clay loans instead of clay. Hence the soils have a fairly stable microstructure that would permit good as a ration and reasonably rapid water penetration and movement.

Therefore, with the use of appropriate fertilizers and suitable rotations, these soils are expected to give satisfactory crop yields.

According to the geological formation, the Ashangi Group consists predominantly of alkaline basalts with interbeded pyroclastic and rare rhyclites erupted from fissures.

2.1.3 Climate

The rainfall of the area based on recordings at Asosa town average 1287 mm annually. It's monthly distribution is shown in table 1. The reinfall distribution pattern is monomodal, with most of the precipitation being received in the months of May to October, December, January and February are invariably dry months, while there is small shower occasionally which comes in November March, April and May. As indicated in table 1, the mean monthly maximum temperature ranges from 24.1°C in the month of July to 31.1°C during February and the mean monthly minimum temperatures ranges from 13.6°C in the month of December to 17°C in March. The coldest months are July, August and December while the warmest months are January, February and April. There is no frost in the area as confirmed by the local people.

Table 1: Climatic Data

Station:	Administrative	rative	Rainfall		pattern	Alti	Altitude asl	ısl m:	No.	of years	rs for	No.	of years	's for
Asosa	region:	Welega	region:	i	1.01		1 560	0	preci	precipitation:	9 :uo1	other	c data:	5
		JAN	FEB	MAR	APR	NAN	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
		29.9	31.5	31.8	31.5	28.0	•	•	23.9	25.6	25.8	27.4	29.3	27.8
Mean min. temp. OC		14.5	15.7	•17.0	17.2	16.7	15.5	15.1	14.9	14.8	14.9	14.4	14.6	•
Mean temperature OC		22.2	23.6	24.4	24.4	22.4	•	19.5	19.4	20.2	20.4	20.9	22.0	21.7
Vapour pressure mb	ш	12.8	13.7	14.7	15.3	20.2	19.6	18.8	18.9	18.5	17.5	16.3	14.8	16.7
Rel. humidity %	ш	78	47	87	50	74	82	83	** 8	78	73	99	95	99
Wind speed 2 m m/s	ш	1.7	1.7	1.4	1.7	1.7	1.4	1.4	1.4	1.4	1.4	1.4	1.7	1.5
Sunshine %		81	73	50	. 71	48	37	33	19	50	19.	49	73	55
Total rad. cal/(cm2 x day)	day) E	7 80	493	442	534	441	394	380	331	777	761	977	443	441
Precipitation mm	di	0	0	31	32	118	189	207	208	207	103	21	0	1 116
PET mm		131	133	144	155	121	86	97	16	106	110	104	118	1 408
Dates					28	16					12	3		
					BM(S)	BH(S)					EH	EM		
												6		
-												EHS		
								,			•	27		
								•		-		EMS		
TCP 28/4 - 27/11						2	=		-				_	
l normal	Days	mean temp.	max.	temp.	oc t	temp.	التى ائ	cal/(cm x c	ad. x day)	2		PET	Δ.	P/PET
BEG-END	213	<u></u>	5.7	15.	.2	20.5		415		1 0.	57	731		1.45
BEG-BHS/BH(S)	18	<u></u>			6.	23.0		465			7,0	79		•
BHS/BH(S)-EHS/EH(S)	177	.7.	5.2	15		0	•	406		6	76	590		1.68
EHS/EH(S)-END	18	2		14.	۳.	20.9		777			6	62	0	•
LGP2	•					•								
BEG-END														
BEG-BHS/BH(S)		+			······································		******				wall collection		······································	
BHS/BH(S)-EHS/EH(S)					 		Manage and Property							
EHS/EH(S)-END		-	- Anna Anna Anna								Brokensen		-	

2.1.4 Vegetation and Land Use

The vegetation of the area consists of savannah woodland and swamp vegetation. Open woodland savannah predominantes the top of the undulations while the perennial rivers are lined with swamp vegetation. The trees are broad leaved woodland largely of combretum spp. and H.rufa being very common. Bamboo thickets occur in the north and northeast and on the slope of Mount Asosa.

Much of the area was originally covered by dense Arundinaria alpin, but recently the activities of man, for case of mechanization and Bushfire have affected the natural cover to such an extent that nearly most of the area is with no vegetation; what is left is now small isolated pockets of forests in the river valleys, on uncaltivated lands and in accessible places. The present vegetation comprises a sparse cover of savannah woodland and swamp vegetation. Open wood land savannah predominates the top of the undulation while the perennial rivers are lined with swamp vegetation, broad leaved woodland largely of combratum and terminalia species, the grasses are mainly of Hypernial species.

The present land use system is mainly rainfed agriculture with minor area of irrigated agriculture. The main croped area founded in 1984/85 was 6,200 ha or 34% of the total project area. Maize and Sorghum being staple and important crops, occupied 70% of the total cultivated area. Other crops such as teff, haricto beans, noug, pepper sunflower and wheat are also produced. In addition vegetables such as potatoe, cabbage, onion and orchards are grown along the river and springs using gravity flow diversions.

A number of peasant associations (the indigeneous people who are muslims and members of the Jeblow trib) are found around the project area. Their economy is dominated by rainfed mixed farming. The crop production is based on traditional system of farming using mainly hand tools cultivating half hectare. The main crops grown are maize, sorghum, teff and each family

has 5-6 mango trees around his tukule.

Livestock especially goats, sheep, and a small number of cattle are kept as cash generating resource. Donkeys provide the main means of transportation over most areas.

2.2. Development in the area

Evaluation of the area for it's suitability to enhance rainfed arable mixed farming on a mechanized agriculture indicats land quality and land characteristics which consists predominantly of the top of the interfluves is generally flat with slope percentage of 1 to 3% with a sharp increase as one reaches the river valleys.

Before this, settlement was implemented, however, Dabus State Farm moved to it's present site near Dabus River. The settlers were, therefore, shifted to this area which has become the uncleus of the (settlement) activities. Apart from the limited area previously developed specifically for settlement, most of the area under cultivation is on the old State Farm land and most of the settlers work on this land and divide the proceeds among themselves and additional alocation of settlers in 1984 and 1985. In the mean time, however, development in the settlement possess 16 units in whole Asosa development project area.

The main disease known in the area is malaria. There are also some other diseases such as amoebic dysentery and T.B. This arises from poor hygenic conditions and lack of preventive measures. There is also testse flies infestation in the area which causes trypanosomiasis in cattle.

The 16 development units accommodate 7,875 heads of families. On the basis of earlier proposals by the Relief and Rehabilitation Commission (RRC) the model has been defined as having 500 family heads per settlement unit of 1250 hectares of land. This would be in line with the settlement model which requires each settlement unit of 500 families settlers to have a minimum of 1000 hectares of cultivable land for the cooperative farm, 50 hectares

homestead plots and 200 hectares for grazing and afforestation. The model also permits allowance for infrastructural development and soil and water conservation structures. The plan, of necessity, has to take into account the developed and underdeveloped land.

The settlement area is located along the perennial springs and rivers viz. Hoha, (Units 1.9.10.11 and 2.3.7.8 and project centre) Selga (Units 4.5.6 and 12) Afa (Units 13, 14,15 (belong to New Settlement No26) 16 and 17). At present there is reliability in the quantity of supply of water and they are not far from habitation sites. However, there is no definite assurance in unit 4 if springs are not regularly cleaned and maintained. To facilitate the treatment and distribution of the available surface water in the area, it is proposed to develop a suitable water supply system.

2.2.1 Origin of settlers

The Asosa Settlement Project was developed in 1979 to accommodate the adversely affected population from the drought prune areas of Wollo and Tigrie Administrative regions Initially there were 5000 settlers and now the population has increased to 28,477 which includes 7,875 families.

The planning of the settlement was carried out in phases to provide for the settlement of 8,000 families in an area of 18,824 hectares divided into 16 units with the necessary infrastracture and services.

2.3 Land survey

The survey intensity in the area was in accordance with specific investigations and obejectives. As a result, an area of some 20,000 hectares was surveyed at semi-detailed and detailed level and classified into five landscape units by taking considerations expressed on difference in landform, soils, hydrographic pattern, slope, relief and vegetation density. Each unit is evaluated for its current and potential land use suitability and the results of the surveywere shown on an aerial photo mesaic and topographic maps at a scale of 1:50,000.

Table 2: Distribution of settlers and land in each unit

Unit	No of Families heads	Caro	pland ha	Mon Cropland ha	Total ha
1	497	373	548	303	851
2	500	462	575	484	1059
3	501	378	473	527	1000
4	500	339	692	333	1025
ù	475	465	532	393	925
€2	488	450	575	1029	1004
7	502	356	762	328	1090
Ü	492	407	792	626	1418
9	498	408	1083	65 3 ⁵	1736
10	503±	405	461	564	1025
11	488	410	665	573	1238
12	475	367	840	364	1204
13	494	403	933	712	1645
14	489	365	356	656 ° 5	1006° 5
16	499	327	425	528	953
17	474	313	540	504	1044
Total	7875	¥6168	**10246	8578	18,824

^{* 1996} lst cultivated area ** Total cropland

3. LAND USE STUDY

3.1 Methods of study

3.1.1 Aerialphoto Interpretation (API)

The essence of Land Use Study for the Asosa Settlement area is to make sure that the development activities being carried and should be carried in the future — meet the needs of the settlers and to help them tackle the main problems and development bottle-necks and to lead them make best use of the development plans in their future development endeavour.

As a result aerialphoto interpretation for the area was one of the basic requirements and invaluable method used to guide land-use study in the settlement.

Thus, investigations show that, the photography was flown in 02.12.1980 at approximately 1:50,000 scale. The API was done with Topcon mirror stereoscope with 3x binocular eyepigce.

After scanning the general area and examining stereo pairs, an API legend was prepared with supporting data from the field survey. This legend was reworked into soils oriented lenged. See appendix 1.

The API legend is shown in Appendix 2 and is thought to be self-explanatory.

The principle points of the AFs were marked on the existing mosaic. Transparent drafting paper was placed over the mosaic and the principle points were transferred and identified by number. The flight lines were drawn by joining the points in the flight line.

The APs with their delineations were placed under the transparency with flight lines in perfect coincidence and the lines and symbols transferred. Some mosaics were more distorted than others and adjustments had to be made during the transfer. Where distortion was too great, the information was transferred to the alternate APs not previously marked so that only information

in the center of AP was shown. thus reducing the adjustments in positioning. The scale of the map was calculated from identifiable point on the 1:50,000 scale and an average figure was shown.

3.1.2 Area Measurement

Another approach undertaken during the course of land use study was area measurement of landscape units. Individual mapping units were measured by planimeter and adjusted for the appropriate scale.

Areas below 15 ha are given to the nearest 5 or 10 depending on size. The sum of the individual mapping units was checked against the whole unit area. Sinuous riverine forest was taken as the difference between the sum of all other areas and the overall area within the unit boundary and hence includes errors. According to table 2 nearly 18,824 hectares were measured by planimeter. This is roughly 94% of the total area surveyed (20,000 ha.)

3.2 Soil Survey and Soil Sampling

Inorder to identify and make a comparison of promising kinds of landuse items applicable to the settlement, soil survey field work was carried in 1986. The approach of the soil survey is described as follows. During the field work observation was made in which approximately 46 descriptions were made (generally to a depth of 180 cm). The augerings were made with a screw-type auger. Both land and soil characteristics were recorded on a standard form for auger descriptions.

Observations include recording of physiography soil surface conditions and soil profile characteristics which were obtained by means of auger taken from small natural exposure.

The methodology for describing soil profile and augerings was adopted from the "Guideline for soil profile description (FAO 1977) and from the

Munsell soil colour charts (1975).

All sampling sites were plotted on ΛP 's which were used as base maps in the field work.

3.3. LABORATORY METHODS

3.3.1 General Description

On the basis of forty six representative soil samples which were chemically and physically analysed by the soil laboratory of the Land Use Planning and Regulatory Department of the Ministry of Agriculture, analytical data were presented in appendix 3.

3.3.2 Method of Soil Analysis

The soil samples were transported from the soil survey area to the soil laboratory in playthene bags with proper identification tags.

Samples Preparation: The soil samples were air-dried at room temperature by spreading on paper sheets. On drying they were ground in metal mortar and & pestle & sieved through a 2 mm sieve.

Texture: The particle-size distribution was determined by modified Bouyoucos Method. 50 g scil was soaked with 100 ml distilled water for one hour. 60 ml of 9% H₂O₂ were added and the contents heated on a hot plate for one hour to destroy the organic matter. Then 2 g of N-hexametaphosphate (calgon) was added and the suspension was transferred to dispersion cup and stirred for five minutes. The suspension was then transferred to the hydrometer jars and volume made to one litre mark. The hydrometer readings were taken at 40 seconds and 2 hours intervals to calculate the silt + clay and clay percentage respectively. Sand percentage was calculated by subtracting silt + clay percentage from 100.

PH: 20 g soil was treated with 20 ml of water or salt solution (KCl or CaCl₂) for half a day with occasional stirring and the pH was read using standard glass and calomel electrodes.

Organic Carbon: (Walkley and Black Method) To soil (passing through 0.5 mm sieve) containing 10-25 mg of organic carbon was added 10 ml of N Potassium dichromate and 20 ml of conc. sulphuric acid. After half an hour 200 ml of distilled water, 10 ml of orthophosphoric acid and 0.5 ml of barium diphenylaminsulphonate as indicator were added and titrated with 0.5 N ferrous ammonium sulphate. The percentage of organic matter was caluclated from the amount of potassium dichromate used to reduce the organic matter.

Total Nitrogen: To 1 g soil (passing through 0.15 mm sieve) was added 1 g of catalyst mixture (containing potassium sulphate, copper sulphate and selenium powder in the ratio of 10:4:1) and 6 ml of conc. sulphuric acid in a kjeldahl flask. The contents were digested till clear and cooled. Then transferred to another kjeldahl flask washing with little portions of distilled water (about 60 ml), 20 ml of 40% NaOH added and NH3 distilled in 10 ml of 0.2 N H2SO4. The excess acid was back titrated with 0.1 N NaOH with methyl red as an indicator. Percentage of total nitrogen was calculated from the acid used.

Available phosphorus: To log soil (passing through 1 mm sieve) is added teaspoonful of activated carbon (Darco G60) and 50 ml of Morgan's extracting solution (10% of solution of Na-acatate in 3% acetic acid). The contents were shaken for 30 minutes and filtered. P was determined in 2 ml of the extract by adding six drops of formaldehyde solution. 1 ml of sodium cobaltinitrite and 2 ml of isopropyl alcohol. The turbidity of the samples was compared with the standards.

Exchangeable cations: 5 g of soil (passing through 1 mm sieve) was leached with 150 ml of neutral (pH 7) N $\rm NH_4$ -acetate and made to 250 ml with distilled water. Ca + Mg were determined in 10 ml of the leachate by acidifying with 0.1N HCl, boiling for a few minutes, complexing Mg with Mg-complexonate, adding 2 ml of 2% aqueus solution of KCN and 3 ml of $\rm NH_4CH-NH_4Cl$ buffer. The contents were titrated with 0.02 N disodium salt of EDTA after adding a pinch of Erichrome Black T.

For determination of Ca, a separate 10 ml portion of leachate was titrated with 0.02 N disodium salt of EOTA using a pinch of HHSNN (Paton and Readers reagent) until the color turns from wine red to blue. Exchangeable Mg was obtained by subtracting exchangeable Ca from exchangeable Ca + Mg.

Exchangeable K and Na were determined by flame photometer using air butane flame.

Cation Exchange Capacity: The soil previously leached with NH $_4$ -acetate was successively washed with 10 ml portions of 95% ethanol using a total of 80 to 100 ml of ethanol. Adsorbed NH $_4$ was then replaced with Na by extracting the soil with 40 ml of 10% NaCl. NH $_4$ was determined in the extract by adding 5 ml of 40% NaOH and distilling NH $_3$ in 10 ml of 0.2 N sulphuric acid and titrating the excess acid by 0.1 N NaOH.

Exchangeable Aluminium: 10 g soil was extracted with 100 ml N KCl by shaking for two hours. 5 ml of KCl extract was diluted to 25 ml with water, 2 ml of 1% thioglycolic acid and 10 ml of aluminium reagents (containing NH₄-aurine tricarboxalate, gum accacia, NH₄OAC and HCl) were added. The contents were heated over boiling water bath for 16 minutes and then cooled. On cooling the volume was made to 50 ml with water, mixed and absorbance measured at 520 millimicrons.

Exchange acidity: Exchange acidity was determined by the potassium chloride-triethanalamine buffer method. 10 g of scil and 25 ml of 0.5 N KCl - 0.2 N TEA buffer were shaken for half an hour and filtered through a gooch crucible containing a moist whatman no. 42 filter paper. Additional 25 ml of buffer solution were used to transfer the scil to the crucible. The scil was then leached with small pertions of 100 ml of replacement solution (0.5 N KCl solution containing 10 ml of buffer solution). The combined leachates in the flask were titrated with 0.1 N HCl using 10 drops of bromo-cresol green and 2 drops of methyl red with the progressive color change from blueish green through violet to pink. The end point was checked against a blank containing 50 ml of buffer solution and 100 ml of replacement solution. Exchange acidity was calculated by the difference between the titration value for blank solution and the leachate.

 ${\tt CaCO_3}$ percentage: 5 g of soil was treated with 50 ml of 0.5 N HCl by gently boiling for 5 minutes. After cooling the contents were filtered and washed with water to wash all the acid out. The amount of unused acid was determined by adding two drops of phenolphatalein and back titrating with 0.25 N NaOH. The percentage of ${\tt CaCO_3}$ was calculated from the acid used.

Exchangeable Ca + Mg in calcareous soils: In case of calcareous soils exchangeable Ca + Mg was extracted using 10 g of soil and 40 ml of KCl-TEA buffer (containing 1 M KCl and 0.2 M TEA, pH 8.2) stirring occasionally formone hour. 10 ml of the filtrate were used for Ca + Mg determination by EDTA method (as described under exchangeable Ca + Mg in M VH₄-acetate extract.

3.4 boil classification and landscape units

3.4.1 Level of detail of soil characterization

It was decided to describe the soil units in terms of the following characteristics;

- Soil depth
- Soil drainage
- soil colour
- soil texture
- Degree of accelerated soil erosion by water
- blope range
- Boil phase

For a description of the classes employed for the description of each characteristics referr to landscape units. Joil classification follow FAO Soil hap of the World.

5.4.2 Landscape units and landform genesis

A hierarchial classification system is applied in the description of the geomorphology of the landscape units. At the broadest level, 1% subdivisions exist, which are related to the general physiographic character of the landforms. These are as follows:

- 1. Wetland
- 2. Ceasonal wetland and seasonally waterlogged land
- 3. Plains and undulating sideslopes
- 4. Plains and low plateaux with hills, moderately dissected
- sideslopes and dissected plains.
- J. Hills with plains
- 6. Low to accerate relief hills.

- 7. Moderate to high relief hills, severely dissected sideslopes and plateaux
- 8. High to mountainous relief hills
- 9. High plateaux
- 10. Moderately dissected plateaux, plateaux with hills and rolling to hilly plateaux
- 11. Rubble land and rock outcrop
- 12. Sand and salt deposits

4. Selection of crops for Land Evaluation

The overall approach used for identifying the requirements of crops was by taking considerations in terms of ranges of suitability based on a standard devise for recording crop requirements through assessment of land qualities and land characteristics determined in the field survey at a semi-detailed scale.

From the guideline obtained from the survey the major kinds of land-use which involves crop production are rain-fed agriculture (annual perrennial and mixed), irrigated agriculture, livestock and forestry.

4.1 Selection of crops

The fundamental requirements for selecting the list of seven crops as land utilization types (LUT) was drawn up which included other perrennial crops excluding forestry species. In terms of boosting crop production in Asosa settlement, this would mean identifying the crops and the legend that bestsuit essentially to grow them. This would enable the settlers to make most efficient use of the land to produce more crop production and for utilization of other forms of land-use in the future. A part from planning other forms of land-use, crop production should also be designed to lead to fulfill the basic needs of the community which should be planned possessing local and national level development endeavours with a capital reserve to up-grade the living standards of the settlers.

From the above approach, activities of paramount importance would be reinforcement of health and education and promotion of basic needs required by the settlement site. A further consideration in determining a list of crops to be treated was the identification of priorities which would would have more potentials for crop production within the settlement development.

Based on the crop requirements, the most fundamental list of crops of Asosa settlement project are as follows: Maize, Sorghum, Teff, Maricot beans, Noug Pepper and Sunflower.

4.2 Cropping systems

A farming system practice such as the seed-complex involves various range of crops. The cropping system practiced by settlers within this type of farming system indicates difference from one locality to another.

For example, the Asosa settlement project practiced a cropping system which consists of some cereals, pulses and vegetables. For instance, project area largely based on Maize and Sorghum is 70 percent of total cultivated land.

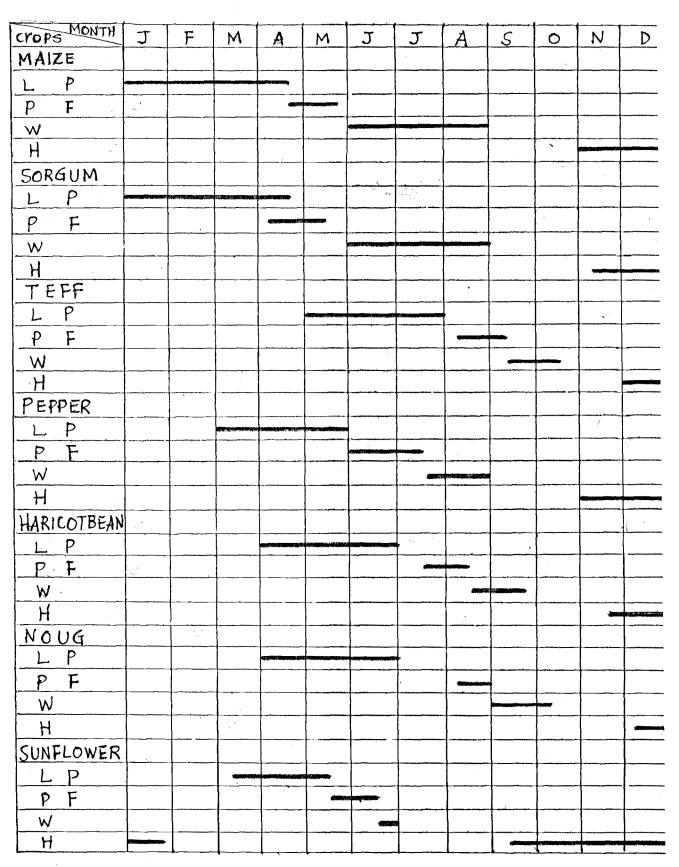
In addition to other undesirable effects, continuous cultivation of Maize and Sorghum could lead to lower crop yield. It is suggested that a crope rotation system be introduced which would include leguminous crops, and Teff, Haricotbeans, Noug, Pepper and Sunflower with other minor crops and vegetables and fruit trees.

The mixture of main food crops and minor crops are cultivated and recommended to meet the needs of the local community. The farming calender is designed to show that crops are grown and nature in adequate conditions for seed repending to fill a food gap to satisfy the needs of the settlement.

4.2.1 Crop Establishment

The main climate factor effecting crop production in the settlement is rainfall and its variation. The average rainfall superior to 30 mm from March to October (8 months). These months represent 98%, having a monthly

CALENDAR OF OPERATION Figure.2 ASOSA SETTLEMENT PROJECT



LP-Landprepention PF-planting fertilizing
W-Weeding H-Herresting

rainfall (1095 mm) the wet season (June, July, August and September) represent 72% of the yearly total, which the period of May to October having a monthly rainfall superior to 100 mm/month represents 92% of the yearly rainfall. Consequently, the settlement has a growing period of atleast 6 months (May to October) depending on the storage of soil moisture available after the rains stop.

The months April and June have enough rain for land preparation possibility. After June, the weather becomes probably too wet for land preparation indicating minimization of problems such as destruction of soil structure, formation of plough sole, and insufficient carrying capacity of the soil.

In terms of crop growth and rainfall reliability, the overall climate sitation was not favourable for crop production. First, plowing starts around mid of January and extends to late June. Except for Maize and Sorghum, plowing starts mid of January until mid of April. Other crops start begining of March to May. Weeding and cultivating seems to be accomplished in the months of June to September to late January. (for detailed information on cropping calender refer to Figure 2).

4.3. The need of reforestation

It is well known that the introduction of settlement is one of the factors that contribute to the progressive reduction of the tree and shrubs for energy and construction needs of the settlers. Tree destraction take place predominantly near settlements and is spreading out into the surrounding woodland and shrublands as the people are obliged to go further to obtain the materials needed for construction and energy.

In Asosa settlement a progressive tree reduction is taking place through the over-exploitation of wood from the limited natural forest resources. Presently the settlers have to travel up to 20 km, to collecting wood. If this excessive deforestation which is faster than the establishment of new plantation continues and is not counter-balanced by intensive reforestation programmes the areas will deteriorate to an extent that they will be incapable

to support the human and livestock population of the settlement. This could mean that settlement will be transporting problems that were existing in drought affected areas to other areas rather than being a solution to alleviate the population from famine relief and make them self-sufficient in particular and promote the national economy in general.

To avoid the 'scological deterioration of the settlement areas and to provide trees for the purposes of fuelwood, windbreak, soil stabilization, for production of fodder trees and development of bee keeping, forests have to be developed and indiscriminate destruction of trees has to be stopped in and around the settlement areas.

Asosa settlement site has already established and launched an extensive reforestration programme for its area but it is possible that the range of species could be extended to include trees which could provided fodder and food.

Observing the plains and undulating slopes where much of this settlemen development is taking place shows that they are often devoid of trees or gradually being affected by land clearance for cultivation and search for building materials and fuel wood. Thus, the advantages of these indigenous species such as Acacia Albida is really appreciated except perhaps by the indigenous pastoralities.

The establishment of tree crops and fruit trees in association with the traditional food crops and fruit trees should be given more attention in planning and extension activities for settlement development.

Consideration should also be given to indigenous multi purpose tree species such as Acacia Albida Mangifera indica which not only provide wooden products but possibly serve various purpose such as soil conservation and improvement, fodder production and food.

Establishement of a system of wind break, soil conservation, forage production and food for settlers, wood supply to inhance handicrafts could be made through the introduction of exotic multipurpose tree species such as Acacia decurrens, Leuceana leucocephala, Azandinchta indica, Eucalyptus Camaldulensis.-----

In existing areas where depletion of tree species has been occurred, careful selection should fit to introduce fast growing trees that could ameliorate immediate problems by giving due consideration to agro-forestry as well.

In Asosa, reaforestation was started in 1981 till 1985. The plan was to raise and plant five million seedlings.

The tree species to be raised in the settlement are as follows:

Acacia albida Acacia decurrens Acacia melanoxylon Albizia lebbek Azandircheta indica Casuarina, equisetifolia Cordia africana Craten macrostachys Delonix regia Eucalyptus camaldulensis Eucalyptus citriodora Eucalyptus globulus Eucalyptus salgna Gnavillea robusta Leuceana leucocephala Mangifera indica Psidium guaiava Schinus malle Meringa stenopetals Carica papeya

5. CROP ENVIRONMENTAL REPUIREMENTS

5.1 General Description

Crop environmental requirement condition is related to the physical conditions of the settlement covering a wide range of climatic, soil and other issues. Climate data for possible crops environmental requirement includes maximum and minimum temperature intensity and frequency of rains and relative humidity for rain-fed agriculture and the land characteristics needed to describe these qualities, The definitions of a land quality and a land characteristic are as follows:-

- A land quality is an attribute of land which acts in a distinct manner in its influence on the suitability of the land for a specific kind of use.
- A land characteristic is an attribute of land that can be measured or estimated. The above definitions involve the following basic statements:

First: (land quality) are fewer in number (the land characteristics), secondly, they direct attention to the effect upon landuse, and thirdly they take an account of interactions between environmental factors.

In accordance with specific investigation for each crop, the requirements are given in two ways. The basic requirements as employed in the land evaluation are given as table in standard form at appendix 2 for 17 land qualities and the land characteristics by which they are measured or estimated.

Approaches considered for crop environmental requirements are as follows:

Abbreviation used for the suitability ranges are:

- Soil texture follows
 - S Sand
 - L Leam
 - Ls Loamy sand
 - Scl Sandy clay loam

S1 Sandy loam
Sil Silt loam
C1 Clay loam
Sicl Silty clay loam
Sc Sandy clay
Sic Silty clay
C (rd) Clay (red)
C (bl) Clay (black)

- Slope classes

0-2% Flat as almost .flat

2-8% Gentle slope

8-16% Slope

16-30% Moderately slope

30-50% Steep

50%+ Very steep

- Drainage classes followFAO methodology as described above except for lands subject to seasonal flooding which are given two classes. One for the period during the rainy season and the other for the rest of the year. This was deliberately done to accompdate requirements of the land evaluation:-

VP - Very poor

I - Imperfect

W - Well

E - Execessive

P - Poor

MW - Moderately well

S - Somewhat excessive

- Rock outcrop descriptions follow FAO methodlogy: - Stoneiness classes are: -

None 1%

Farily stony 1-3%

Stony 3-10%

Very stony 10-50%

Exceeding stony 50-90%

Rubble land 90%

```
-Effective soil depth are (in cm)
    Z 25
            Very shallow
             Shallow
    25-50
             Moderately deep
    50-100
   100-150
             Deep
   > 150
             Very deep
-PH Soil reaction
    < 4.5 Strongly acid
    4.5-5.5 Medium acid
     5.5-6.5 Slightly acid
     6.5-7.5 Neutral
     7.5-8.0 Slightly alkaline
     8.0-8.5 Medium alkaline
    > 8.5 High alkaline
-Electriacl conductivity \rm nm has \rm /cm at \rm 25^{\rm C}C
  4 mm has/cm Non saline
    4-8
                   Slightly saline
                   Medium saline
    8-15
                   Highly saline
    >15
-Organic matter classes are (in%)
    < 1
                   Low
    1-3
                   Medium
    3-10
                   High
                   Very high
    >10
- Castion exchange capacity classes are: (me/100g)
   < 16
                   Low
   16-35
                   Medium
   35-70
                   High
    > 70
                   Very high
- Available phosphorous clases are (in ppm)
    < 5
                   Very low
     5-10
                   Low
   10-15
                   Medium
   15-25
                   High
    > 25
                   Very high
```

- Erosion (All lands)

Symbol	Description Term	
1	None to slight erosion	Less than 25% of criginal top soil removed
2	Moderate erosion	From 25 to 75% of original top soil removed; occasional gullies may be present.
3	Severe erosion	From 75% of original top soil to 25% subsoil removed; occasional deep gullies or frequent shallow gullies may be present.
4	Very severe erosion	All of original topsoil and 25% to 75% of subsoil removed.
GL1	Slightly & Moderatly Gully land	An intercate network of very frequent moderatly Sullies are presents. The scil has been eroded to the extent that all or practically all of the original surface soil, or A horizon, has been removed. (This GL1 will be practiced only planting trees and grass).
GL2	Deep Gully land	An intericats network of very frequent deep gullies are present. Soil profiles have been destroyed except in small areas between gullies. (This GL2 will be practiced planting trees, and structures)
EPM ×	Exposed parent in a material and/or Rock	Areas consisting of exposed parent material and/or rock resulting from the complete, removal of all of the original topsoil and subsoil by natural processes where attributed to man-induced processes, it will be differentiated by placing the symbol in parenthesis.
The classes	s used the description	of soil drainage soil texture refer to the

The classes used the description of soil drainage soil texture refer to the standard soil description classes — in FAO "Guidelines for Soil Profile Description"

5.2 Modifications to Crop Requirements for High levels of Inputs

Possible consideration was elaborated initially to identify the requirements for tack crop at each of three input levels i.e. low, medium and high. As forseen for the different levels of input, certain environmental deficiencies have to be overcomed or ameliorated at higher levels of inputs.

e.g. discontinuation of drainage impedence by introducing drainage works, improvement of erosion hazard through soil conservation work etc.

Besides, phased introduction of the high level mechanization may call for more stringent environmental requirements.

At high inputs levels as in settlements the following adjustments in the values of the land characteristics are made:-

Soil drainage (land quality: drainage) for imperfect improve the suitability by one class i.e. N1 (currently not suitable) becomes 83 (Margainally suitable) and S3 becomes S2 (moderately suitable) and S2 becomes S1 (highly suitable).

Stones and rock outcrop (land quality management land preparation and mechanization potential).

Change the suitable ranges of most crops as follows:-

```
Sl none to fairly stony (0-1% of the area)

S2 Fairly stony (1-3% " )

S3 Stony (3-10% " )

N1 Very stony (10-50% " )

N2 Exceeding stony and Rubble (Over 50% )
```

This adustment is made on the basis that stones and rock outcrops impede land preparation and mechanization activities.

Slope angle (land quality - degradation hazard)

```
      S1
      Slope of 0-8%

      S2
      " 8-16%

      S3
      " 16-30%

      N1
      " 30-50%

      N2
      " 50%
```

The adjustment is made on the basis that at high inputs levels slope of 8-16% are moderately suitable for cultivation if provision is made to maintain the area through soil conservation works. The environmental requirement

for crop combination for Asoma settlement project is shown in table of Appendix 2.

6. LAND RESOURCES MAP

6.1 General Description

The land evaluation methodology used in the preparation of the land-use plan is in accordance with the FAO framework evaluation (FAO-1976) and the FAO Agro-Ecological Zones (AEZ) project (FAO-1978). The development and proceeding to obtain the land resources basis for land evaluation a series of thematic maps were combined into a land resources map at 1:50 000 scale which has integrated information on Agro-climatology, Geomorphology and Soils.

They are the main indicaters for potential agricultural production. The land resources map involves the framework of the land resources inventory by consisting the necessary assemblage and integration of resource data to carryout a land suitability evaluation.

Thus, the main components of the land resources map are thematic maps of thermal zones, lengths of growing periods geomorphology and soils.

Mapping of thermal zenes (Tz) and lengths of growing periods (LGP) is based on the methodology of the FAO Agro-Ecological Zone Project and Assistance to Land Use Planning Project ETH/82/010 Project. The fundamental data for geomorphology and soils results from geomorphological interpretation of aerial photo and available surveys.

Field traverses and agro-climate information eminated from landscape units roughly small groups of land systems.

6.2 Land Resources Units

The matrix table shown below was developed as part of a comprehensive Land Resources Map legend for the map units derived from the integration of information mentained in the thermatic maps described above. However, a brief description with illustrative example is presented to the user to help him

understand the nature of Land Resources units described on the map and the means by which thermatic data on thermal zones, length of growing periods and geomorphology and soils have been integrated to delinate them. See appendix 4.

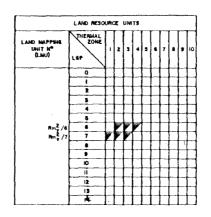
6.2.1 Land mapping units

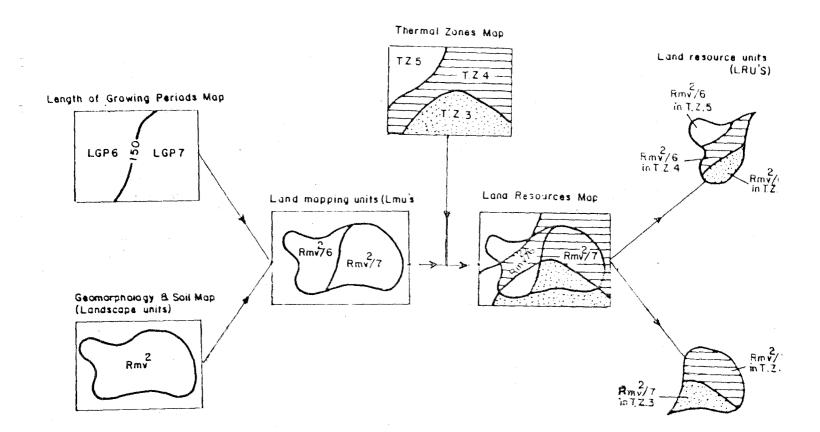
The combination of landscape units from the geomorphology and soils map and the various zones from the length of growing poriod map. The symbols are comprised of two parts, for example $\text{Rm}_{\nu}^{2}/7$.

The first part of the symbol, Rmv, represents the landscape component; the second part, /7 represents the growing pariod zone. Both aspects are explained in more detail below see Land Resources map 2.

Figure 3

Method of integrating thematic data and lad resources units





6.3 Explanation of thematic map inputs

6.3.1 Thermal zones

Thermal zones are defined by mean daily temperature (in ^OC) during the growing season. The following relation between temperature and altitude was determined from data from 155 meterological stations throughout the country

The relation $T^0C=30.20-0.0059\times Altitude$ was defined, resulting in a gradient of $C.59^0C/100$ m altitude.

R^2	72	0.90	Gradient	=	Ο,	59 ⁰ C/	100	m	rise
-------	----	------	----------	---	----	--------------------	-----	---	------

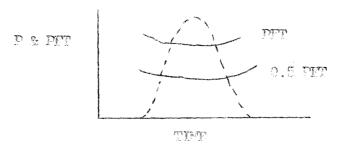
Thermal zone	Temperature zone	Altitudinal meteres	Altitude Regions
	OC.	m	
1	> 27.5	ر 500 T	
2	27.5 - 25.0	500 - 900 -	Bereha
3	25.0 - 22.5	900 -1300 -	Kolla
$d_{\mathbf{r}}$	22.5 - 20.0	1300 - 1700 -	MOTIC
5	20.0 - 17.5	1700 - 2200 7	Woina Dega
6	17.5 - 150	2200 - 2600 -	world bega
7	15.0 - 12.5	2600 - 3000	Dega
8	12,5 - 10.0	3000 -3400 T	
9	10.0 - 7.5	3400 - 3800	Wurch
10	< 7.5	> 3800	

6.3.2 Lengths of growing periods

Moisture availability is a very critical component in determining rainfed crop suitabilities. For the purpose of this evaluation it was estimated by the length of growing period (LGP), which is defined by a simple water balance model comparing rainfall with potential evapotranspiration (PET). The PET is calculated according to Pen man's (1948) formula.

The LGP's in Ethiopia are closely related to altitude (temperature) and the mean annual rainfall, the latter in all its three attributes of amount distribution and pattern. Two main types of LGP's were identified, normal and intermediate.

The Asosa settlement project has a normal growing period which is defined as the period (in day) during a year when precipitation exceeds half the potential evapotranspiration (MAT), plus a period required to evapotranspire an assumed 100 cm of water from excess precipitation (or less if not available) stored in the soil. Normal LAP's in all to LAO days.



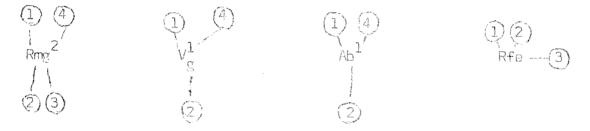
For convenience of tabulation, NAP zones are assigned numerical codes as follows,

Growing period	Length of gro	
230	To the second	S
0	Less than	one day
1	of J. visa	45 days
2	46	60
3	6] 40	75
4	76 -	90 1
5	91 -	120
6	121	150
7	A O L	180 "
8	181	210
9	211 -	240
10	241 -	270
The state of the s	2771	300 11
12	301 ***	330
13	331 -	364
14	365	Gays

Fifteen ICI's are defined for the country as a result of the agroclimatic resources inventory carried out by the Assistance to Land Use Planning Project ETH/82/010. TZ's and LGP's are both mapped as individual thematic presentations and are also incorporated as essential components of the land resources map.

6.4 Explanation of Landscape Units Legend

Landscape units, defined as mapping units which are reasonably homogeneus with respect to geomorphology, soils and vegetation, have been delineated on this map. Manual interpretation of aerial photo 1:50 000 scale, existing survey, field surveys, agreelimatic information, and geologic and topographic maps have been used in the delineation and description of these landscape units. the symbols on the map represent on hierarchial classification of landscape units. An explanation, with examples, of the operation of the classification follows:



(1) Six subdivisions, represented by the capital letter reflect the genesis on the landforms, i.e. the geomorphic types.

Alluvial	A
Volcanie	V
Aeolian	D
Structural	S
Evaporite	Ē
Residual	R

② Subclasses of these geomorphic types are indicated by the first lower case letter. m in Rmg² refers to the subclass of the residual geomorphic type that is "moderate to high relief hills" "b" in "Ab" refers to the subclass of the alluvial geomorphic type that is 'basins and decressions with seasonal drainage deficiencies. The full range of subclasses, or geomorphic units, is given below

in the summary legend.

(3) Structural and residual landforms require a third character, the subscript lower case letter, which indentifies the main parent material origin of the landform. Alluvial, Aeolian, Evaporite and Volcanic landforms do not have this third character.

The subscript letters are as follows:	
Volcanic (basalts, tuffs, etc)	V
Felsic Precambrian basement (gnaisses, granites, etc)	g
Metamorphic precambrian basement (slates, schists, phyllites, etc)	m
Evaporite (predominantly gypsum)	8
Sandstone	S
Calcareous (predominantly limestone)	С

Such symbols are normally used alone but may be used together, for example, short, where parent materials are mixed and not easily separated at this scale of mapping.

@ Geomorphic units are further subdivided on the basis of soil association which occur within them into final landscape units of the type described above. This final subdivision is represented by superscript numbers. The superscript number is absent where each occurrence of the geomorphic unit has the same soil association.

There are listed below in the legend, organized according to the general physiographic character of the landforms, for example, wetland, low to moderate relief hills and high plateaux in Asosa settlement site. See Land Resources Map 2.

6.4.1 Summary Legend

Rn²_g - Hilly plains comprised of undulating plains and low plateaux with a substantial proportion of low to moderate relief hills - western highlands

Residual landforms

Rqg - Hilly terrain of moderate to high relief with a substantial proportion of moderately sloping valleys interspersed throughout Residual landforms

6.5 Significant land facets

The specific features upon which the detailed descriptions of landscape units are based on the legend of the map are land facets.

Characteristics used to describe significant land facet

Landscape Unit No Geomorphology Total area (Km²) Significant land facet Area (%), Geology Slope range Dominant Vegetation and/or Land use FAD classification Colour (moist) Texture Orainage classes Rockout crop Surface stones Effective denth pН OM (organic matter)% CEC (Cation exchange capacity) Available P SMU No (Soil management Unit)

The description of landscape unit is presented in the appendix 4.

7. LAND SUITABILITY CLASSIFICATION MAP

7.1 Land suitability evaluation

The results of the land suitability classification conducted in Asosa settlement project are presented in two main ways.

- Land suitability mans
- Land suitability classification tables

For the seven (7) crops considered within the rainfed agriculture, One (1) group combination 1:50 000 scale of land suitability maps have been prepared for the Asosa project.

Similar land suitability maps for the forestry land utilization type and the livestock land utilization types have also been complied at 1:50 000 scale. The second major result of the suitability classification is contained in appendix 2, Land suitability classification tables.

Here, details of suitability limitations for S2 (moderately) S3 (marginally suitable), N1 (currently not suitable) and N2 (permanently not suitable) are indicated for all matchings invloving these two classifications. No limitations are assumed present for these areas indicated as S1 and are thus not tabulated.

7.2 Land suitability classes

"Suitability classes indicate degrees of suitability, within the order suitable (s). It is usual to recognize three classes, "highly" "moderately", and "marginally suitable. The following names and definitions may be appropriate in a qualitative classification.

Class Sl Highly suitable

Land having no significant limitations to sustained application of a given use, or only minor limitations that will not significantly reduce productivity or benefits and will not raise inputs above an acceptable level.

Class S2 Moderately suitable

Land having limitations which in aggregate are moderately severe for sustained application of a given use; the limitations will reduce productivity or benefits and increase required inputs to the extent of bing—overall advantage to be gained from the use—Although still attractive, it—will be appreciably inferior to that expected on class—Sl land.

Class S3 Marginally suitable

Land having limitations which in aggregate are severe for sustained application of a given use and will so reduce productivity or benefits or increase required inputs, that this expenditure will be only marginally justified.

Class Nl Currently not suitable

Land having limitations which may be surmountable in time but which cannot be corrected with existing knowledge at currently acceptable cost; the limitations are so severe as to preclude successful sustaine use of the land in the given manner.

Class N2 Permanently Not suitable

Land having limitations which appear so severe as to preclude any possibilities of successful sustained use of the land in the given manner

According to the land suitability evaluation detailed above 12,287 hectares of land in the area, comprising land suitability units CU, 1 % FS,1 have been recommended for cooperative farms and homestead production of crops adapted to the area i.s. Maize, Sorghum, Teff, and miner pulses, Haricotheans, Noug, and Sunflower and Pepper. On the other hand 8,557 hectares, which combines all the other land suitability units are available 2,868 hectares for livestock grazingland and afforestation 3,656 hectares.

7.3 Land suitability subclasses

Land suitability subclasses reflect kinds of climitations, e.g. moisture dificiency, erosion hazard. Subclasses are indicated by lower-case letters with mnemonic significance, e.g. S2m, S3m.

There are no subclasses in class S1. Example of symbols are given below:

- m Drainage deficiency
- e erosion hazard
- p management limitation
- x toxicity limitation
- r rooting condition deficiency

7.4 Land suitability units

The land in Asosa settlement project has been evaluated for rainfed agriculture and classified into five suitability units. Their distribution is indicated in map 3 land suitability classification map.

8. DEVELOPMENT PLAN

The development plan incorporation at improvements most suited to the subwatershed and offering optimum benefit to the settlements.

Any activities that will improve or atleast sustain prouction, or that is of benefit to the settlement, may be termed a development option. The options considered are those that will lead to improving or atleast sustaining agriculture, forestry or livestock production. Marketing and storing produce together with water development (springs, farmponds, dams and diversion weirs) are also considered. Farm management is considered as an essential continuous input.Components such as reforestration or strip cropping established as a development input must be continued under a good farm management programme.

Table 3. Limitation and Recommended use of Land Suitability Classification in Asosa

Land suitability closs	~ 1		S38	N2e ion
Recommended use and treatment	Land having no significant limitations to sustained application of a given use. Cultivation of maize, sorghu, teff, haricotbeans noug, pepper and sunflower. Field to to be on the contour cropping, grass strips every 30-50 m and grasswater way ælong the depressions. Use of phosphatic fertilizers, e.g. DAF.	Seme as S1 but field to be on the contour cropping below 10% slope, more grass strips every 20-30 m and 10-16% of slopland with soil conservation (bench terrace and reducing slope, persent down to 10% and countour strips and ploughing along the contour use of phosphatic fertilizers, e.g.DAP.	Same as S2, but narrow grass contour strips for better soil and moisture conservation best suitable t) posture development after soil conservation (bench terrace) cultivation of cereals and pulses.	Erosion controlled by hillside terrace and/or soil and stone bunds for afforestretion in selected area. If lanrge area keep in wieldlife conservation
Limitation	No significant limitation deep and well structured granulized clamp low phosphorus.	Moderate erosion slightly acidic and low phosphorus	Severe erosion slightly ecidic and low phosphours	Very severe erosion rockout crops.
Significant Land Facet	Undulating plains and low plateau	Rolling plains and low plateau	cow to moderate	Coderate to high relief hills
Landscape Unit Symbol	er 4	Çel .	ന	C.

Land suitability classes	NIN
Recommended use and treatment	Grazing during dry season or horticulture for ofter draining. Afforestration and building moterials (micrc basins).
Limitation	Moderate to poor drainage
Significant Land focst	Small valleys O-8% slope
Lendscape Unit Symbol	i.c.

8.1 The development plan map

The development plan map and the table of inputs are the most important parts of the development plan. Plan to locate on the ground where the various soil and water conservation measures are to be built. Furthermore, the map is esstial as the planner for determining the extent of the areas and the volume of inputs required.

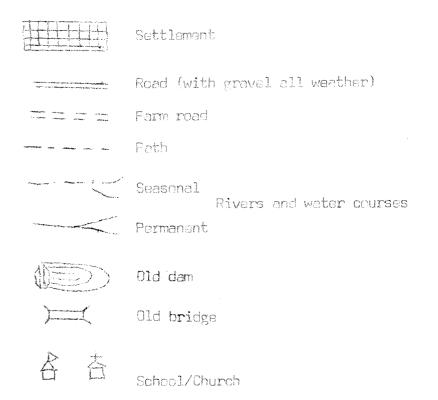
Any development work that has been previously implemented should be transferred to the development map using the symbols as given in table 4. It is important that the new plans are complementary to the existing work and that there is no duplication.

The additional development work, including maintenance or improvement of existing structures, should be added to the plan. Theses are scheduled for soil or stone bunding, hillside terraces, micro basins, etc. The location of farm ponds, spring development, water storage dam, diversion weir, check dam are shown on the development plan man, using symbols as given in table 4.

Thus the complete development map of the physical work is prepared, development map, to a scale of 1:20 000, seen in map 4.

Table 4 LEGEND FOR DEVELOPMENT PLAN MAP LEGEND

Symbol	Detailed
Cu	Arable land (cultivated land)
Gr	Grazing land
Fs	Forest shrubland
Wl	Wood land
R	Rockouterop / Boulders
Fp	Forest plantation
Rp	Range pasture
Nu	Nursary site
2w	Water logging



Development work and improvement

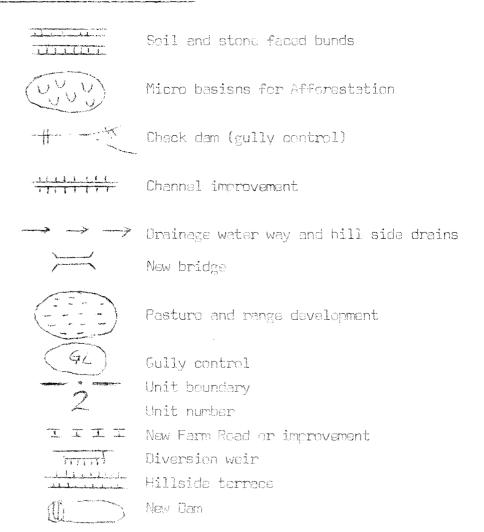


Table 5. Development Plan of Work Components

Work Components	Unit	r	c	c	•	tı	Ç	t	c	c		ŗ	((•	ļ	Ę	
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Present Land Use																			
Cultivated land	Т	548	575	473	692	532	575	762	792	1083	461 (999	048	833	350	425	540	10,240	
Cultivated land	7	j	ŧ	í	t	í	i	1	ì	. 1	1	1	i	1	ı	149	1	149	
Forest shrubland	Н	8	144	157	ı	ß	ï	ŧ	351	155	42	1	1	75	1	1	1	1,004	
Forest Land	77	75	103	86	123	123	114	35	112	117	205	209	96	92	88	55	117	1,830	
Grass land	-	į	ı	í	í	ſ	595	ŧ	1	ş	1	1	•	1	187	1	1	782	
Grass land	7	ŧ	t	ł	i	ł	ł	1	1	ij	ŧ	1	ì	į	ı	1	167	167	v
River valley	co Co	150	165	180	150	160	272	148	113	305	242	275	217	475	307	197	175	3,531	
Mursery	r-I	1	ì	1	i	ŧ	f	ı		1.5	ŧ	7	1	1	1.5	1	- 1	ហ	
Range pasture	RP																		
IAR	ţ	1	1	ı	ť	¥	4	į	ģ	ŧ	i	ı	13	1	ı	ł	ţ	13	
Bamboo Forest	က	1	ţ	i	t	ı	ţ	ı	į	1	ı	i	F	1	.	9	ť	8	
Settlement	H	48	72	35	9	3	48	82	S	75	75	28	38	20	65	29	45	1,037	
Total	Ha	851	1059	1000	1025	925 1	1604 1	1090	1418	1736.5	1025	17383	204 1	12383204 1645 1006,5	306.5	953 1	1044	18,824	
Development plan					,								•						
Proposed cultivated land	d lend	578	119	630	692	582	575	762 1	1148	1238	503	665	840 1(1008	350	425	540	11,250	
Afforestration		150	185	188	198	203	250	691	368	270.5	326	348	204	329	250.5	213	204	3,656	
Pasture Improvement	٤		ŧ	·	ì	ą	595	ſ	è	1	1	ŧ	ŧ	i	187	149	167	1,098	
Natural grazing la	land	75	83	8	75	8	136	74	57]	153	121	138	109	238	154	66	88	1,770	
IAR	***	ì	1	9	1	i	i	ı	1	1	١	1	33	1	ſ	1	ı	13	
Settlement		84	72	92	8	8	48	85	ß	75	75	87	38	2	65	67	45	1,037	
Total	Ha	851	1059	1000	1025	925 1	1604 1	1090 1	41817	14181736.5 1	1025 12	1238 13	1204 16	1645 10	1006.5	953 1	1044	18,824	
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Check Labs		site dans	TAROL LORGE	SUPPLIE MOST	CERTAL LATOVARANCE	Aversion wit					

8.2 Engineering Measures for Soil and Water Conservation

Any measure that involves the physical movement of soil or stones, or requires construction, is termed as an engineering measure. Usually, such measures are not complete in themselves and require the addition of a vegetative cover before becoming fully effective and permanent.

8.2.1 Soil and Stone Bunds and Hillsite Terrace

The construction of soil and stone bunds is an effective method of retarding rainfall runoff and thereby reduce soil erosion from arable grazing or forest area. Well maintanined bunds will eventually develop in level bench terraces.

The bunds are constructed along the contour at intervals of 10 to 20m. apart and from 0.5 to 1.0m in height. The distance apart and height will be dependent on the degree of slope and rainfall intensity. Hillsite terrace may be considered as a closely spaced developed stone bunds. They are constructed on slope 30% and over, where there is adequate soil depth and an abundance of stone. The width of these terrace should not be greater than 1½ to 2m. While their height will vary from 0.5 to 1.0m. Hillside terrace is not a major soil conservation component. In Asosa settlement except at Euzi hill and above units 10 and 11.

8.2.2 Gully control

In units 1, 2, 3, 5, 8 and 14 the majority of the gullies, are of a modest size and can be easily protected by vegetation measures. In unit 16 and part of 17 the gullies are moderately deep and extensive.

In these areas, the revegetation must be supported by the construction of structures. Gullies are formed by a construction of rainfall runoff flowing down a hillside and slopey lands. Frequently road culverts or warm foot path and cattle tracks are the initial cause of a gully. Graded bunds bunds on hillside drains constructed without proper cutlets may be another cause. Once established, a deep gully is exceedingly difficult to repair. It's seldom possible to

more stabilize its condition, thus preventing further growth. One way of controlling gullies from developing by stopping the overland flow to enter the gully.

This must be done by diversion drains. Steep side slope must be reduced to slopes less than 1:1 ratio in order to facilitate the revegetation.

The spoil will be put on the bottom of the gully, and strips of grass sods are placed across the gully at a distance 10-20m, depending on the gully bottom slope.

The grass sods (with roots) are to be found in the near vicinity of most gullies. Dimensions of the sods are 10x15 cms, width of the grass strips in 20-30m. If grass strips across the gully are not sufficient, check dams must be constructed.

They can be made of stones or wood (branch). Care must be taken with the application of these construction as they locally increase water velocities and thus the erosive force of the water. There are too many examples of check dams which caused excessive erosion.

8.2.3 Grass water way

Interception ditches at the bottom of each row of plots will generally have a slight gradient towards grassed water ways. The uppermost interception ditch must be large enough to accept the considerable runoff from the ridge. The grassed waterways will convey the runoff downhill and terminate in natural depressions. If possible, they should be sited in a wide natural depression or gully shaped, so as to spreadout the flow as widely as possible to reduce the velocity.

Excavated waterways will be needed where natural channels are absent. When stone channel, debouches from the plots areas into the farmland, it should flareout into a grassed waterway. In units 1, 10, 11 and 5 the majority of the grass waterway are of a modest size and can be easily established and protected by vegetation measures. In unit 2 and 3 there are 6 to 12% of slopes along the depression, so as to spread out the flow down as widely as possible or established dropping structures between 50 meters interval to

reduce the velocity.

In most cases, the internals roads or tracks which allow access to the row paths and to the farmland will be on the catchment divide. Since they run radially down slope, they will develop into gallies.

Therefore, where these roads cross the interception ditches, they should be slightly hunged i.e. the hump of the road is an extension of the ridge of the ditch, and runoff will be stopped by the hump and diverted into the ditch channel.

8.2.4 Check dams

Check dams are made to slow down excessive water velocity and to promote sedimentation. After introducing check dams the runoff diminish the power of runoff so that it has less effect on vegetation. Although check dams are used to slow down the waterspeed and erosion, the locally increase them. Specially the side slopes just above the checkdam and the bottom and sideslopes just downwards must be well protected.

A common error made is to hinder the ranoff too much. The discharge capacity of the checkdams must be as big as possible to diminish the risks of collapsing and meandering. Depending on risks, availability of money and materials, a lot of different types of check dams exist. For permanent use, checkans will be of timbers, masonary, reinforced concrete. These check dams must be trenched at least0.5 m in the reshaped gully panis and 0.25 m into the gully bottom. Unless the gully is very deep (3-5m) check dams must continued to the upper limit of the gully banks.

In units 1, 2, 4, 5, 6 and 17 are O-8% of sideslopes along the depression.

5.3 Vegetation and Agronomic measures for Loil and Water Conservation

A good vegetative cover is a very effective method of controlling soil erosion. Unfortunately the cover, so valuable for the protection of the soil is constantly removed by man's activities. However, with some discipline, there

are methods by which the cover can be maintained and at the same time provide a greater yield than—left to undisciplined exploitation. Ideally, vegetative measures for the control of soil erosion should, if practical, always take procedure over engineering measures. The fact that engineering work involves physical movement of the soil is, in itself creating an erosion hazard if it is not carefully carried out. All agriculture activities must be aimed at diminishing—the amount of runoff, specially if gully—formation took place. The first possibilities to minimize runoff is to plough in the proper direction and to adopt crops (for crop rotations) to the natural environment. If the amount of runoff is not decreased sufficiently by this measures, strip cropping and the construction of terraces must be considered. Special care must be taken around the gullies, which must be given a good protection against erosion and runoff could be minimized by farming the crops closely.

Livestock Development

Integrating the livestock into the crop production of the settlement is one ways of raising the settlers income and introduction of deversified production system. This is becase they can be kept for cash income and meat production. Donkeys can also provide means of transportation while oxen will substitute partially the mechanization decreases high cost of crop production.

The major constrains to livestock production, is desease, especially Troporosomisis and poor nuitrition.

So the most important measure to be taken would be improvement of the vetrinary services, control grazing (rotation closuse of areas) and planting of fodder trees.

Fishery

It is advisable to start fishery development in the settlement which gives additional nutrition and income to the settlers.

8.3.1 Natural forest conservation and Afforestation

The process of clearing natural forest for need of agriculture land, construction and fuel wood has been in progress since the establishement of the settlement project. What makes the danger of devegetation more feet is that

the soil of the area is highly erodible and the remaining natural forest and shrub occuld be cleared within few years, which could just be sufficient to provide the wood demand of the inhabitant under proper management.

Upto now the natural forests area around the settlement have not been surveyed or managed. So there is anurgent need to survey and identify area of potential wood resources.

Afforestation to assure the supply of fire wood and to stabilize the ecology is being carried on in the settlement. Though 5 million seedlings have been raised and planted over the past 5 years, due to termite problem and absence of cultivation after planting the survival rate has been below 60%.

The continuation of the afforestation programme, with proper species selection and proper management, covering the provision and consuption of fuel wood, agroforestry, wind break and propogation of fruit trees could guarantee the future of the project.

Proposed tree species

- Species for wood lot establishement
 Casuarina equistifolia
 Cupressus luistanica
 Eucalyptus camaldulensis
 - " soligna
 - " citrodora

Melia azandrachta Leuceana leucocephola Grevollea robusta

b) Species for the establishement of a system of wind break

Acacia melanoxylon
Casuarina equistifolia
Cupressus luistanica
Grevelle robusta
Melia azandrachta

c) Species for soil conservation and improvement

Acacia albida
Cordia africana
Delonix regia
Leuceana leucocephala
Mangifera indica
Erythrina abysinica
Pilicostigma thonningii
Sesbania aculata
Schinus molle

8.3.2 On pasture and grazing land

Pasture and grazing lands comprise a small area in Asosa settlement. These lands carry a large number of livestock, so large that overgrazing has taken near the surrounded settlement areas. This results in a fall in the quality and quantity of fodder, so fewer animals can be supported. The soil is left without a vegetation cover, thus prone to erosion by water and wind. Loss of topsoil through erosion reduces the fertility of the soil, and thus the likelihood of reestablishing a good quality pasture goes down. The land is with 8-30% slope with no worse than slightly eroded or irregular topography. The implecation is that, it can be cropped from time to time in a long ley system to exploit the fertility built up without incurring excessive erosion penalities. The unit 5. 14. 16 and unit 17 has about hectares of pasture potential land. Unit 8 has about hectares of pasture land.

The pasture management will probably require a system of rotational grazing and forage conservation.

Acess to pasture poss the problem of straying into field of growing crops. Desirable shade and browse trees should be planted in the pasture areas.

Natural grazing that can be recommended will come from two classes of land. One is dissected slopes 16-30% slopeland will provide the upland grazing in the wet season. Grazing must be done carefully, more areas will need

to be managed with care and needed strict grazing control: The depressional areas during the dry season, don't graze the gully when the soil is wet or in the dry season, so that the vegetation is not damaged. During the wet season, cattle must not be allowed in the gully and sheeps and goats are preferred. Mowed grasses must be removed out of the gully, so that it does not hamper the runoff.

It can be used as hay or mulch material. These areas could also be used for water storage in the future as suggested in water storage dams..

8.3.3 On cultivated land and Homestead plots and cultivated land

Apart from the physical structures for soil conservation, a number of agronomic measures can be used in combatting erosion on cultivated land and homestead plots. The methods directly increasing surface storage capacity would be tillage systems like countour cultivation, chiseling and ridging.

Contour cultivation aims at intercepting the flow of water and spreading it across the slope, thus increasing the time for infiltration. Chiseling loosens the soil without turning it around, and while the infiltration is improved, the soil is left less susceptible to erosion than if it has been ploughed.

Ridging, as done for sweet potatoes, shape the soil into micro basins which retain the water and leave it a longer time to infiltrate.

Indirect methods of increasing infiltration rates are by the use of farmyard manure, green manure and crop residues, as well as by some types of minimum or zero tillage. The higher content of organic matter in the soil increases the infiltration by creating more stable aggregates less susceptible to splash erosion and by encouraging a higher porosity through higher biological activity. Ordinary agricultural methods for increasing productivity, i.e., supporting a higher plant population, like rotation systems and the use of fertilizer and manure, lead to increased vegetative cover and therefore can be raised to have beneficial effects for soil conservation.

Slowing down the speed of the water on certain parts of the slope are strip cropping, narrow grass strips, residue or mulch lines and hedges. In a strip cropping system, contoured belts of crops inviting high erosion risk

are alternated with belts of crops with low prosion risk.

Narrow grass strips, mulch lines or hedges used for building up a terrace. The strip slows down the speed of the water and the soil settles in the bund: Therefore a terrace slowly develops. The process can be enhanced by the farmer ploughing up soil to the bund from both sides when cultivating. It is important that the plots be equal in size according to the settlement model and allocated by the producers cooperative. Since the plots are intended to be cultivated intensively for supplement food and obtain cash for the family, vegetable garden, fruit trees, raising poultry, etc. unfavourable soil should be identified by a soil survey in advanee and not used for plots or, extra area should be allowed. Unless the topography is very even. plot dimensions will not be uniform, generally narrower at the upperend. Plot dimesion should aim to be 40-50m long 20-25m wide along the contour lines, but there is no hard and fast rule and the length is dependent on the distance required between interception ditches which protect the upper end of each plot from runoff from the plot above. These ditches will run on the contour or a slight gradient and will generally not be parallel to each other. Therefore, the plot lengths will vary and plot widths will also vary in accordance. Paths along each row of plots run below the ridge of the interception ditch.

The advantage of more frequent ditches is that they receive smaller volumes of runoff and hence can be of smaller gradient and allow opportunity for runoff to infiltrate in the ditch itself. In this use, trees planted on the ridge would benefit from the improved moisture regime.

8.4 Water Development and control Measures

Although some components of water development are not directly related to soil conservation, this aspect of subwatershed management and development is considered particularly important. The development of a farm pond or spring reduces the movement of livestock for watering, this will immediately result in less erosion.

The more movement of livestock destroys **v**egetation, and their warn tracks are a frequent cause of gully erosion. A good source of clean water is essential for the health of the settlers. Furthermore, if the source can be

made available close to homesteads, much time will be saved for more productive work than collecting water. The Afa, Hoha, Selga, rivers and perennial springs are have good potential for irrigation and water supply for human and livestock use. Units 1, 9, 10, 11 and 2, 3, 7, 8 and project centre get water for drinking from Hoha river and Units 4, 5, 6 and 12 get water for drinking from perennial spring and river. Units 13, 14, 15, 16, 17 get water for drinking from Afa river.

The nurseries unit 14 and 11 get water from perennial river but, it is proposed that the nerseries and horticulture farms that will be established for the settlement will get water by pumping or diversion weirs from these rivers.

8.4.1 Farm ponds, Dams, and Wells,

In Assosa there are seasonal and perennial rivers and have good potential for farm ponds and dams, diversion weirs and wells. The construction of those facilities should be considered as part of the development programme. Idealy, the ponds, and wells should be located in natural depressions where the soil in impervious, or an imprevious layer can be spread on the bottom. Seepage losses will therefore be small, and if the ponds and dams are relatively deep to their surface area, evaporation loss will be reduced.

- Pollution of the ponds by livestock is a serious problem. It is necessary to fance to keep the animals out of the pond, and to pipe the water from the pond to a nearby water trough.
- The siltation of ponds and dams. Generally, pond and dams are constructed across natural water courses. Care has to be taken that the spillway is of adequate size to accommodate the runoff from the catchment area.

The capacity of the reservoir (dam upto 8m in height, dependent on the size of the dam) should be consistent with the volume of runoff.

A disproportionately large catchment will require a large spillway, and heavier silt load will more quickly reduce the capacity of the reservoirs.

Where the water table is less than 2 or 3 m deep, the construction of wells may provide a good water supply for domestic and livestock needs.

8.4.2 Diversion Weirs

Diversion weirs are structures, usually concrete, built across either permanent or seasonal rivers to divert river flow into a channel. No water storage of the river flow is intended, although sometimes the structure raises the water in the river to facilitate its diversion into a channel. Weirs may be constructed to divert flow for irrigation purposes and to fill pools and sometimes dams in adjacent catchments. Units 9 and between 10 has a good potential sites for diversion weir from perennial river Moha, get water for irrigation of nursury and horticulture.

8.4.3 Swamp Drainage, Waterlogging

Experience with the drainage problems is rather limited as the majority of the unit management, have more than average rainfall. Most problems are related to maize and other crops, that changed its colour (becoming yellow) during the months of heavy rainfall.

This changing of colour can be the symptom of an unbalanced nutrient uptake due to the excess water in on the soil. Other problems were that going in the field was very difficult or impossible for man (July to August) and for tractors (July, August to Mid September).

The introduction of a surface drainage system will solve partly the above mentioned problems. The presence of furrows related to row drilling, facilitates the overland flow and weeding, which favorate both crop performance.

Accessibility of the fields for men can be improved by drainage, but the use of wheel tractors in these clays during the rainy season will always be troublesome.

The use of wheel tractors is even odissuade, as destruction of soil structure is nearly inevitable in these conditions. Unit 15 to between 16 and mear—unit 14 has been water logging for 50 days on the depression small valleys.

8.5 Other measures

The principal soil and water conservation measures that might be required in an subwatershed development programme have been outlined in the three subsections above.

These are the measures that will lead to improving or atleast sustaining yields. However, in order to obtain the maximum benefits from the soil and water conservation inputs and satisfy the integrated approach to settlement development, other measures are required. Listed below are some of the measures not directly related to soil and water conservation but all closely connected with agriculture output, and these should be considered in the formulation of the development plan. However, in other circumstances other development options may be appropriate, such as sericulture (silk production) apiory (bee keeping), and aquactilture (figh farming) marketing, food storage and energy conservation.

8.5.1 Access roads and tracks

Remote and inaccessible areas are difficult to develop. Ease of access to and from the farmland is an essential requirement when the settlers are to be reached by the extension service or by education and health schemes.

As road construction is a frequent cause of landslide and gully erosion, particular care should be taken over their alignment. The improvement of tracks should not be overlooked. In some areas these are vital for the movement of people and pack animals. As in the case of roads, tracks are a common cause of gully erosion. Any accumulation of runoff along the track should be channelled away at frequent intervals. Critical lengths and possibly these on relatively steep grades may have to rock-paved in order to prevent erosion.

Appendix I

Photo-Interpretation and Soil Survey Mapping Legend

SOIL DEPIH (ALL LANDS)

Symbol	Range (Cms.)	Descriptive Term
5	less than 25	Very shallow
4	from 25 - 50	Shallow
3	from 50 - 100	Moderate
2	from 100 - 150	Deep
1	more than 150	Very deep

TEXTURE (ALL LANDS)

Symbol	Descriptive Term for Texture Group	Included Texture Classes
F	Fine (light)	Clay (C) Sandy clay loam (Scl) Silty clay loam (Sicl) Clay loam (CL)
M	Medium	Silt loam (Sil) loam (1) Very fine sandy loam (vfsl)
L	Course (light)	Fine sandy loam (FSL) Sandy loam (SL) Loamy fine sand (Lfs)
С	Very coarse (very light)	Loamy sand (LS) sand (S) Course sand (CoS)

COARSE FRAGEMENTS: ALL LAND)

a) Gravel, cobble, and other coarse fragements will be mapped when they occur in sufficient amounts to influence land use. They will be shown as textural modifiers of the present top soil as follows:

Mapping Symbol	Descriptive Term	Size Range (diameter)
g	Gravelly	up to 3"
c	Cobbly	3" to 10"
S	Stone	10" to moveable
r	Rock	unmoveable

b) Quantity of course fragments will be mapped in accordance with the amounts shown in the following table:

Mapping Symbol	% gravel by volume	% cabble volume	% stone by volume	% rock by volume
gc	30 - 50	30 - 50		
Vg Vc	50 - 90	50 - 90		
SI			30 - 50	
S2			50 - 70	
S3			70 - 90	
\mathbf{R}	*	,		10 - 50
700				50 - 100

c) Areas containing more than 90% of coarse fragments and more than 50% Rocky will be place into an appropriate miscellaneous land type.

COARSE FRAGMENTS: (ALL LAND)

a) Coarse fragments for soil classed as to series will be denoted as follows:

SIZE	OF FRAGMENTS
3" - 10" in diameter	More than 10" in diameter to moveable
: % by Class : Volume	! % surface area Class ! Occupied by rock
S1 : 30 - 50 S2 : 50 - 70 S3 : 70 - 90	R 10 - 50 700 1 50 - 100

- b) Areas having surface rock outcropping and/or accumulations of loose, detached rock fragments (greater than 10 inches in diameter) in excess of 50% will be classed as Colluvial Rock land.
- c) The "S" and "R" symbols, when mapped, will follow the depth class symbol.

PERMEABILITY (ALL LANDS)

Sumbol	Permeability Class	Probable Texture	Probable Structure	Approximate Per Rate Cm
2 3	Slow moderately slow	fine (heavy) fine or medium	pr, abk, pl pr, abk pi	0.13 to 0.5 0.5 to 2.0
4 5	moderate moderately	medium coarse	pr, sbK sbk, gr, cr	2.0 to 6.3 6.3 to 12.5
6	rapid rapid	very coarse	cr, sg	12.5 to 25.0

Parent Material

This item should include information on the origin of the parent material and, where possible, on the nature of the parent $\operatorname{rock}(s)$.

 $\underline{\mbox{Type}}$ & Underlying Material will always be shown regardless of depth of soil material (All Lands).

Symbol	Description
v	Volcanic (basalts, tuffs, etc)
g	Felsic Precambrain basement (gneisses granites, etc.)
m	Metomorphic Preceambrain basement (slates, sehists, phyllites, etc.)
e	Evaporite (predominantly gypsum)
S	Sandstone
c	Caleareous (Predominantly limestone)

Slope (ALL LANDS) Both class and degree of slope will be mapped.

Example:

Class Symbol	Degree in % slope	Descriptive Term
A	0 - 2	Flat or almost flat
В	2 - 8	Gently slopping
C	8 - 16	Slopping
D	16 - 30	Moderately Steep
E	30 - 50	Steep
F	50 +	Very Steep

Erosion (All Lands)

Symbol	Description Term	
1	None to slight erosion	Less than 25% of original top soil removed
2	Moderate erosion	From 25 to 75% of original top soil removed; occasional gullies may be present.
3	Severe erosion	From 75% of original top soil to 25% subsoil removed; occasional deep gullies or frequent shallow gullies may be present.
4	Very severe erosion	All of original topsoil and 25% to 75% of subsoil removed.
GL1	Slightly & modera— tely Gully land	An intercate network of very frequent moderately gullies are present. The soil has been eroded to the extent that all or practically all of the original surface soil, or A horizon, has been removed. (This GL1 will be practiced only planting trees & grass).
GL2	Deep Gully land	An intericate network of very frequent deep gullies are present. Soil profiles have been destroyed except in small areas between gullies. (This GL2 will be practiced planting trees, and structures).
EMP	Exposed parent material and/or	Areas consisting of exposed parent material and/or rock resulting from the complete, removal of all of the original topsoil and subsoil by natural processes where attributed to maninduced processes, it will be differentiated by placing the symbol in arenthesis.

Presence of Salt or Alkali

Exact classification of saline, alkali and saline-alkali soil conditions must be based on laboratory data, but the following simple classes, as defined in the Soil Survey Manual, can usually be distinguished n the field and can be included with advantage in a field soil description:

Class 0	Soils free of excess salt or alkali. Practically no crops are inhibited by, or show evidence of injury from excess salts or alkali.
Class 1	Soils slightly affected by salt or alkali. The growth of sensitive crops is inhibited but that of salt-tolerant crops may not be.
Class 2	Soils moderately affected by salt or alkali. Crop growth is inhibited and no crop does well.
Class 3	Soils strongly affected by salt or alkali. Only a few kinds of plants survive.

Where conductivity measurements are available, the following classes of salinity, as defined in the Soil Survey Manual, can be recognized.

Approximate Limits of Salinity Classes

Class		Conductivity of Saturation extract in millionhos per cm ²
Class 0:	Free	0 - 4
Class 1:	Slightly affected	4 - 8
Class 2:	Moderately affected	0 - 15
Class 3:	Strongly affected	above 15

Drainage

The following definitions for soil drainage classes for use in soil profile description are derived directly from the Soil Survey Manual:-

- Class O Very Poorly Drained water is removed from the soil so slowly that the water table remains at or on the surface the greater part of the time. Soils of this drainage class usually occupy level or depressed sites and are frequently ponded.
- Class 1 Poorly Drained water is removed so slowly that the soil remains wet for a large part of the time. The water table is commonly at or near the surface during a considerable part of the year. Poorly drained conditions are due to a high water table, to a slowly permeable layer within the profile, to seepage, or to some combination of these conditions.
- Class 2 Imperfectly Drained water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Imperfectly drained soils commonly have a slowly pereable layer within the profile, a high water table, additions through seepage, or a combination of these conditions.
- Class 3 Moderately Well Drained water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time. Moderately well drained soils commonly have a slowly permeable layer within or immediately hebeath the solum, a relalively high water table, additions of water through seepage, or some combination of these conditions.

Special Features

<u>Symbol</u>	Description
	Tukul Settlement
(H)	Village
7//////////////////////////////////////	Town, Public Buildings
(金) (金)	Cemetry: Christian, Moslem
各田省杏	School, Hospital, Mosque, Church
111111	Levee
	Dam, Reservoir
	Check Dam, Gully plug
	All weather raods
	Farm Honds
<u>Y</u>	Culvert
-) (-	Bridge
\sim	Perennial streams
	Lake or pond
(S)	Spring
	Wells or water tanks
<u> </u>	Swemp or march
33333	Lava flow
$\begin{pmatrix} v \\ v \end{pmatrix}$	Outcrop Rock
mm	Cliff
m	Escarpment
	Sand dunes
2	Unit boundary
	Unit Number
2	Landscape Unit Number
	Location of major soil samples Reference Numbers
	Seasonn1 streums

Land Use

Symbol Symbol	Description
(F)	Forest
(T)	Thicket
(Ba)	Bamboo
(P) (R)	Plantation
(R)	Riverine forest
(EW)	Eucalyptus, Woodland
(s)	Scrub
(S_c)	Scattered Trees
(Lc) (B)	Cultivated Land without Conservation
(Le)	Cultivated Land with Conservation
(B)	Bareland
(G)	Grassland
(EPM)	Exposed Parent Material
(GL1)	Moderate Gully Erosion
(GL2)	Severe Gully Erosion
(A)	Strongly Affected Salts and Alkali
	Ridge
→ →	Grass water way
	Food path
N	Nursery

SOA SHUM

No LAND QUALITY TEMPERATURE REGIME 2 GROWING PERIOU MOISTURE 3 AVAILABILITY	1	LAND CHARACTERISTIC UNIT	TINO					
	RATURE 91ME		11	HIGHLY SULTABLE	MODERILY SUITABLE MARGINALY SUITABLE CURRENTLY	S3 MARGINALLY SUITABLE	CURRENTLY Not.S	ARMANIENTLY NOT.S
	RATURE 91ME				13270 - 1400	1400-1300	1300 - 1200	1200
	41%E	און למסליבוא	Ę	1500 - 2200	2200-2270	2270 - 2350	2350 - 2460	72400
		Mean Temperature	,		L1 - 71	30 20	-) 2 - (< 1.5
		(Mernial Zone)	ن ا	78 -43	24 - 26) i	26 18	>35
	GROWING PERIOD	Length of Growing Deriou	day	180 -240	176-180	160-170	130 - 160	65/7
	1100	Effective Soil Depth	\$	2515	150 -100	100 - 50	50-25	725
	AVAILABILITY		and the second s	, c	180 - 200	160 - 180	041 -01/1	97) [/
		A TOPE WITHOUT	aay	200 - 200	250 - 27E	>2.70	001 041) }
- DAMAGE	77	Soil Diaz. 200			d-1	p - VP	7 27	ナーコン
۲ - ا	147		Class	/VIW — VV	W - SW	SW - C	VI – E	1
		Maan Tomperature			11- 11	74 - 75	75-18	<15
		(Thermal Zone)	,U	C+ - 81	92- ho			>35
The state of the s	DE GRADATION	Length of prowing period	day	180 - 2460	04/- 08/	091 - 021	160-150	750
	IALAND		class	7 - 20	75-57	Sic -c(61)	C (rd)	V 3
		Stonimess	class	hone	fairly string	proto	very story	exceeding story
		Slope angle	%	8-10	191-08	16-30	25-05)	>50
	+	Soil Texture	Class	7 - 50	75 - 57	Sil - c(bl)	(pu))	8
6 NUI	NUIKIENI STATUS AND				6.5 - 6.0	6.0 - 5.0	5-0-45	< 4.5
	ENTION	Soil REACTION	2	6.5 - 7.0	7.0 - 7.5	7.5 - 8.0	P.O-F.5	7.8.5
		Organic Matter	%	9-6	3 - 2 .	75-9.0	9.0/-0.0	> 10.0
ROOTIN	ROOTING	Effective Soil Depth	₹	V/50	150 -100	100 - 50	50-25	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
	CONDITION AND WORKABILITY	Stoniness	class	hae	fairly stong	story	very story	exceeding story
		Soil Texture	claes	7-50	75-87	Sic - (161)	(c(rd)	> >h

SORGHUM
FOR CROP
REQUIREMENT
ENVIORNMENTAL

APPENDIX 2

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No	LAND QUALITY LAN	LAND CHARACTERISTIC UNIT		HIGHLY SUITABLE MOBERTLY SUITABLE MARGINALLY SUITABLE MORERTLY SUITABLE MARGINALLY SUITABLE	82 RTLY SUITABLE MARGIN	48GINALLY SUITERIE OUE	N V WILL OF SHIP OF SHIP OF	NZ N	V
Ċ) L(A) () / 0 L	Salimity	hos/cm	7-0	8-7	8-12	12-15	> 15	?
\sim	1001011163	Alkalimity	ESP	9-0	01-9	10 -13	13-15	77	
	MAGEMENT	Slope Angle	%	0-8	91-8	1630	25-08	255	
9	LAND PREPARATION AND MECHANIZA-	staniness	Llass	hone	fairly stony	unota	very story	exceeding stone	3
	TION POTENTIAL	Soil Taxture	Class	7 – SC	p75-15	S;c - 4 (61)	C (vd)	S	5
S	LAND QUALITY	LAND CHARACTERISTIC	SISTIC		CROP	RATING	CROP	RATING	
	and the same of th		we will have you wrong yo	VH- Very high emergy required	und Songhum	工	Chiekpea	Σ	
	CONDITION AFFECTING	Seed-bed proparation	arvi _g a very very	工一工		Planton Planton Portugue Portuge Portugue Portugue Portugue Portugue Portugue Portugue Portug	Deplace		
2	ESTABLISHMENT	5		M - Medium "	Enert	I	Noug		
or Manager Billion AVIII				307-7	to	# >	Suntlower	I	
***************************************	Sanda Plana (1800 al 1800 al 1		-definitions of the principles - Millians	VL-Verylow "	Haricothean	M	Seasame	H >	
				+ + + + + + + + + + + + + + + + + + +	Sorghum	Σ	chick pen	×	
				M - Medium	Maize		Pepper	-	
Approximate the second	FLOOD HAZARD	Allack by surface	32	T - Tolerant	Wheat	(-1	Noug	H	
		Walter			164	Н	Seasame		
	en annañ-auton haved Paris Three		and a set fig. no make injury per setting grows in particular		Havicotbean	٤	Sumflower	Σ	
		`		S - Sensitive	Sorghum	v	Chickpea	8	
and of the second se					Maize	V	Pepper	Ŋ	
4	CHMATE HAZARD	Food Considerity		1	Wheat	()	Noug	8	
?				T - lolerant	Tet.	-	Seasame	Ŋ	
- Land Control of the			**************************************	-	Haricotbeam	N		Princepholines de la Carte	
				< - Semaitive	Sorghum	γ,	Chiekpea	-	
1000			•	1	Ma:3e	open jake filosopal de filosopal	pepper	Σ	

VIORNMENTAL REQU		ENVIORNMENTAL REQUIREMENT FOR CROP No LAND QUALITY LAND CHARACTERISTIC	001	CROP	RATING	CROP	APPENDIX 2 RATING
CLIMATE HAZARD Hail Sensitivity	Hail Sensitivity		T-Tolerant	wheat Teff Havicot beano	XFX	Noug Seasame Sunflower	F F S
SALINITY Folerance to Salinity		ļ [*] 1	VH - Very high toleance to Salinity Songhum H - High M - Medium L - Low VL - Very Low TEX	mity Songhum Mouse Wheat Pepper	をコキシコ	Chieck pea Noug Seasame	111
Saturation of the exchange complex with Na ions			s - Seneitive M - Modevately T - Tolerant	Songhum Moisse Wheet Tett Havicotbean	ΣΝΣΣΝ	Chiedspea Peppen Noug Seamene Sunflewer	いさいさん
TOXICITY Ca Co 3	(a (b)		L - Low Tolerance M - Medium Telerance H - High Telerance	Songlum Maine Wheat Test Howestlemo	L M L Not Know Not Know	Chiekpen Peppen Noug Seadonne Sanflower	Not Kasew
WORKABILITY NON MECHANIZI tarming (tillage)	Non Machanized tarming (tillage)		2—Low workingutreguired M— Medium " H—High "	d Songhum Maize Wheat Teff Hasicot bean	T Z T T Z	Chickpea Pepper Noug Seasame Sunflower	エ コエエエ
WORKABILITY faming (general)	Mechanized faming (general)] [L-Low M-Medium H-Kigh	Songhum Marye Wheat Teff Haricetbeans	TTTXT	Chickper pepper Noug Saacame Sunffrust	エコイノコ

CHILL PEPPER
FOR CROP
REQUIREMENT
ENVIORNMENTAL

					RANGES	S OF SUITABILITY	アコ	
2	No LAND QUALITY	LAND CHARACTERISTIC UNIT	FIND	HIGHLY SULABLE	MODERILY SUITABLE MARGINALY SUITABLE CURRENTLY	MARGINALLY SUITABLE	CURRENTLY Not.S	FERMANENTLY NOT.S
		77.7.14		C	1000 - 800	800-700	100 - 600	7600
	TEMPERATURE	AITITUAE	/m:	1000 - 2000	2000-2200	2200 - 2300	2300 - 2400	22400
•	Kraime	Mean Temperature	,		15-17	71- 71	11-8	8>
		(Thermal Zone)	ر د	10 - 44	25-28.	29-31	32 - 35	>35
7	GROWING PERIOD	Length of Growing Deriod	day	150 -240	041-251	140-130	130-120	<120
	NOISTIBE	Effective Soil Japth	3	100 -130	251-25	25-50	10 -25	710
₆	AVAILABILITY	Growth cycle	day	220 - 240	380 220		0.81-041	<170
4	DRAINAGE	Soil Damage	class	N	W W S W	7-P	P = 8W	2 - JA
		Maan Tamperature			15-17	12-14	11-8	& >
		(Thermal Zone)	,U	18 - 84	25-28	29-31	32-35	>35
Ļ۲	DE GRADATION	Length of prowing period	day	150 -240	150 -140	140 -130	130-120	<120
>	NAZARU	Soil Toxture	class	72 - 67	S:c1	Sc	Sic - c(b)	V
		Stoniness	class	hone	fairly stony	yes	Very stony	exceeding stony
		Slope angle	, %	8-0	197-18	16-30	30-35	>350
	H. 11 0 +12)	Soil Texture	Class	72-57	Sic/	ر ا	Sic - (by)	h
9	NUIKINI STATUS AND	.+ 0 - 1)		6.5 - 6.0	6.0 -5.0	5.0 - 4.5	44.5
)	RETENTION	Soil REACLION	E Q.	6.5 - 7.0	7.0 - 7.5	7.5 - 8.0	8.0 - 8.5	78.5
		Ovganic Matter	%	3-6	3- 2	7.5 - 9.0	9.0 - 10.0	0/人
	ROOTING	Effective Soil Depth	£	100-150	50 -100	25 - 50	10-25	470
<u></u>	MORKABILITY	Stoniness	class	hone	fairly story	stony	Very story	executing setory
		Soil Toxture	clàro	72-57	l'ais	***************************************		

EN	ENVIORNMENTAL RE	REQUIREMENT	FOR	FOR CROP CHILLI	CHILLI PEPPER				APPENDIX 2	cul.
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2				HIGHLY SUITABLE	MORERTLY SUIT	ABLE MARGI	NAZLY SUITABL	MORERALY SUITABLE MARGINALLY SUITABLE CURRENTY N.S	S PERMANENTLY. M.S	M.S
Ċ	70807	Salinity	hos/cm	7-0	ムーケ	- 7	21/2	12-15	7/5	
×0	10/10/163	Alkalimity	ESP	9-0	01 - 9	/	10-13	13-15	715	
	MAGEMENT	Slope Angle	%	2-0	91-8		1630	30-35	>35-	}
0	LAND PREPARATION AND MECHANIZA-	Staniness	Class	hishe	fairly story		story	very story	exceeding stone	226
	TION POTENTIAL	Soil Texture	Class	7	Sic/	A	Sc	Sic - c(61)	1	0
No	LAND QUALITY	LAND CHARACTERISTIC	STIC	. Cl		CROP	RATING	CROP	RATING	
	Alary xiry					Songhum	r:	Chiekpea	٤.	
0	GEAMINATION AND	preparation		H - High "		Maize	Σェ	Depper	1 I	
	ESIMBLISHMEN I	Popular All Popular Services			101	#	N. H.	Suntlower	·	
			general de la company de la co	low	II Ha	Haricothean	Σ	Seasame	H >>	
				T - Intolerant		Sorghum	Σ	chiek pea	Σ	
00000 A 2 A 19000 W. A			,	1	-	Maize	Σ	Pepper	-	
	FLOOD HAZARD	Alfack by surface	3	T - Tolerant	M	Wheat	r-1	Noug	Н	
***************************************		Water			-	Tett	Н	Seasame	Н	
					Hav	Havicotbean	Σ	Sumflower	Σ	
				S - Sensitive		Sorghum	V	Chickpea	60	
				7 7 7		Maize	V	Pepper	V	
7	PUMATE HAZARD	Frank (passifivity	2	N - Meduzin	48)	Wheat	n	Noug	Ŋ	
-				T - lolerani	164		-	Spasame	V)	
					Havi	Havicotbean	S			
		and an analysis of the		5 - Semailive	-Parameter (Proposale Prop	Sorghum	'n	Chiekpea	ļ- •	
			*	•	•	07.0	v	pepper	Σ	

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No LAND BANDITY LAND CHARACTERISTIC CLASSES CROP RATING CROP RATING CLAMATE HAZARD Hail Sensitivity To Telerant United To Haman Hall Sensitivity To Telerant United To Haman Hall Sensitivity To Telerant District Salarity Scalabora To Scalarity To Telerant District Salarity Scalabora To Haman Hall Sensitivity To Telerant District Scalarity Scalabora To Scalarity To Scalarity Hadament Scalarity To Scalarity To Telerant District Scalarity Scalabora To Haman Hall Scalabora To Haman Haman To Haman Haman To Haman To Haman Haman To Haman Haman Haman To Haman H		L							
INDERNIENTEL REQUIREMENT FOR CROP CHILLI PEPER LAND GUMLITY LAND CHARACTERISTIC CLASSES CROP CLIMATE HAZARD Hail Somestavity T - Tolepart Wheat M. Nowage Hail Somestavity T - Tolepart Medical form M. Charles M. Sachiman M. Charles M. M. Hadium Tolemacto Salinity Society M. Pepper J. Nowage Salinity M. ins Sachiman M. Nochonge complex M. Machina Tolerance Machine M. Nochonge Sachiman M. Machine M. Machine M. Nochonge Sachiman M. Machine M. Machine M. Nochonge M. Nochonge Sachiman M. Machine M	ENDIX 2	RATING	L F '	n	111	NZNZN	Not Knoew	えしエエエ	エコイフィ
INDERVISEL REQUIREMENT FOR CROP CHILLI FEPPER LAND QUALITY LAND CHARACTERISTIC CLASSES CROP CLIMATE HAZARD Hail Sensitivity T - Tolerant Telf Haucoteknow WH - Very high Idean to Society Society Marchange complex N - Needevately Tolerant Saturation of the S - Sensitive Nocke Work WITH Na ions T - Tolerant Haucoteknow TOXICITY Ca. Co. No. Machanized N Needevately Machanized L - Low Tolerant Houset Kenn Machanized N - Medium Elevant Telf Houset Kenn Machanized N - Medium Elevant Telf Machanized No. Medium Society Machanized N Low working wind Machan Machanized N Medium Medium Machanized N Medium Medium Machanized N Medium	APP	CROP	Noug Seasame	Sun-lower	chieck pea Noug Seasame	Chickpea Pepper Noug Seamanne Sunflower	Chiekpea Pepper Noug Seasanne Sanflower	Chick pea Pepper Noug Seasame Sunflower	Chickper pepper Noug Saasame Sunflewer
HAND GUALITY LAND CHARACTERISTIC CLASSES CLIMATE HAZARD Hail Sensitivity T— Televant Salinity T— Veryhigh telemacto Salinity Salinity T— Lew Normane complex M— Medium Elevant T— Lew Televant Saturation of the S— Sensitive Saturation of the S— Sensitive Exchange complex M— Medium Elevance T— Lew Televance H— High Medianized M— Medium Mechanized M— Medium M— Migh M		RATING	Σ٢	Σ	87±27		L Mot Know Not Know	ΣΣΙΙ Σ	т к т Х т
LAND QUALITY LAND CHARACTERISTIC CLIMATE HAZARD Hail Sensitivity CLIMATE HAZARD Hail Sensitivity Folinity Salinity Salinity Normalianise Modianized WORKABILITY Mechanized WORKABILITY Mechanized WORKABILITY Mechanized WORKABILITY Mechanized Mechanized Jaming (femeral)		CRAP	wheat	Harricotbeamo	inity Songhum Mouze Wheat Pepper	Sorghum Moine Wheet Teff Havicotbean	Songhum, Marx Wheat Teff Howestblum		Sorghum Marze Whest Tef Haricetbearo
No LAND QUALITY LAND CHARACTERISTIC 12 CLIMATE HAZARD Hail Sensitivity 13 SALINITY Folerance to Salinity Salinity Salinity Mith Na ions Non Machanized Non Machanized Non Machanized Machanized Machanized Machanized Toming (Fillage)		SESSYTO	1		VH - Very high toleancto Sal H - High M - Medium L - Low VL - Very Low	1 1 1	1 ()	2-low workingutzeguive M-Medium " H-High "	L-Low M-Medium H-Kigh
No LAND QUALITY 12 CLIMATE HAZARD 13 SALINITY 14 SADICITY 15 TOXICITY 16 WORKABILITY 17 WORKABILITY 17 WORKABILITY	REMENT FOR CROP	LAND CHARACTERISTIC	Hail Sensitivity		Tolerance to Salinity	Saturation of the exchange complex with Na ions	(م ه)	Non Madnamized tarming (tillage)	Mechanized faming (general)
NA S 1	IORNMENTAL REGUL	LAND QUALITY	CLIMATE HAZARD		SALINITY	Sadicity	TOXICITY		WORKABILI TY
	ENV	્ર	7		<i>w</i>	4	7.5	A State and a profession because a commence of the commence of	

<u> </u>		1	4		•	RANGES	YTUIBATIUS TO S	アレニ	
	Na	No LAND WUALITY	LAND CHARACTERISTIC DNIT		HIGHLY SUMABLE	MODERILY SUITABLE	MOSERILY SUITABLE MARGINALLY SUITABLE CURRENTLY NOT S	CURRENTLY Not.S	REPAINENTY NOT.S
L			111. 1 1		. 1	1400-1200	1200 - 1100	1100 - 1000	
	******	TEMPERATURE	Amtuak	Ę	1400 - 1200	1800-1900	1900 - 2000	2000-2100	72100
, , , , , , , , , , , , , , , , , , , 	•	KEDIME	Mean Temperature	0	11-25	Oct - 21	10 -14	4-6	77
			Linermal Lone)	2		26-28.	29-31	31-35	>35
	7	GROWING PERIOD	Length of Growing period	day	180-120	05/-05	22 - 90	20-02	<70
		NO. TYPE	Effective Soil Dapth	3	50-100	25-50	10-25	0/>	1
	3	AVAILABILITY				00/-06	05-02		
1			treeth caux	A CON	100-120	120-130	>130	0/>	1
	_	- Alaka.		•		7	T	d11 - a	, JT
	+	DIMINA C	-on wamay	Class	MW W	₹	٥	I A	J
			Maan Tamperature	(61-00	81 -61	18-17.5	<17.5
		·	(Thermal Zone)	,U	20-22.5	22.5-23	40-80	24-25	>25
	Lر	DEGRADATION	Length of froming period	day	100 - 120	90-100	50 -60 5/30	70- 80	>70
	·	NACARU	Soil Toxture	elass	75 - 67	57	C (rd)	C (PI)	8
			Stoniness	class	hone	fairly strry	sterry	vory stony	exceeding stone
			Slope angle	%	8-0	8-16	05-91.	36 - 35	35
L		H	Soil Texture	Class	75 - 75	75	C (rd)	C(U)	'n
	9	NUIKIENI STATUS AND	÷			5.5 - 5.3	5.3 - 5.0	5.0-4.7	24T
		RETENTION	Soil Reaction	<u>г</u>	7.0 - 6.6	6.7 - 7.0	7.0 - 7.3	7.3 - 7.6	>7.6
			Organic Matter	%)3	3-2	2-1	0-1	
		तेव्याग्र	Flective Sil Depth	કુ	50-loo	25-50	10-25	6. X	1
	7	MORKARION AND	Sioniness	cha	has	taile story	don	Very story	exceeding stong
,	•		Soil Toxfure	Saga	77-78	3 × 5		N	7

INVIORNMENTAL REQUIREMENT FOR CROP HARICOTOGANS

HIGHLY SUITABLE MORERALLY SUITABLE MARGINALY SUITABLE CURRENT Y N.S PERMANENTLY M.S exceeding stony > 35 7/2 7 PATING N n Σ - H H Σ Z 5 J I 30 - 35 Sun flower Sunflower very story Seasame chick pea seasame Chickpea (19)3 Seasame Chickpa Chickpea Pepper CROP pepper Noug Pepper Noug beger Noug 5 SUITABILI RATING 16-30 91 3 Σ IZI Σ n V ZH 15-2 C(PG) A store Haricothean Somhum Havicotbean Haricothean Sorghum Songhum Sorghum RANGES CROP Maize Wheat Maize Wheat Wheat Maize Teff 184 7-1.5 Teff fairly story 6 91-8 7 VH- Very high emergy required I - Intolerant - Senditive M - Medium T - Tolerant 5 - Semaitire T - Tolerant M - Medium H -High M - Medium VL - Very low 70-75 0-5 210 mod- 1 hone び 9 Ŋ LAND CHARACTERISTIC UNIT Class hos/C ESP <u>elass</u> LAND CHARACTERISTIC 9.0 Allack by Sunface Frost Semsitivity Preparation Soil Teadure Slope Angle Staniness Seed-bed AKalizity Salinity CONDITION AFFICIANS GEAMINATION AND LAND QUALLY CLIMATE HAZARD **ESTABLISHMENT** LAD PREPARATION FLOOD HAZARD LANDQUALITY AND MECHANIZA-TION POTENTIAL TOXICITIES MACMENT ٥ 12 0 Do __ 0

AFFENDIX 2

EN S	ENVIORNMENTAL REQUIREMENT FOR CROP	REMENT FOR CROP	HARICOT BEANS			App	APPENDIX 2
No	LAND QUALITY	LAND CHARACTERISTIC	CLASSÈS	CROP	RATING	CROP	RATING
7	CLIMATE HAZARD	Hail Sensitivity	T-Tolerant	wheat	×	Noug	F
				+=+	- :	Seasame	۲
				Harresteems	Σ	nan-lomer	7
			VH - Very high toleance to Sal	inity Songhum		chieck pea	اـ
,		Tolerance to	H - High	Seriom (1 1	Nond	
<u> </u>	SALIMIT		Not - Low	Perios Y		Seasame	1
	race All channel to)	V2 - Very Low	121	-		
		oft to with a vital	s - Semaitive	Sorghum	×	Chickpea	ν¥
4	Sadicity	exchange complex	ı	Mary	ΩΣ	Nond	v) :
		with Na ions	T - Tolerant	13		Seamonne	€ ∨
				Harricot bean	n	Sum-Towner)
				Songhum		chiek pen	1
	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	(L - Low Tolerance	Marie	≨ -	Perper	NotKubers
5		ره (۵) کار	M - Medium Telerance	Wheat	Not Know	Seasonne	: -
-			H - High Tolenance	Hariestbeams	Not Know	Somflower	=
	Ĩ	Non Machanized	1 -) - un work input required		T X	Chickpea	Σ٦
-2	WORKABILITY	tarming (tillage)	M-Medium "	Misses A	-	Nous g	
intelligence (No. 1994). Well			H-High "	Tet.	T 5	Spagame	T I
on the second of the second of			•	Haricotbean	2	Suntioner	-
		Mechanizad	1-10W	Sovahum	***************************************	Chickper	T _
E	WORKABILI TY	faming (General)	M-Medium	ment to		None	1-1
and the same and t)	H-Kigh	五	× :	Sassame	1
				Haricolpeano		Sunflower	

ENVIORNMENTAL REQUIREMENT FOR CROP

SUNFLOWER

					RANGES	S OF SUITABILITY	<u> </u>	
% N	No LAND QUALITY	LAND CHARACTERISTIC UNIT	FIND	S) HIGHLY SUTABLE	MODERILY SUITABLE	A KGINAL	CURRENTLY NOT.S	REPUTATION S
					1200 - 1100	2501-2011	0201-2501	41000
***	TEMPERATURE	Altitude	ξ	1200-9000	2000 - 2200	2200 - 2500	2500 -2500	72800
	KEG!ME	Mean Temperature			19-21	81 - 51	11-01	0/ >
		(Mermal Zone)	S C	22 - 24	25 - 30	31 - 35	88-98	355
7	GROWING PERIOD	Length of Growing	day	90 -150	90-85	22-128	80 - 75	<75
	110.44	Effective Soil Dapth	Z	251-001	201-05	25-50	10-25	0/>
W	MOIS TURE AVAILABILITY				011-001	001-05	00 1	as \
		trouth choin	gos	04/- 0//	091-071	09/<	0/-00	0 0 \
,) Anna				7	d	d	VP
4	UKAINASE	Joil Wamage	Class	MW - M	SE	SE	П	2
	والمساورة	Maan Tamperature			12-51	15-18	71-01	01>
		(Thermal Zone)	ه ن	72 - 27	25-30	31 — 35	36-38	>38
L	DE GRADATION	Length of Growing	day	90-157	90-85	25-58	50-75	< 75
ر. د	HAZARD	Soil Texture	class	725 - 57	115	2.5	(hd)	$\subset (bl)$
		Stoniness	class	hone	fairly story	protes	Very stray	exceeding story
		Slope angle	%	2-0	91-8	16-30	30-35	>35 0
	(Soil Texture	Class	725-57	/iS	Sic	C (rd)	(191)
4	NUTRIENT STATUS AND	<i>-</i>	-		6.5 - 6.0	6.0 - 5.5	5.5-50	0.57
)	RETENTION	Soil Keaction	D.	6.5 - 7.0	7.0 - 7.5	7.5 - 8.0	8.0-8.5	78.5
		Ovgamic Matter	0/0	>3	2-3	7-7	7-0	
	ROOTING	Effective Soil Depth	S.	100-150	22 -100	25-50	10-25	6/>
<u> </u>	COND NOTIONAL	Stoniness	class	hone	fairly - strony	ptony	Very story	exceeding story
		Soil Toxture	elano	725-57	9 7.50	23.5	111/10 15110	3

EN	ENVIORNMENTAL	REQUIREMENT	FOR	FOR CROP SUNFLOWER	DWER			.	APPENDIX 2	,
N _O	LAND QUALITY	LAND CHARACTERISTIC UNIT	UNIT	HIGHLY SUITABLE MORERATLY SUITABLE MARGINALLY SUITABLE MARGINALLY SUITABLE MARGINALLY SUITABLE MARGINALLY SUITABLE	RANGES LORERTLY SUITABLE	ES OF SI	SUITABILITY SLYSUITABIL OIL	Y WIND SUN Y N.S.	NZ NZ KI	
Ċ	,	Salimity	man, hos/can	7-0	8-7	8-12	/2	12 - 15	+	2
α	IOXICITES	Alkalim; ty	ESP	9-0	01-9	- 0/	-12	12-15	715	T -
	MAGEMENT	Slope Angle	00	2-0	918	1630	30	30-35	735	
0-	LAND PREPARATION AND MECHANIZA-	staniness	Llass		fairly story	proto	-	very story	exceeding strong	3,
	TION POTENTIAL	Soil Texture	Class	725 - 502	8:1	Sic		C(vd) - C(bl)	P V	<u> </u>
S/N	LAND QUALITY	LAND CHARACTERISTIC	RISTIC	3	CROP		RATING	CROP	RATING	
				VH- Very high emergy required			エ	Chiekpea	۶	
<u> </u>	CONDITION AFFECTING	1NG Seed-bed Preparation		いまれて、五五十五			Σ	pepper		
2	ESTABLISHMENT			M - Medium "	Wheat	escripto de del del como de	エ	Noug	I	
				" mon - 7	to	PT-14-1-10-10-10-10-10-10-10-10-10-10-10-10-1	ΛΗ	Suntlower	I	
			a control and a second	VL - Yery law "	Haricathean		Σ	Seasame	ΥН	
				T - Tatolerant	Sorghum		×	chiek pea	×	
	(Maize	**************************************	Σ	Pepper	-	
	FLOOD HAZARD	ALACK by Sartach	م م م	T - Tolerant	MARGI		[]	Noug	H	•
		Walter			Tet		H	Seasame) – (
parameter and the second se					Haricotbean		Σ	Sumflower	Σ	
				5 - Sensitive	Sorghum		8	Chickpea	9	
					Maize		V	pepper	Ŋ	
7	CUMATE HAZARD	Frast Sensitivity	>		Wheat		n	Noug	∽	
n .				1 - lolerani	Tet		 	Spasame	V)	
m Pilipanas en el Millinnas					Havicotbeam	peam	S			
general three const			,	5 - Seneitive	Sora	Jum -	n	chiekpea	-	
accessed.	access.				Ma; 2e		ν.	pepper	Σ	
								W. W.	-	

ORNMENTAL REDILAND GUALITY CLIMATE HAZARD	ing	ENVIORNMENTAL REQUIREMENT FOR CROP No LAND QUALITY LAND CHARACTERISTIC 12 CLIMATE HAZARD Hail Sensitivity	SUNFLOWER CLASSES T-Toleyant	CROP Wheat Teff Harriot beans	RATING M T	CROP Noug Seasame Sunflower	APPENDIX 2 T T S T S S S S S S S S S S S S S S S
SALINITY Folerance to Salinity	Toleran Salini	tre to	VH - Veryhigh toleance to Salini, ty Songhum H - High M - Medium L - Low VL - Very Low Test	inity Songhum Moure Wheat Pepper	87427	Chieck pea Noug Seacame	111
Safura. Sadicity with N	Safura. exchance with N	Saturation of the exchange complex with Na ions	5 - Semeitive M - Modevately T - Tolerant	Songhum Maire Wheet Teft Havicotbean	ΣΝΣΣΝ	Chickpea Pepper Noug Seamame Sunflower	いえいくく
JOXICITY Ca Co 3	ره هه م		L - Low Tolerance M - Medium Tcherance H - High Tolerance	Songlum Marze Wheet Test Howestberno	L M L Not Know Not Know	Chiekpen Pepper Noug Seasanne SanHower	Not Kauses
WORKABILITY Non Mail	Non Mal	Non Machanized tarming (tillage)	2-20w workingutrequived M-Medium " H-High "	Songhum Marze Wheat Teff Haricot beam	ΣΙΙΣ	Chickpea Pepper Noug Seasame Sunflower	えーエェエ
WORKABILITY faming	Mechan	Mechanized faming (general)	L-Low M-Medium H-High	Songhum Marze Wheat Teff Harretbeano	TTTXT	Chickper pepper Noug Saasame Sunflewer	エコイノー

Nous

RENNALLY SUITABLE CURRENTLY NOT.5 13.00-14, 7-9 10-14, 7-9 29-31 32-34 100-110 90-100 100-110 90-100 100-110 90-100 100-25 33-35 31-32 33-35 100-110 90-100 25.01-5.0 (M)-0(b) 25.3-5.0 (M)-0(b)						RANGES	S OF SULTABILITY	TI	
TEMPERATURE Atti-tude	No I		LAND CHARACTERISTIC		HIGHLY SUTABLE	MODERTLY SUITABLE	MARGINALLY SUITABLE	CURRENTLY NOT.S	PERMANENTYNH.S
TEMPERATURE					<u>(</u>		12 cm - 1400		007/
NEGINE		TEMPERATURE		Ë	000/- 000/	_			
STAINF PRIOR Cont. C	-	KEGIME	Mean Temperature		100	13-17	71-01	4-6	47
GROWING FERNOD Lawring day 120 - 150 110 - 120 100 - 110 96-160 MOISTURE Effective Soil Bapth Com 50 - 100 35-50 10 - 25 - 6 MAILABILITY Greath Cycle day 120 - 150 110 120 100 1 JRAINAGE Soil Duainage Class MW - W SE P T VP T JRAINAGE Soil Duainage Class MW - W SE P T VP T JRAINAGE Soil Duainage Class MW - W SE P T VP T JRAINAGE Soil Duainage Class MW - W SE SE - 20 31 - 32 33 - 33 - 33 - 33 - 33 - 33 - 33			(Thermal Zone)	S		24-28	29-31	32-34	>32
MAILABILITY Specific Soil District Soil	7	GROWING PERIOD	Langth of Growing	day			0//-00/	001-06	< 90
MAILABILITY Greech Cycle day 120 - 150 110 120 110 90-100 100 110 90-100 100 110		1017/02	Effective Soil Depth	Ş	50-100	25-50	10-25		210
DRAINAGE Soil Desirage class NW - W I I I VP I DEGRADATION Length of Servains HAZARD CThermal Zone C 21-27 21-23 18-20 15-17 DEGRADATION Length of Servains HAZARD CThermal Zone C 21-27 28-30 31-32 33-35 HAZARD HAZARD Length of Servains Construction of Soil Texture Class SL-CL LS Sicl-Sic C(rd)-C(b) 100-120 100-110 90-100 90-100 90-100 90-150 10-35	3	AVAILABILITY	snowth cycle	day		1		001-06	<90
DMAINTREE		Joseph / -				I	I		Ţ
Maam Tampersture C	4	UKAINAGE		Class	MM - MW	SE	đ		J
DEGRADATION Length of Growing day C 21-27 28-30 31-32 33-35 HAZARD Length of Growing day 120-150 110-120 100-110 90-100 HAZARD Spil Taxture class 5L-CL LS Sicl-Sic C(rd)-C(b) Stonimess class hone favily story story story story NUTRIENT Soil Taxture class 5L-CL LS Sicl-Sic C(rd)-C(b) NUTRIENT Soil Reaction pH 5.5-6.7 LS Sicl-Sic 5.0-4.7 STATUS AND Soil Reaction pH 5.5-6.7 6.7-7.0 7.0-7.3 7.3-7.6 RETENTION Soil Reaction pH 5.5-6.7 6.7-7.0 7.0-7.3 7.3-7.6 ROTHUGH Effective Sil Reaction pH 5.5-6.7 2.7-7.0 7.0-7.3 7.0-4.7 ROTHUGH Effective Sil Reaction pH 5.0-100 3.5-5.0 6.7-0.7 7.0-4.7 ROTHUGH Effective Sil Reaction ph 5.0			Maam Tamperature		,	1	1	15-17	<1.5
DE GRADATION Length of Gnowing day 120 – 150 110 – 120 100 – 110 90-100 HAZARD Soil Texture class base 5L – CL LS Sicl – Sic C(rd) – C(b) Soil Texture class hane faible stand stony soil Texture class SL – CL LS Sicl – Sic C(rd) – C(b) NUTRIENT Soil Texture class SL – CL LS Sicl – Sic C(rd) – C(b) RETENTION Soil Reaction pH 5.5 – 6.7 5.5 – 5.3 5.3 – 5.0 5.0 – 4.7 ROTING Soil Reaction pH 5.5 – 6.7 6.7 – 7.0 7.0 – 7.3 7.3 – 7.6 ROTING Effective Sil Depth cm 50 – 100 25 – 5.3 2-1 1-0 ROTING Effective Sil Depth cm 50 – 100 25 – 5.3 3 – 2 2-1 1-0 ROTING Effective Sil Depth cm 50 – 100 25 – 5.3 5.1 – 5.0 1-0 -0 ROTING Effective Sil Depth cm <th></th> <td></td> <td>(Thermal Zone)</td> <td>ů</td> <td>21-27</td> <td>28-30</td> <td> </td> <td>33-35</td> <td>>35-</td>			(Thermal Zone)	ů	21-27	28-30		33-35	>35-
HAZAKD Seil Taxture Clas SL-CL LS Sicl-Sic C(rd)-c(by)		DEGRADATION	Length of frowing period	day	120 - 150	1		96-100	<90
Stonimess dass hone fairly story storiness das hone fairly story	· · · · · ·	HAZAKD	Soil Texture	elass	l	57	Sic/ - Sic	c(rd) - c(b1)	
NUTRIENT Soil Texture class 5.5 - 6.7 6.7 - 7.0 16-30 30-35 NUTRIENT Soil Reaction PH 5.5 - 6.7 LS 5.cl - 5: C(M) - C(b) STATUS AND RETENTION Soil Reaction PH 5.5 - 6.7 6.7 - 7:0 7:0 - 7:0 5:0 - 4.7 RETENTION Congamic Matter % >3 3 - 2 2-1 1-0 ROUTHWG Effective Soil Japth cm 50 - 100 25 - 5.3 5.2 - 7.3 7:3 - 7.6 ROUTHWG Effective Soil Japth cm 50 - 100 25 - 5.3 5.0 - 4.7 1-0 ROUTHWG Effective Soil Japth cm 50 - 100 25 - 5.3 5.0 - 4.7 1-0 ROWNTABILLITY Soil Toxture daa husae faish 5L - CL LS 5:cl - 5:0 5:cl - 6:0 5:cl - 7:0 7:cl - 7:3				class	hone	favily story	prom	very stone	exceeding strong
NUTRIENT Soil Texture class 5L - EL LS Sicl - Sic C(Md) - C(bl) STATUS AND RETENTION Soil Reaction pH 5.5 - 6.7 5.5 - 5.3 5.3 - 5.0 5.0 - 4.7 RETENTION Congonic Matter % >3 3 - 2 2-1 1-0 Ruting Effective Sil Bepth cm 50 - 100 25 - 50 10 - 25 1-0 Ruting Effective Sil Bepth cm 50 - 100 25 - 50 10 - 25 1-0 Ruting Effective Sil Bepth cm 50 - 100 25 - 50 10 - 25 - CONDITION AND Storingss ctoningss cha 50 - 100 25 - 50 10 - 25 - NORKABILITY Soil Texture cha 5L - CL LS C(M) - C(M) - C(M) - C(M) - C(M)			Slope angle	%		191-3	16-930		7350
NUTRIENT 2000 TOO 200 TOO 200			Soil Texture	Class		57		C(M) - C (b)	
RETENTION Soil Reaction PH 3:3 - 0.7 6.7 - 7:0 7:0 - 7:3 7:3 - 7.6 ROTING Effective Soil Depth cm 50 - 100 25 - 50 10 - 25 - ROTING Effective Soil Depth cm 50 - 100 25 - 50 10 - 25 - ROTING Effective Soil Depth cm 50 - 100 25 - 50 10 - 25 - ROMING Effective Soil Depth cm 50 - 100 25 - 50 10 - 25 - ROMING Stoniness chaa hore faidly stony stony 10 - 25 - Soil Texture diaa 5L - CL LS Sicl - 5ic C(M) - CU)	9	NUTKIENI STATUS AND		-			1	1	7.4.7
ROTING Effective Soil Depth cm 50 -100 25-50 10-25 - CONDITION AND Stoniness class have faisly story story story WORKABILLTY Soil Texture das 51-01 1.5 Sicl-5ic (C(A)-C(b)))	RETENTION	Soil Keaction	g.		6.7-7.0	7.0 - 7.3	- 1	>7.6
ROTING Effective Soil Depth cm 50-100 25-50 10-25 - CONDITION AND Storiness clad home fairly atomy story story WORKABILITY Soil Toxfure class 5L-CL LS Sic C(M)-C(b)			Ovgamic Mader	%	>3	3-2	2-1	0 /	
CONDITION AND Storiness clad home faidy story st		Rootive	Effective Soil Depth	₹	50 -100	25-50	10-25	1	< 10
56:1 Toxfure dia 56-CL LS 6 Sic/- Sic	<u></u>		Stoniness	Class		faidy stom	wota	very story	Oxceeding stony
				classo	- 1	0 57	Sic/- 5ic	C(A) - C(b))	76

7		1. N.S				Mony	>										•									
APPENDIX 2	Nz		210	715	>35	exceedingstony	S	RATING	٤.	1	I	工	٧H	2	<u> </u>	- F	۱ ۱	Н	Σ	9	Ŋ	v)	٧٦		- The state of the	>
	77	CU	01-6	12-15	30-35	very stony	c(M)-c(B)	CROP	Chickpea	pepper	Noug	Suntlower	Seasame	0 0 0 0	CMON POLIN	repper	Noug	Seasame	Sumflower	Chickpea	Pepper	Noug	Seasame	*	chiekpea	700000
	SUITABILITY	INALLY SUITABLE	6-2	10-12	16-30	water	1-8:c	RATING	I	Σ	I	= >	Σ	2	À	، ک		Н	Σ	V)	V	h		S	\$	1
	RANGES OF	MOREKTLY SUITABLE MARGINALLY SUITABLE		1 01-8	1 91-8	poteny	5.5 S	CROP			Wheat	764	Haricothean	Sorahum		Maine	Wheat	1484	Havicotbean	Sorghum	Maize	Wheat	7	Havicotheam	Sorghum	
Nous			2-9	8	<i>∞</i>	fairly	57 0		high emergy required	> } =		-			int	microscoperius	+-		-	ze.			+>	econdo selector de espera espera -	8	-
FOR CROP <u>NG</u>	\rangle \rangl	H16H	9-0	9-0	8-0		8	10	VH-Very high ex	では、エーエ	M - Medium	1 - Low	VL - Very low		I - Intollerant	M - Medium	T-Tolerant			s - Seneitive		M - Medum	T - Tolerant		5 - Semaitive	
FOR	CUNIT	The sale	hos/c	ESP	%	Llass	Class	RISTIC								0,0	7				r	•	۲۱۲ ۲۱۲۶			
ZUIREMENT	LAND CHARACTERISTIC UNIT		Salinity	Alkalimity	Slope Angle	Stoniness	Soil Texture	LAND CHARACTERISTIC	,	Sped-bed Droparation	10 10 10 10 10 10 10 10 10 10 10 10 10 1				-		Atack by sarrank	Water				-	Frast Seasifivity			
ENVIORNMENTAL REQUIREMENT	LAND QUALITY LAND		TOXICITIES				TION POTENTIAL S	LAND QUALITY		CONDITION AFFICING	ESTABLISHMENT					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	FIND HAZAKU					CONCILL TELLINO	- CARAIL TA 46.7		** A service of the service of th	496.
ENV	8		Ò	0		<i>a</i> -		92		(2											,	7		and the same of	

No LAND GAMITY LAND CHARACTERSTIC CLASSES CROP RATING CROP RATING 12 CLIMATE HAZARD Hail Sensitivity T-Tolerant United M Now of Tellipouse Scalinity T-Tolerant United M Scalinity M Norderstally North M Scalinity M Norderstally North M Scalinity M Northwest M Northwest M Scalinity M Northwest M Northwest M Scalinity M Northwest M M Northwest M M Northwest M M M Northwest M M M Northwest M M M M M M M M M M M M M M M M M M M		 	T							ļ —				<u> </u>	3				, , , , , , , , , , , , , , , , , , , 	Jun		1			
URRKABILITY MORKABILITY MORGABILITY MORGA	ENDIX 2	RATING			V	١	7	7		νΣ	V)	٤	√)	1	Not Knu	÷ =	£	Σ -	ı	I ,	II.	エ	- 1	1 1	1
VIORNMENTAL REQUIREMENT FOR CROP MOUSE LAND QUALITY LAND CHARACTERISTIC CLASSES CROP CLIMATE HAZARD Hoil Sensitivity T-Telerant wheat Salinity T-Telerance to M-Nedwin Polancto Salinity Socialum H - High Mouse to Mouse Saluration of the S-Sensitive Mouse Saluration of the S-Sensitive Mouse Mouse working to the M-Nedwortely Workability Toxicity Toxicity Non Madhanized M-Nedwin Mouse Machanized M-Nedwin Machanized M-Nedwin Mouse Machanized M-Nedwin M-Nedwin Machanized M-Nedwin M-Nedwi	APP	CROP	Nong	Seavame	Sun-lower	Chieck pea	Noug	Seasame		Chiekpea Peppen	Nond	Seamonne	Sunflower	chiek pen	Pepper	Noug	Santlower	Chickpen	Nous	Seasame	Sunflower	chick pen	papper	Noug	Sunflower
VIORNMENTAL REQUIREMENT FOR CROP NOUSES LAND GUALITY LAND CHARACTERISTIC CLASSES CLIMATE HAZARD Hail Sensitivity The Telepant Salinity The North Hail of the Sensitivity The Lead of the Salinity The High Made of the Sensitivity The Salinity The High Madeium " Lead to the Salinity The Salinity		RATING	Σ	-	٤	Z	<u></u>	r >	, 1	X	νΣ	Σ	b	1	∑ .	Not Kame	Not Know	7.	ΞΞ	エ	Σ	I	I I	= X	Antonios de la constitución de l
UDRNMENTAL REQUIREMENT FOR CROP LAND QUALITY CLIMATE HAZARD Hail Sensitivity Tolerance to Safinity Safinity Normalians complex Exchange complex Morkability Toxicity Workability Normadianized Machanized		CRAP	wheat	Teff	Harrietbeam	inity songhum	Monay	Wheat	Tellar P	Sorahum	More	7	Haricotbean	Sorghum	Marze	wheat	Horiestelems			Tet	Haricot beam	Songhum	Mary	Wheel Tel	Haricotheano
ENVIORNMENTAL REQUIREMENT FOR CRO No LAND QUALITY LAND CHARACTERISTIC 12 CLIMATE HAZARD Hail Sensitivity 13 SALINITY Folerance to Salinity Salinity Salinity Salinity WORKABILITY Non Machanized Non Machanized Machanized Machanized faming (fillage)	_	CLASSES	T-Tolerant						1	1	ı	1			1	1	1		M-Madium "	H-High "	>				
No LAND GUALITY 12 CLIMATE HAZARD 13 SALINITY 14 SQDICITY 15 TOXICITY 16 WORKABILITY 17 WORKABILITY 17	REMENT FOR CROI	LAND CHARACTERISTIC	Hail Sensitivity)			I loranto t	Salinity)	Saturation of the	exchange complex	with Na ions			,	ره (ه)		Non Machanized	tarming (tillage)				Mechanized f (Canaval)	(mary d) burn	
N N N N N N N N N N N N N N N N N N N	10RNMENTAL REQUI	LAND QUALITY	CLIMATE HAZARD					SALIMITY	:		Sadicity				71774				WORKABILLIY				WORKABILI TY		
	ENV	Š	7					<u>.</u>	i							52					act time on the				

	Γ-	T b	I	1	ı —	1	1	Ì												-					
7		17 N.	,	,	<u>م</u>	Stony	5																		
APPENDIX		DERMANENTLY N.S	25	7.57	75.0	Ox cooling stony	り	RATING	۶	7	I	I	>	٤	-	Н	Н	E	8)	V	v)	Ŋ		F	Σ
	177	HIGHLY SUITABLE MORERILY SUITABLE MARGINALLY SUITABLE CURRENTLY N. S	12-15	13-15	30-50	very stony		CROP	Chiekpea	Depper	Noug	Sun flower	Seasame	chiek pen	Pepper	Noug	Seasame	Sumflower	Chickpea	pepper	Noug	Seasam e		chiekpea	Depper
	SUITABILITY	INALLY SUITABL	8-12	10-13	16-30	prote	CL(b1) - C(b1)	RATING	工	Σ	I	3	Σ	٤	Σ	r-1	Н	Σ	V	V	'n	 -	Ø	'n	V
	RANGES OF	SUITABLE MARG	8-1+	01-9	8-16	Story	5c/ CL	CROP	Songhum	Maize	Wheat	10	Haricathean	Sorghum	Maize	Wheat	16#	Havicotbean	Sorghum	Maize	WARRI	Tet	Havicotbeam	Sorghum	Ma;3e
7年77		ITABLE MORERTL	+			2 fairly story	-7 (19) T		VII - Very high emergy required) <u>.</u>	lium II	3	1 CW 11	- Tato lexant	Medium	- Tolerant			Senaitive	- Medimm	-1	lolerani		Senaitive	Madium
FOR CROP			4-0		2-0.		D - 1.5	10	YH-Very	エーだれ	M - Medium	1 - Low	VI-Very	**	W - W	101-1			5 ~ 50	1		<u>0</u> 1 -		5-50	M - M
5		SS	hos/C	ESP	%	Class	Class	RISTIC								ACE ACE					7:10				芝
RUIREMENT		LAND CHARACTERISTIC UNIT	Salinity	Alkalimity	Slope Angle	Staniness	Soil Texture	LAND CHARACTERISTIC	-	seed-bed proparation						Affack by surface	water		-		Frast <pre>constituito</pre>				Hail Sonsitivity
ENVIORNMENTAL REQUIREMENT		LAND QUALITY LAND		10XICI11ES		LAND PREPARATION AND MECHANIZA-		LAND QUALITY		CONDITION AFFCTING	ESTABLISHMENT				!	FLOOD HAZARD					PUMATE HAZARD		•		
ENN		NG	Ċ	×	mana da Africa de Africa d	0-		No		9	2										~)			
	C								L																

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APP

工作工

ENVIORNMENTAL REQUIREMENT FOR CROP

					RANGES	S OF SUITABILITY	777	
2	NO LAND QUALITY	LAND CHARACTERISTIC UNIT		HIGHLY SULABLE	MODERILY SUITABLE MARGINALLY SUITABLE CURRENTLY NOT.S	S3 MARGINALLY SUITABLE	CURRENTLY Not.S	PRMANINTYNH.S
					1700-1500	1500-1300	1300-1000	<1000
****	TEM PERATURE	ATITODE	Ę	1700-2300	2300-2500	2350 -2600	2600-2800	72800
-	KEGIME	Mean Temperature	,	1	7/- 1/2	9C 76	70 35	01 >
		(Mermal Zone)	,)	13-20	21 -24			735
7	GROWING PERIOD	Length of Growing Deriou	day	90-120	90 - 70	70-60	60-45	745
	2007	Effective Soil Dapth	\$	> 570	50 -25	25-10	15-10	0/>
w	AVAILABILITY		_	100/100/	05-021	02-06	7	, , , , , , , , , , , , , , , , , , ,
		tremth call	day)	120-130	>130	0100	7.70
			•	701	I - P	D/1- d	Q/K	11
4	UNAINAGE	Joil Damage	Class	M - 7	W-SW	SW-E	1 /	O III
		Maan Tamperature	,	6	71-21		76 05	212
		(Thermal Zone)	,U	15-20	21 - 24	23 AU	6 / A	>35
L	DEGRADATION	Length of browing period	day	90 -/20	.02-05	70-60	60-45	< 45
)	HAZARU	Soil Toxture	class	Sil - C(bl)	75 - 7	C7 - C(91)	27	V
		Stoniness	dass	hone	fairly story	struy	Very satory	excueding story
		Slope angle	°°	8-0	21-8	16-30	30-56	>5-6
	1	Soil Texture	Class	$S_i/-c(b_i)$	75 - 7	CL - C(b)	75	b
2	NUTKIEN! STATUS AND	H	-	1	6.5 - 6.0	6.0 - 5.0	5.0-4.5	< 4.5
)	RETENTION	Soil Reaction	<u>о</u> -	6.5 - 1.0	7.0 - 7.5	7.5-8.0	8.0-8.5	7 8.5
		Organic Matter	%	3-6	3- 2 6.c - 7.5	25-10	9.0-10.0	> 10.0
	ROOTING	Effective Soil Depth	£	>50	50 -25	25-15	15-10	0/7
<u> </u>	MORKABULTY	Stoniness	class	hone	fairly stray	story	Very story	pacceding stong
		Soil Toxfure	clàro	Sil - C(b1)	75-7	CT - CC6U	, 750	200

		·						,			1						ten ti provincia de la comezión de la constancia de la co				
APPENDIX 2	RATING	<u> </u>	۲v	7		1 -	:	NΣ	V) S	E V	1	Not Kadew	: ÷	=	ΣΊ	工	エエ		= 1	71	1
APP	CROP	Nong	Seasame	13 mail	chieckpea	Noug	Jedeums	Chielspea	Nong	Sunflower	chiekpen	Pepper	Noug	Southower	Chick pea.	Noug	Spagame Sunflower		Perper	Nond	Sunflewer
	RATING	×	F 2	ž			7 7	Y	νΣ	Σν	-1	≨ -	Not Knoe	Not Karon	Σ	· 工:	ıΣ	3	- 1	τ Σ	=
	CROP	Wheat	Teff	Hanco Ceemo	inity Songhum	Mainze	Pepper	Songhum	Warze	Tett Haricotbean	Songhum	Marze	Wheat	Howiestbeams	·	Wheat	Teff Harinthean		Marie	white the state of	Haricotheano
O TEFF	CLASSES	T- Tolerant			VH - Very high toleance to sal	H - Hish M - Medium	L-Low V2-Very Low Test	s - Sensitive	I	T - Tolerant		L - Low Tolenance	١	H - Argh tolerance	2 - Low workingutraguired	M-Medium "	H-High		1	M-Medium 11-Kieh	
ENVIORNMENTAL REQUIREMENT FOR CROP	LAND CHARACTERISTIC	Hail Sensitivity	•			1 °	ऽबाजार	Sat 12 ration of the	exchange complex	with Na ions		ا ر ر	<u>۾</u> ع		Non Machanized	farming (tillage)			Mechanized	faming (general)	
IORNMENTAL REQUI	LAND QUALITY	CLIMATE HAZARD	,	0.000		SALINITY			Sadicity			X L I DIXVL			V+	NON MECHANIZI				WORKABILI TY	
ENV	No	12				2	neagatilliannangatilliannana.		4			ļ	-5			2	а дай то паподна гу удуг т о опита ам			E	

EN	ENVIORNMENTAL R	REQUIREMENT	FOR	FOR CROP MAIZE	1.13			APPENDIX 2
NG	LAND OWALI TY	LAND CHARACTERISTIC UNIT	E	ñ	RANGES	OF SUITABILITY	177	
2				HIGHLY SUITABLE MORERTLY SUITABLE MARGINALLY SUITABLE CURRENTLY N. S PERMANENTLY N. S	BERTLY SUITABLE M	ARGINALLY SUITABL	E CURRENTLY N.S	5 PERMANENTLY M.
Ċ	VHI HIOISOT	Salimity	hos/Ca	7 -0	8-7	8-12	12-15	5人
\sim	100101	AlKalimity	ESP	9-0	01-9	(0-13	13-15	7/5
	MAGEMENT	Slope Angle	60	2-0	8-16	16-30	30-50	`072<
0	LAND PREPARATION AND MECHANIZA-	stanine ss	Class	hone	fairly stony	mate	way stony	execeling stony
	TION POTENTIAL	Soil Texture	Class		75-157	Sic - c'(nd)	2(19) 2	S V
No	LAND QUALITY	LAND CHARACTERISTIC	SISTIC	Cl	CROP	RATING	CROP	RATING
				VH- Very high emergy required		T	Chiekpea	۶
<u> </u>	CONDITION AFFECTING	16 Seed-bed preparation		工一工		Σ	pepper	-1
2	ESTABLISHMENT			M - Medium "	Wheat	I	Noug	エ
		and a suit of the suit		1 - Low ==		H >	Suntlower	-1
			entergency processes - Only	VL - Very low	Haricatbean	M	Seasame	H >
				T - Tato levant	Sorghum	Σ	chiek pea	×
				M - Medium	Maize	Σ	Pepper	-
	FLOOD HAZARD	Affack by Jartack	7. 2.	T - Tolerant	Wheat	- 1	Noug	H
		Waltr			Tet	1-1	Seasame	Н
					Havicotbean	\ \ \	Sumflower	Σ
				s - Seneitive	S 019hum	8	Chickpea	60
	nold market Annaber	Anny Market Vinages			Maize	V	pepper	V
	PHMATE HAZARD	Toach Committee		i	Wheat	n	Noug	ν)
?			<u> </u>	T - lolerant	Teff	-	Spasame	v)
	nag ^{ha} Siginaliya kandan		······································		Haricotbeam	M		
				5 - Seneitive	Sorahun	ъ У	Chiekpea	F
		Hail Somsitivity	4	M - Madium	Ma;3e	ν,	pepper	Σ

					RANGES	YTI HATINY	<u>T</u>	
No	No LAND QUALITY	LAND CHARACTERISTIC UNIT		SI MGHLY SULTARLE	MOBERTLY SUITABLE	S 3 MARGINALLY SUITABLE	MONERALY SUITABLE MARGINALLY SUITABLE CURRENTLY NOT.S	ABMANENTLY NOT. S
			1		1300 -1200	1200 - 1100	000/-001/	
-	TEMPERATURE	Altitude	Ę	1300-2200	2200-2270	2270-2350	2350-2400	>2400
	KEGIME	Mean Temperature	,	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	21- 71	97 20	72 12	イネ
		(Mermal Zone)) ၁	5	24-26			>35
R	GROWING PERIOD	Length of Growing Derica	day	210-150	150-140	081-071	130-120	120</td
	7	Effective Soil Depth	\$	> 150	150 -100	25 - 001	30 -25	1 d 3 5
3	AVAILABILITY			16-140	09/- 051	251-071	3777	8
		trouth cacin	day	, , , , ,	170 -180	28/5	0 + / - 0 6 /	000
•	20100				d- I	$d\Lambda - d$	C .	1_
4	UKAINAGE	John Damage	Class	M 7	M - SM	SW-E	VF = E	UE R
a nor y Yannagiron Wighward		Maam Tamperature		r	14-17	05-76	7	カノフ
والمنافقة		(Thermal Zone)	ů	1919	9e- he		27 - 36	>35
L	DEGRADATION	Length of frowing period	day	210-150	0.41-051	140 - 130	130-120	6120
)	HAZAKU	Soil Taxture	class	7 - 50	75 - 57	Sic - c (rd)	c (b/)	h
		Stoniness	class	hone	fairly story	story	very stony	exceeding story
		Slope angle	%	& 70	191-18	16 - 30	30 - 50	0 05<
	1	Soil Texture	Class	7-50	75-57	Sic - c(rd)	C(bl)	Ŋ
2	NUTKIENI STATUS AND	; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	-	0.2 - 57	0.9 - 5.9	6.0-5.0	5.0 - 4.5	74.5
)	RETENTION	Soil Keachion	E Q.		7.0 - 7.5	7.5 - 8.0	8.0 - 8.5	> P. S
and park a support of the support of		Organic Matter	0/0	3-6	80-7.5	7.5 - 19.0	9.01 -0.0	0.0/<
	ROOTING	Effective Soil Japth	£	> 15-0	001-051	100 - 50	50-25	<25
<u> </u>	MORKABLI ITY	Stoniness	class	hone	fairly story	young	Very story	extending stony
analitikaanid		Soil Toxture	clàro		75 - 57	Sic - (c(Nd)	0 CODO	s sh

APPENDIX 2

APPENDIX 2

MAIZE

ENVIORNMENTAL REQUIREMENT FOR CROP

2	LAND QUALITY	LAND CHARACTERISTIC	CLASSES	CRAP	RATING	CROP	RATING
17	CLIMATE HAZARD	Hail Sensitivity	T- Tolerant	wheat	×	Noug	 -
		>		Teff		Seasame	
***********				Harristbeans	Σ	Sun-lower	S
			VH - Very high toleance to Sali	inity Songhum		Chieck pea	1
			エーエント	Show L		Noug	1
	SALINITY	Salinity	M Heardon Whard L - Low Pepiser	Deviser	۲ / ×	Seacame	1
	and the same of th)	VI - Very Low	Tett			
			< - Semaitive	Sorghum	W	Chickpea	νX
	Sabicity	SACHAMAO COMOSTAC		Marie	vΣ	Nond	V
<u>+</u>		with Na ions	T - Tolorant	1 2 2 4 5 4 5 4 5 4 5 4 5 4 5 6 5 6 5 6 5 6 5		Seamonne	Z
managhad shrapp de				Haricotbean		Sumflower	V
				Sorghum		chiekpea	1
		(L - Low Tolerance	Marze	≨.	Pepper	NotKur
5		د وع) مح)	M - Medium Telerance	wheat	7 1 1 V	Noug	-
-			H - High Tolerance	Horiest blums	Not Know	Santlower	£
		Non Machanized) -) Lin work in but has using		X 2	Chickpea	Σ-
91	WORKABILITY NON MICHANIZI	farming (tillage)	M-Medium "	Marze	ΞΞ	Nou a	
			H-High	持二	T 3	Spagame	エコ
				Haricotbeam	A second	Sunflower	-
		Moclos	mo7-7	Sorghum	= :	Chickpen	エ _
E	WORKABILI TY	faming (general)		men in the second	c I	Nond	1-1
arindana kadalahin kenada da arin			オード・チャ	12	X =	Sassame	1 -
				Harvelbeano	T.	Sumflewer.	1

Study Area/Project	:	_ASQSA	Field	Number:	Unit 1-17
Location / Coordinates	3 /	Weloga	rvakurratiyisiikkain sadadsar ettir too	alangan kandan kand	ay di dikuktigi yarang ang pay tingun kantu ana ang kirit bahin dina ana ana ang kirit di dina di dikutish ord

		Daget,		Textu	re, % (Ø= mm)		Texture	pH,	1:1	ln.	C0C03	Free
Lab. No.	Field No.	em.	> 2	2-0.2	0.2-0.05	0.05-	<0.002	Class	H20	KCI	NoF	%	%
855	A-1-L				51.6	16.0	26.4	ScL	6 05				
856	A-1-2	mariguet error antice surfre			35.6	12.0	52.4	C	5.75			1	
857	A-1-3				33.6	22.0	44.4	c	5.70				
858	A-J-3				37.6	10.0	52.4	C	5.35				
						-							

		Depth,		A COLOR DE LA COLO	Excl	rangsable	s, milliequiv	rolent / l	00gm s	oll			Base
Lab. No.	Field No.	em.	Na	K	Ca	Ма	Al+H	Al	н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat.
855	A-1-1		0.271	0.256	20	3						18.2	
856	A-1-2		0.217	0./28	12	2						13.2	
857	A-1-3		0.27/	0.192	14_	3_	-					15.6	
858	A-1-3		0.217	0.096	5	5			· · · · · · · · · · · · · · · · · · ·		-	15.4	
													

Lob, No.	Field Na.	Dapth,	Org.C	Tot. N %	c/ĸ	0. M %	Avail P ₂ O ₅ ppm	Avail, K ppm	Satur.	Field copacity %	Available H ₂ O %	ngunungan menjada di Mala Kalangan Pangal
855	A-1-1		-	0.252		5.969	0.8					
856	A-1-2			0.252		3.519	0.6					
857	A-1-3			0.196		5.589	1.4					
858	A-1-3			0.084		1.829	004	-				
												†
	Dote			an angles an aller delanger es derper		Chief of	Lab				 and the second s	

Study Area/Project	:	150SA	Field Number:	Unit 1-17
Location / Coordinates	:	Wolega	anakan melalikan ayud bar albi mada encembanan kenselirinin dapi meniliriliri kenselirinin	

	Field No.	Des. 1t.			re,% (Texture	pH,	1:1	in .	CaCO3	Free Feg Og
Lab. No.	Field No.	em.	>2	2-0.2	0.2-0.05	0.05-	<0.002	Class	H ² 0	KCI	NoF	%	%
859	A-2-1				55.6	28.0	16.4	54	6.50				
860	A-2-2				53.6	24.0	22.4	364	4.75				
			ļ										
			-		-						-		-
-	1		***************************************				1	†				1	

		Dupth,		magan a saasigamamamamamamamamamamamamamamamamamamam	Exch	angeables	, milliequiv	rolent / IC)Ogm s o	Ī			Base
Lab. No.	Field No.	cm.	Na	к	Ca	Ма	Al+H	Aì	н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat. %
859	A-2-1		0.27/	0.416	24_	1						23.4	-Cap - agricultura Aldrick (1977) consul
860	A-2-2		0.27/	0.128	5	Q						17.4	
		and the same of th			pagani sentilipentife anagemente, gifar has ti	**************************************		n agityanan in gastrapid ing may enterent in					,
			Trainblandade agains		AND SECURITY OF A PARTY OF THE SECURITY OF THE								

					haya daari ayaa ahka ka k				har tilligen, aptiggang a marine i state de.			<u> </u>	

Lab, No.	Field No.	Dapth, cm.	Org.C %	Tot. N	c/k	0. M %	Avail. P2 05 ppm	Avail, K ppm	Satur.	Field copacity	R W.P	Available H ₂ 0 %	Andrew Control of the
859	A-2-1			0.266	e and interference against the contract of the	6.452	1.6						por accompany or need about 200,000
860	A-2-2			0.238	demonstration and the second s	3.347	0.04	************					erneckenskildelski stere e _{ve} f
								1					
	Dote	pringermente d'Algebrage (Progréssion MANS), de			re somewhat the religions of the second	Chief o	f Lab	Madell Matter - saa-			tings to be a second address of the second second second second		~

	y Area stion/Co				A So Weled	SA Ja	\$	ield i	Num be r		Un.	it 1-	17
		Dest:		Textur	e,% (Ø= mm)	ge speinteilinig na en grietingskat na en grietingskat i state en grietingskat	Texture	pH,	1:1	in .	Cc CO3	Free Feg O
Lab. No.	Field No.	ens.	> 2	2-0.2	0.2-0.05	0.05-	<0.002	Closs	H50	KCI	NoF	%	%
861	A-3-1				The street was a second or the second of the	26.0	28.4	CL	6.30				
862	A-3-2				55.6	18.0	26.4	Sch	5.55				
		, dag selper the explore supplications in			e alledijalisti eranavailista sa. v								-
													
Principal Princi	1												
						The Section of Contract Contract	******	 	ļ				
												1	
**************************************	Plant sta	Dapih,			Exc	hangsables	, millienu	ivolent /	100gm \$0	sit .			Base
Lab. No.	Field No.	cm.	Na	к	Ca	Mg	Alth	Al	н	Sum	C.E.C. Sum	C.E.C. Det.	Sature %
861	A-3-1		0.271	0.256	25	5						26.2	
862	A-3-2		1.217	0.096	12/	9					 	20.4	
006	HAD: E	†	10,20	0.020		1-/						20.	
-		-	.	<u> </u>	ļ					-			-
**************		 			-					 	 	-	
	-	·			<u> </u>	-		-		-	 		
	- 			1	-			1	1				
			The control of the state of the										
Lab. No.	Field No.	Depth,	Org.C %	Tot. N	C/N	0. M %	Avail. P2 05	Avail. K ppm	Satur.	Field copocity %	RW.P	Avaitable H ₂ O %	
861	A-3-1	-		0.266		8.142	1.2						
862	A-3-2	-	-	0.168	-	5.451	4 11			-	 	-	-
<u> </u>	1000			10.100	-	3.731	+: +	1			-		1

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		-	_	 			 	-} -	_		-		
~~~~	Date	1		1			1			1			

Study Area/Project	:	<u>ASOSA</u>	Field	Number:	Unit 1-17
Location / Coordinates	:	Welega	yr. ar endandddion ar gynny i gold ogg	glud voca inflanting in quantitation of Algebrasia - Alge	tanta di matikingangan ani usi dingan panin-terangga kari sebaha persepiran sebenggapan sebas sa padapan 27-per 1

		Dasit,			re,% (Texture	pH,	1:1	in .	C0CO3	Free
Lab. No.	Field Mo.	em.	>8	2-0.2	0.0-3	0.05-	<0.002	Closs	H ₂ 0	KCI	NoF	%	%
863	AHI				-	26.0			5.93	•			
864	A-4-2			ļ	39.6	16.0	44.4	c	5.40				
865	A-4-3		-		33.6	10.0	56.4	<u>c</u>	5 .85				
	1												
	-												

		Depth,			Exct	rangeables	, milliequiv	ralent / IC	Ogm so	H			Base
Lab. No.	Field No.	cm.	Na	ĸ	Ca	Ма	Alth	Al	н	Sum	C.E.C.	C.E.C.	Saturat.
863	A-4-1		0.217	0.128	26	4						12.8	
864	A4-2		0.217	0.128	//2	3				-add-According and graphy are offer		25.6	
865	Ð-4-3	The state of the s	0.217	0.128	10	4						24.2	
	 												
			1										

Lab, No.	Field No.	Depth, cm.	Org.C	Tot. N %	c/k	0. M %	Avail. P ₂ O ₅ ppm	Avail. K ppm	Satur. %	Field copacity %	RWP	Available H ₂ 0 %	
863	A-4-1			0 182		5.313	1.6		1				
864	A-4-2			0.14		4.382	1.0						
865	A-4-3			0.048		3.243	8.0						
			and the state of t			e ignaria dianampanya (diana							***************************************
								1			<u> </u>		

Stud	y Area	/Proje	ct :		A502	SA	F	ield !	um be r	. :	Unit	t 1-	17
	tion/Co			taganasan	ASO. Weley	ja		politicam actività i ritti di politica di	utanamanya sasananana	······································			
	•				C	,					•		
		Daget,		Textur	•,% (Ø= mm)	mgf indirektild medit vikromyttekti	Texture	pH,	1:1	In	1 1	Free Fe ₂ O
ab. No.	Field No.	≪ns.	> 2	2-0.2	0.2-0.05	0.05- 0.002	<0.002	Closs	H ^S O	KCI	NaF	%	%
866	A-5-1				59.6	20.0	20.4	SeL	6.20				
							-	ļ					
			a. organistics, and coefficiency concerns										
									!			-	ļ
								 	 			 	
	 	,,,	·					-	<u> </u>		****		

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	T		1		~~~~~ ~~		-					···	T
		Depth,			Exc	hangsables	r, millioqui	ivalent 🖊	100gm sc	ii			Base
Lab. No.	Field No.	cm.	No	к	Co	Мо	Alth	Al	н	Sum	C.E.C. Sum	C.E.C. Det.	Sature %
866	A-5-1		0.217	0.288	24	6					1	20.8	
			-	ļ	1							-	
	-												-
-			-		 			_	-				ļ
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- The state design of the state of the stat			n, Andrewski speciming activ	ak-tuara-r			n harr -againstan-arenna		***************************************				And and a second
Lab. No.	Field No.	Depth, cm.	Org.C	Tot. N	C/N	0. M %	Avail. P ₂ O ₅	Avail. K	Satur.	Field copecity	RW.P	Available	
822	1		-	A AFA		-		+	-	1			
866	A-5-1	·		0.252	<u> </u>	7.314	1.2				-		+
	-	1				+		-	_	<u> </u>	†	-	+
10.0° 0.0° 0.0° 0.0° 0.0° 0.0° 0.0° 0.0°	1		1		1		1			1			
			1	1							L	T	T
		<u> </u>										management and a second	
データー (1975年 - 1975年		-				es de esta bacantiquationes							
						na ne a rapada den como na troide	arrio a constitución de consti						
						en er van han tarrengstellandskring ng at a vanskring der er er er er er er er ng at a van han betyde er							

Study Area/Project	:	ASOSA	Field	Number:	Unit 1-17
Location / Coordinates	:	Welega	estantina de la companio de la comp	gydnychlangarysedddaena ydd haarnd felf i brish adames ig	- A-Galak karaturun dapuk adapuk arint katalak karaturun darin darin darin karaturun dari darin

		Dagit,		Textu	re,% (Ø= mm)		Texture	, · •	1:1	In .	C0C03	Free C-
Lab, No.	Field No.	ens.	> 8	2-0.2	0.2-0.05	0.05-	and the second of the second of the second		H ₂ 0	KCI	Naf	%	%
86Ŧ	A-6-1				119.6	18.0	32.4	Sch	5.95				
868	A-6-2				47.6	24.0	28.4	Sc.E.	5.75				
869	A-6-3		-	-	45.6	12.0	42.4	<u>_c</u>	5.10				

						e de la companya de l							

		Depth,		Exchangeables, milliequivalent / 100 gm soll										
Lab. No.	Field No.	cm.	Na	. K	Co	Мо	AI+H	Al	н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat.	
867	A-6-1		0.217	0.544	17	4						19.4		
868	A-6-2		0.271	0.192	15	5	- and the Military of Military and the con-	- martin salah di didak di didak di didak di	kuntatio, jagu kunga sak night giri mka n I			19.8		
A69	A-6-3		0-217	0/28	8	2	·····································	j nghaj nazis pasista di nganga naha saba				11.8	ļ	
	1						, a constante de la constante							
			1						***************************************				1	

Lob. No.	Field No.	Dapth, cm.	Org.C	Tot. N %	C/N	0. M %	Avail. P ₂ O ₅ ppm	Avail, K ppm	Satur.	Fleid copacity %	RW.P	Available N ₂ 0 %	
867	A-64		-	0.21		6.762	6.0						
868	A-6-2			0.154		5.865	1.6		-				
869	A-63	-		0.126		3.45	0.3						
			1			editya yaki ya kalip difikada ekalipata isto yaki yaki kalipata isto kalipata (hi	e y kuluajain diagonis	 			***************************************		
		†				estra di matalanta disembatikan matalan da salah s		oranga yannga sehiyahalir 1 mi			-	-	
	Dote	<u> </u>				Chief o	l Lab				<u> </u>		 -

Study Area/Project	:	ASOSA	Field Number:	Unit 1-17
Location / Caardinates	:	- Welega	en distributions device effer registry distribution date of speed on the distribution of the state of the	

inh Na		Dagt:,		Textu	re,% (Ø≈mm)		Texture		1:1	In .	C0C03	Free Fee O =
Lab. No.	Field No.	em.	> 9	2-0.2	0.2-0.05	0.05-	<0.002	Closs	H20	KCI	NoF	%	Fe ₂ 0 ₃
940	AFT.			-					6.10				
87.1	A-8-1				55.6	22.0	e ca contra establece name escret annimatica contra establece establece	50L	5.65				
* Administration and the						- service de la company de la	e-ctulolik salas establikan					-	·

		Depth,	Exchangeables, millienvivolent / 100 gm soil										
Lab. No.	Field No.	cm.	Na	K	Co	Мо	AI+H	Al	Н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat. %
870	A-7-1		0.217	0.256	20	10	are elektriski grade saman garden elektris are elektriski grade saman garden elektriski g		- Angelegen (Agent Agent) - Angelegen (Agent)			27.4	
					rae forthered - etagetterrysderi	in and the continues on a property of the continues of th	, arabara, kipinga, kippen da baka. Laur da digitaran bakan da dibarahada a		e omage. All en skilvin onight with the e	The state of the s			
	A-8-1		0.217	0.096	12		egydd A _{r e} gyddiddig ydd digolaet Pennad Ar ysgodiogo dlor y capyl mei han ymend Ar wellon y ddi Geney dly chyyddiae i y	erian persona archinagente contra con				15.6	
ker dikeraka dikadikan apara apara sara sara sara sara sara sara sara						a - Agust de myr ng dat di diddi ana, tri di tripajak sebuat Maran tri di didiran di tripajak diddian digi sebuat di tripas tribas.	de - Merceloneau e de Politico en cons atratago - desprendo entre entre ent	en Bestrangskriften ist film met konstigen Militer i Greffigen en militer i Steffinder grejf (Denny - c	ene spaniseder Albertagbegeren.				
	+	}	1	<u> </u>							1		

Lab. No.	Field No.	Dapth, cm.	Org.C %	To1. N %	C/N	0. M %	Avail. P ₂ O ₅	Avail, K ppm	Satur.	Field councity %	R W.P	Available H ₂ O %	
270 	A.7.1			e de la companya de l		ender om vorregenskommenskommer 	The state of the s						
										en de series de después de la companya de la compan	grandinaritani da historia da distributura da		
	A-8-1				1 W 1 W 1 W 1 W 1 W 1 W 1 W 1 W 1 W 1 W	n var	2.5	The transmission of the second of					
						co di coministria. Maja mongozami o balinco Si e giro condino co cynolika kaci e da gradin	n vi go i golde a steppensydelensyde olden ei Troden i 1804	Bernalden State (*) Antonio	kura karanga sa ka pisa daga an sa Aranga sa kabunda karang a ka nga banga sa ka			er og det er fragstar og det storet er starten for det storet er storet er storet er storet er storet er storet	
	Dote				a Laure ween research	Chief o	/ Lab	Arranaministra	ingender – vor sig i de parte selpside kajang væreter Manuschille die seiner i dienskrivingskom væreteren V				

NATIONAL SOIL SERVICE PROJECT MINISTRY OF AGRICULTURE Addis Ababa

Study Area / Project	.	ASOSA	Field	Number	Unit 1 - 17
Location / Coordinates	:	<u> Welega</u>	and the state of t	asadinin in Principal paga yang digit melalah salah hiji hijikhin Melaksa e melahin apadan di	julik yahig sala neserantu, da unikalikhasaka SAFAHRO samahari nahanggari saha su sankan du du i

	Field No.	Dest:		Textu	re,% (Ø= mm)	**************************************	Texture	рН,	1:1	ln .	CaCO3	Free
Leb, No.	Field No.	em.	>8	2-0.2	0.2-0.05	0.05-	<0.002	Class	H2 0	KCI	NoF	%	Fe ₂ 0 ₃
872	A-9-1				3.6	26.0	20.4	SeL	5.90	e er er eine er			
843	A-9-2				63-6	20:0	13.4	34	6.50				
874	A-9-3	- igagggga managan kanagan abar per 1990 ya Pangan kin hidungan di pangan abar dan pengan			39.6	8.0	52.4	<u> </u>	5.55				
875	A-10-1				38.6	20.0	40.4		5.65		***		
876	A-10-2				29.6	6.0	24.4		5.45			****	

		Depth,	Exchangeables, milliequivalent / 100 gm soll										
Lab. No.	Field No.	¢m.	No	К	Ca	Мо	AI+H	Al	н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat.
BIA	A-9-1		0.217	0.192	18	2	en de la constitución de la cons		a anagimente republicano e			16.0	
113_	11-9-2		0.217	0.128	19		er i constitui delle este delle e					18.8	
BILL	A-9-3		0.271	0.128	7	i i i i i i i i i i i i i i i i i i i		- ngh _e antin siryesiya gajangganag addin d Siryesiya ng 2,460 yadang ada- aba- he				13.8	
895	A-10-1		0271	0.128	10	5	e conferencia esperiale de algunero e q					11.0	
876	A)-10-2		0.271	0.046	7	3	era - Sanakole - Alakole -					10.4	

Lab, No.	Field No.	Daptii, cm.	Org.C %	Tot. N %	C∕N	0. M %	Avail. P ₂ O ₅	Avail, K ppm	Satur.	Fleid corncity %	R W.P	Arailable H ₂ 0 %	
872	A-9-1						2.4	ļ					
973	A-2-2					oraș prințered redificățieșie planțimaterii Prințe redirinte Alfandaliție liceție resp	0.6						
874	A-9-3			0.112		3.519	1.4						
8 75	A-10-1			0.154		5.21	1.4		ari a dinakirina digirikada di majaha Barajara sa masasa di mahinda di di	a part of state of the state of	and an artist of the second se		
316	A-10-2					arag i majanak kudhan wananda in 20 Milya Majan di wakaka kuta kuta kuta kuta kuta kuta kuta	4.9		angunda nia 1940 ku a ngandana kangga an Kan-T a n-Kan Kanada kunah an ana			-	
***************************************	Dote					i Chief o	/ Lab		and we consider the second				

4

Study Area/Project	:	A505/1	Field	Number:	Unit 1- 17
Location / Coordinates	:	ulelega	alian di Salaman Salay ay ay ay ay ay a	हेकृतिकार्ष्यक्षीतमञ्ज्ञात्रकारम् व्यवस्थानं व्यवस्थानं वृत्ताः वृत्तीः वर्षत्यः पृष्टिविकारम् स्टब्स्यस्य स	

erromente en	Field Str.	Desit,		Textu	re,% (Ø= mm)	randa basi arrec ray 1 dilib 26. Dilib	Texture	pH,	1:1	ln.	C0C03	Free Fe ₂ O ₃
Lab. No.	Field No.	em.	> %	2-0.2	02-0.03	0.05-	<0.002	Class	H ₂ 0	KCI	NaF	%	%
877	ALLI				33.6	32.0	114.4	52	6.05				-
RIE	A-11-2				49.6	18.0	324	SCL	5.85				
879	1-11-3				48.6	12.0	44.4	C	3 .33				
					-	 Pittingendytteleiningene Magnetine om en en							
						er i roma, oligi erdilgiyalirili Palaigua vot saçın.	enterfection on their effects						

		Dapth,		Exchangeables, milliequivalent / 100 gm soll										
Lab. No.	Field No.	cm.	740	к	Co	Ма	AITH	Αl	н	Sum	C.E.C.	C.E.C. Det.	Saturat.	
XYE	A-11-1		0.217	0.416	16		an and analysis of the self-bearing of	- contraction, was despite any collect and	, dag en alle sind gerickhein in gelle tribby och vor e generalle tribby sind sind tribby var et sind ver de sind sind sind sind sind sind sind sind	era etter verstisse sinskthispun ett i		25.0		
37E_	A-11-2		0.217	0.196	JŦ.		- 1873 - 1827 BB HB - ANGER VAN BBC S Grade Let Hillerine EN Alpha Minister C	ong meneral dikanining selangan penganpan Langkan kanina dikining milik meneral m	errelation explorite light of a thick global other a	and the second and second and second and		11.0		
ष्टाव	A-11-3		0.434	0.096	8	en e	- Brownie, it sprzyciali rhadzesta rowanie Langua w 1960 Mei protospoje w 1964 antoni	。	engenser signere en estat haspe o			20.6		
			-				A No. 1986 1 (Alfred)		or over the electronic and the e					
Pro est confection for confection for the second section of the section of the second section of the section of the second section of the section o		garantan serina yapinadan in di s				Andrew Street Street Street Street	a 14 - ag 16 agorda a	Triansi Mariagia (California de 1997)						

Lah. No.	Field No.	Dapth, cm.	Org.C	Tot.N %	C/N	o. m %	Avoil. P _B O _B	Avail. K ppm	Satur.	Field corecity %	Available H ₂ O %	
BILL	A-11-1		ļ	0.196		6.555	1.8			- Michigan Sayaran Marketina (Michigan Marketi		
178	A-11-2		1	0.154		1.898	1:24					
917	A-11-3			0.126		3.657	0.04	en is managed dat i an digundament	ger gr. ne er fleden eyngelikkeringle-var – konseptigeri Pr	e de employe en escriber apparatual de est e		
and district the second se Second second						The state of the s	n - sovo Parodas das as deservi - consistencia de Casaldona de Casald	ver man expension ver more				
			-			Andrew Comment				-	 <u> </u>	
	Dote				a grande statem es estate	Chief of	/ Lab	to the territory of	and and the second		-	***

Study Area/Project	;	ASOSA	Field	Number:	Unit 1-17
Location / Coordinates	:	Welega	an allina or lightlighten ligare ray o geller de	gar yn naidd rhigwegowyg o nen'n raes brown nei'nddirig Globadiau salen sa fy	pand distribution and appear individual behind the artist in management and account and an experience and an e

Field No.	Dast.	The first of the contract of t					Texture	pH,	1:1	In	C0CO3	Free
Field No.	em.	>8	2-0.2	02-0.05	0.05-	<0.002	Class	H20	KCI	Nof	%	%
A-12-1	,			50.4	33.6	16.0	L	5.85	e er y son digen opfense stjere yn di			The second secon
A-12-2	-		1	40.4	326	20.0		5.40	in i de-riggge metar higas, -e-a, gira in g-ad-scriptus right atanapanyan un			-
A-12-3				54.4	31.6	14.0	SL	5.50	ja, marka appenistrika, populatio at appenistrika	k der de se septembles gewegt erigere		Aye and the second seco
1-12-4				52.4	67.6	20.0	12	5.75				1
					and making along ballogue and street county and representation of the street county and street county							
	A-12-1 A-12-2 A-12-3	Field No. Cm.	A-12-1 A-12-2 A-12-3	Field No. Dasy::, cm. >9 2-0.2 A-12-2 A-12-3	Field No. 2007. A-12-1 A-12-2 A-12-3 50.4 A-12-3 54.4	Field No. Dags:, cm. >2 2-0.2 02-0.05 0.05-0.002 A-12-1 50.4 33.6 A-12-3 40.4 37.6 54.4 31.6	Field No. DRS 12. 2-0.2 02-0.05 0.05 <0.002 A- 2- 50.4 33.6 (6.0	Field No. Dayler, cm. >9 2-0.2 02-0.05 0.05- 0.002 Class Class	Field No. $\frac{\text{Dagst.}}{\text{cm.}}$ >2 $2-0.2$ $0.2-0.05$ $\frac{0.05-0.002}{0.002} < 0.002$ $\frac{\text{Closs.}}{\text{Closs.}}$ $\frac{\text{H}_2 \text{O}}{\text{Closs.}}$ $\frac{\text{A}_{-1}2-1}{\text{A}_{-1}2-2}$ $\frac{40.4}{39.6}$ $\frac{39.6}{20.0}$ $\frac{1}{14.0}$ $\frac{5.40}{5}$ $\frac{40.4}{31.6}$ $\frac{39.6}{14.0}$ $\frac{14.0}{5}$ $\frac{5}{5}$	Field No. $\frac{0.65^{++}}{600}$, $\frac{0.05^{+-}}{600}$, $\frac{0.05^{}}{0.002}$, $\frac{0.002}{0.002}$, $\frac{0.002}{0.0$	Field No. Dagle Texture Class H2 0 KC1 Nof	Field No. $\frac{\text{Dags.}}{\text{cm.}}$ >2 $2-0.2$ $0.2-0.05$ $\frac{0.05-0.002}{0.002} < 0.002$ $\frac{\text{Clown}}{\text{Clown}}$ $\frac{\text{H}_2 \text{O}}{\text{KC} \text{I}}$ $\frac{\text{Nof}}{\text{Nof}}$ $\frac{\text{Nof}}{\text{No}}$ $\frac{\text{A}-12-1}{\text{A}-12-2}$ $\frac{40.4}{39.6}$ $\frac{39.6}{20.0}$ $\frac{14.6}{14.0}$ $\frac{5.40}{5.50}$

	Field No.	Depth,		Exchangeables, milliequivolent / 100 gm soff										
Lab. No.	Field No.	cm.	No	к	Co	Мо	VI+H	ΑI	Н	Sum	C.E.C. Sum	C.E.C. Det.	Saturot. %	
980	A-12-1		0.271	0.096	12		a na pina kaka kaka kaka kaka kaka ka					17.4		
381	12-12-2		0.325	0.128	8	2. <u>2</u>	, spiraga kupi dalimit organizationing year (9.6		
882	升12-3		0.271	0.224	16			e ighunne en geltregeljeligelige velkteringel grundlighelige filmfalligheljeligheljelige van d	enemen derey fordelse generalisch floren und			15.0		
883	H-12-4		0.217	0.128	14		a. Lajún Lith Órandalago na nagastasan cu a. Lajún Lith Sandalago na nagastasan cu	o., i s. k.c. unspillingspyske sien stad steph Konsultagigading eisteriansgeröffen.				15.0		
	-		 			and the second control of the second control	a ide deste i deste a gia i deste della con	e-manufacturis appropriate de la compactica de la compact						

Lab, No.	Field No.	Daptii, cm.	Org.C	Tot. N %	C∕N	0. M %	Avoil. P _R O _B ppm	Avail, K ppm	Satur. %	Field copacity %	R W.P	Available H ₂ O %	
880	A-12-1					- Same and the second s	0.8				er erveterbagene sonattebalerte pysistekken De erveterbagene begrettere gegen e d		
681	A-12-2			0.112		3.002	0.04		er eine er eine gegen die eine geben der eine geben				
882	A-12-3			0.154	a paragraphic de la paragraphi	4.83	1.2						
883	A-12-4			0.168		5,279	1.2		on a finish remaining disease or remaining				
					n graega i innert til ngjytnyn no mit min	er i geriget dage westere i systematis.	alectic city and the contract		angun annu i sider u againdheach dhannainn a				
rikalitystyriski lygy estudiau halptunaunyu	Date				A MARINE SERVICE AND ARTHUR ARTHUR AND ARTHUR AND ARTHUR ARTH	Chief o	/ Lab			and the same transfer and the same transfer and the	<u></u>		

Study Area/Project	:	ASOS)	Field	Number:	Unit 1-17
Location / Coordinates	:	Welega	, egan i sili <u>angana</u> e desi <u>n, e</u> i séon e s	· · · · · · · · · · · · · · · · · · ·	rissa sajantinan 4 meranda mangan mangan kenangan kenangan pengan pengangan menangan pengangan pengangan penga

		Daget,		Textu	10,%	Ø = mm)	real reconfiner regards bit species	Texture	р Н ,	1:1	In	C0CO3	Free Feg 03
Lab, No.	Field No.	ens.	> 5	2-0.2	0.2-0.05	0.05-	<0.002	Class	H20	KCI	NoF	%	%
884	A-13-1				54.4	21.6	1810	1	5.60	terresis esta esta esta esta esta esta esta est			
385	A-13-2			*********	52.4	25.6	28.0	SEL	7.00	- Colored Address and Colored			
en sittersione dyktopionyskit representation og						e en	1957年1月1日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日						
						ngan sang aya dan dinangganagan dan dinangganagan kan dinanggan dan dan dinanggan dan	e e na filosofie e de la desta de la desta de la desta de la del de la deliminación deliminación de la deliminación deliminación de la deliminación de la deliminación de la deliminación deliminación de la deliminación						
			-	-	englere et egeneration place et communication de la communication	is tigh Wilpinda differences according	-modelikaskan ar-krose-Alkimbir;	ale alementu agaire. Alemen Africa	g	t estampentopositopositoposi	Trajection and proper to the contract of		
- convergence and activity of the					-	Para establica de la seguira d	and the state of t		1				1

	Field No.	Depth,		Exchangeables, milliequivalent / 100gm soll											
Lab. No.	Field No.	cm.	Na	ĸ	Co	Ма	AI+H	Al	Н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat.		
884	A-13-1		0.217	0:192	10	2	na or dintraga anggaranggana	anagement in serve and reserve				10.6			
885	A-J3-Z		0:217	0:888		2	er en engelsky kristerie konstigerier was die e					9.2			
gertieren begen der gester gereichte gereichte der gester					ngari a Manadi nanga kanada na dalam na gag	entres appears to the tree figures demonstrate and	erregada i grafici filologica popularente, accesso de maser agalentes de colonia escala filologica e	e de como esta esta esta esta esta esta esta esta	and the second s						
						en' - Alling and divident polyhelikan a ga	- Name of the State of the Stat								
	1	<u> </u>	1				}								

Lab. No.	Field No.	Dapm, cm.	Org.C	To1, N %	c/k	O. M %	Avail. Pg Og	Avail. K ppm	Satur.	Fleid copacity %	R W.P	Avaitable H ₂ O %	music graph Frigangemus Philosopa.
2874	A-13-1		1	0.126		3.864	0.8						
885	A-13-2			0.154		3.208	1.0						_
							an angle shake ya makan	A TO STATE OF THE PROPERTY OF	The Street Stree				
gener Mariyası ayın veri angazırının dayası asalasının						an gara, marita (1886-1886) belgada begada b	Service of the servic	no maka y ka ilima kangkaley yakaley	o d an a so uge a conjugat distributo colitico.	a franchista () o cambining and construction of the cambining and cambining an			
engistetti osaanisistetti osaagastaania, araantaania. Naisto totainin ayaatiista yoo ayaa araanisista							- construids of Prop. of colorograph		. Letter and the separate and the separa				
	Dote			· · · · · · · · · · · · · · · · · · ·	more and annual syndia.	Chief of	Lab	nest hands after the second second	Marting officery of the Agric agric and a second		And the state of t		**

Study Area/Project	:	ASOSA Weloga	Field	Number:	Unit 1-17
Location / Coordinates	:	Weloga	- Antonio de Maria de	anna a's sgaigeallachaire agus agus an mBhainnin aig ann agus agus agus agus agus an san an a	paragadas para indipatron ya angula sumbula paragamenten his sederatura na apatata hasa se indipatro festivo t

	Field No.	Dast:		Textu	re,% (Ø= mm)	and the second second second second	Texture	рН,	1:1	in .	CoCO3	Free Fe ₂ 0 ₃
Lab, No.	Field Mo.	em.	>8	2-0.2	02-0.05	0.05-	<0.002	Class	H20	KCI	Nor	%	%
886	A-14-1				36.4	19.6	24.0	5cL	5.90				
₹88	A-14-2				60.4	21:6	18.0	54	5:70				
888	A-14-3.		-	-	56.4	19.6	24.0	Sc4	5.75	a Tayla, aggland (Ar. Marahilla Sta.			
						and all departments of the contract of the con	a mendering distribution and a general design was						
	<u> </u>		-										

		Depth,			Exch	angeable	, millioquiv	rolent / IC	Ogm 40	ii			Base
Lab. No.	Field No.	cm.	Na	к	Co	Ма	Al+H	Al	Н	Sum	C.E.C. Sum	C.E.C. Det.	Saturet.
886	A-14-1		0.27/	0.192	12	agagagasa etirologiki - siisib ti 			alvandi nalganarina, idaa isid va cid	y ay, inneggyaliyakan ay daliya bilibili ay in yoʻl iliga estarilgada sarib ilibi yosa mon		17.0	
887	A-JU-2		0.217	0.128	9	iya dashar o oo ahaa sababbiilgan dasabbi	o produktivní kora kjerněji – vajejsko se a aktivi V produktivní kora kjerněji – vajejsko se a aktivi	in open en e		and the second s		13.4	
888	A-14-3		0.217	0.256	6_	a usa yakta te nga mping-uting-reksa ya	- na konstalik. Za lakostarojikostalikalikalikalikalikalikalikalikalikalik	, gykjanasi ja Mikipija saina ir Mantyd John Maria in Mika Mikipija saina ir mini	annahiruph-upppungspilakunga tilipidaria: ar. harmitalkung spilipindar ligip si libeda h. n	and the state of t		10.2.	
			-			to to a processor or the first of the second section of the section of th				e en applier regeneration est			
	1		1			a governi i terresidi independente fe						-	

Lab, No.	Field No.	Dapth,	Org.C	Tot. N %	C/N	o. m %	Avail. P ₂ 0 ₅ ppm	Avail, K ppm	Satur. %	Field conacity %	RWP	Available H ₂ O %	
286	A-14-1			0.126		14.278	3.2						
887	A-14-2			0.126		3.829	1.0						
888	A-14-3	-		0.154		4.106	0.8	to the state of th	and a strike on the strike of	and a control of the applications about			
alphia directo anticologic de la colonia di serie di La directo di La di La directo di La differenza di La directo di La differenza di La directo di La dire						anting and many representative of the contract	an si bansanah samera		en i i en anticalario giudicario e estable. -	ery self-en-configuration enter a self-configuration en-			
						and an appropriate to problem the propriet con-	B-rigila titiggs sissificinggesiaferatori a-rigilaringgs a fisc , silpradpingati	era - yamuluk sehisakkir - y ma		The second secon			
handele fallenge seje anleg se anne anne	Dote					Chief o	marings of the endoughed marin	icher den der	en i direktira sasan teri cenandan katalan Marana darah cenandan dan dan dan dan darah Marana darah cenandan dan dan dan darah dan darah dan darah darah darah darah darah darah darah darah darah d				p.

Study Area/Project	:	ASOSA	Field	Number	4mit 1-17
Location / Coordinates	:	Welegan	: २१: र न्यानीवास्त्राम् राज्योक्षास्त्राः व्यक्षाः र्या	den de seu de seguir es se se de trades de sedas es se seguir de se se seguir de des seguir de seguir de segui Se seguir de seguir es se se de trades de seguir d	iras, eta sympäitätä eringana erunkuntiissin kisäkiseinasyy erinäänny, esekagyyntiin vai vaihystynin, justus

		Dest.		Textu	re,% (Ø= mm)		Texture	pH,	141	in	C0C03	Free Feg Og
Lab. No.	Field Mo.	em.	>8	2-0.2	0.2-0.05	0.05-	<0.002	Class	H ₂ O	KCI	NoF	%	%
889	A-15-1		-		60.4	25.6	14.0	SL	5.85	an constitution of south spirits and			
8.10	A-15-L				46.4	11.6	36.0	SC	5:45				
801	11-15-2	Andrew Control	 		60.4	29.6	10.0	SL	5.50	g sammany være sprender his			-
802	A-15-2		1		54-4	23.6	22.0	ScL	5.65				
893	A-15-3		 		78.4	1.6	20.0	Sch	5.50				
894	A-15-3				42.4	5.6			5.75				
Problem and appropriately the state of the s	·	 	}			And the second of the second	and the state of t						

	Field No.	Depth,	Exchangeables, millienuivalent / 100 gm soll										
Labi No.	Field No.	em.	740	к	Co	Ма	ALLE	Αl	Н	Sum	C.E.C. Sum	C.E.C. Def.	Saturot.
801 840	A-15-1		0.271	0.736	16	4		- Company of Parishing Assessment	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	7, 1114, 1114		22.0	
840	11-15-1		0.217	0.320	12	0	and the state of t			Control of the Contro		11.2	
		***			hogos mangering grant con	. c. es approximation	· Component families for	****					
891	A-15-2			D-224	8	2	- Lung a property consideration con-	a the same and the first state of the same and the same a		-	1	16.2	
892	A-15-2	The same of the last of the la	0.271	0 224	18	2-	· S	les and the transplant of the copies were				17.0	
- 239	A-15-3		1 3 3	1		o as, godalance	Commission of the state of the	in the state of the state o	e et a merchant and annual participation and		and a second second		
803	alfa dip activities and the col	}		0.192	15	Lan observation	N. S Charles S. Mallion on the Ch. Photon - etc.	- Contract of the Contract of		-	-	19.0	
- DIE	A-15-3	ļ	10.217	0:128	4	2	- A-Wall - Manager - American	-		-		111.4	
	1	<u> </u>	 		upraero regigiolotrosco-der un isi	- 1 - desentanteles sale	- A		}	-	ļ		

Lab. Na.	f ield No.	Depth, cm.	Org.C	To1, N %	c/N	о. м %	Avail. P _R O _B ppm	Avail, K ppm	Satur. %	Field copacity %	P W.P	Arailable H ₂ 0 %	
989	IA-15-1			0.21	and the second	4.795	1.2		-				
890	A-15-1			014		3.519	1.0						
891	A-15-2		1	0.14		3.46	0.6				***************************************		
892	A-15-2			0.182	energia e de maria de la composición dela composición dela composición de la composición dela composición dela composición de la composición de la composición dela composición de la composición de la composición de la composición dela c	5.348	1.0						
893 814	A-15-3 A-15-3			0.182	, m. 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	4.658	9.4		-			-	
844	A-15-3			10.042		1.07	0.4						
gging, go o Page Migreganin - 4 mily			-	-		and the state of the state of the state of	and the second s		No. of Street, someone over the state of the			-	

NATIONAL SOIL SERVICE PROJECT MINISTRY OF AGRICULTURE Addis Ababa

Study Area/Project	:	<u>ASOSA</u>	Field	Number:	Unit 1-17
Location / Coordinates	•	<u> Welega</u>	and the second second	gaydina cirthyrrigan a ag godd rhaesir againnigan agringiff a'd gadhallin a bourta, narda rh	

Lab. No.	Field No.	Dest.	Texture, % (Ø* mm)							1:1	In .	CoCO3	Free Feg Og
			> 2	2-0.2	0.2-0.05	0.05-	<0.002	Clous	H20	KCI	NoF	%	%
895	A 16-1				50.4								
846	A-16-2				52.4	9.6	38.0	54	5,40				
					eng ge standigte ford differ hids say anyon is								
						al erga das edosabelettes a escen		A ALTERNATION AND THE STREET					
	1			1	1	, protectivation Hope - ve sca es alte	***************************************	***************************************		1	1	-	

		Depth, cm.	Exchangeables, millienuivalent / 100 gm soll										
	Field No.		740	к	Ca	Mg	AI+H	Αl	н	Sum	C.E.C. Sum	C.E.C. Det.	Saturat.
895	A-16-1		0.217	0.096	9	1	ann degine sakang daga daga daga daga daga daga daga d	Laboration of Capacita	a than die militaria de participa de la company			13.8	STATE OF STA
876	A-16-2	andra dipulpulpulpulpulpulpulpulpulpulpulpulpulp	0.271	0.128	10		a - pionesi Majo Mhiddes ngagija nada dha d an cina cina Mhidden ana na gapajija nasu abana	o, sayayi nashari, Maridi Shidi ya hadi mahari ee sa	kardukis, elik-spissoles ilgik spissoles i providira algus sepingilgal algus delesio			15.6	
						enementalister och det til 14-16-16-16-16-16-16-16-16-16-16-16-16-16-	ik kansada sak sak sakkada sakkada da sak sak sak sak sak sak sak sak sak sa	e spirante de productiva de la composición del composición de la composición del composición de la composición de la composición de la composición de la composición del composición de la composición del composición del composici					
			1			en an <mark>dere</mark> and an indicate state of a second	ay - ramatura Marijacolas da scrigidación o s a - collipsolitic NAMA, o r - 4, ya ar colore socio		, in an about paying and paying and a second paying a				
						Andrew Andrewski (1994)	ar-klikk - sligte op ; sku - reke ret						

Lab, No.	Field No.	Daptit, cm.	Org.C %	To1. N %	C/N	/0	Avail. P ₂ O ₅ ppm	Avail. K ppm	Satur. %	Field corneity %	₽ ₩.₽ %	Araitoble H ₂ O %	
895	A-16-1		-	0.168	en ji magalakan din ayu sheesan iy alga i'	3.933	0.6	-					
896	A-16-2			0.126		3.83	0.4					er generaliste til ett ett ett ett ett ett ett ett ett et	
Militaria indica de consultación magaza e a Mario del Mario de participa de la companya de la co						_{ar} a _r - c'equ ande a rrendes	Alembardelitaja kalkulususia usta nyilää siikintäikuulla yksiksias	or the second control of the second control					
				an de caracter especie co lonidade que de combre o polonio cienquisi) mediques desidendos que en o polonio cienquisi) mediques desidendos que en		ng ganagana dinagnakan dinagnakan ber ng ganaganan dinagni sepanak nabbuhi ng ganaganan nabbuhi	. O - o o o o o o o o o o o o o o o o o o	, a fina contratigue antido terrorio del tratto i non dicina distributo della mone i i i antido programa a secondo di antido della distributo i il antido	n - Serie ya Manazaria Administra wa Manazaria na Manazar				

4

Study Area/Project	:	195051	Field	Number:	Unit 1 - 17
Location / Coordinates	:	<u> </u>	rramanamentonas e Sapa na - affirmad	general statement and statement and which comment and statement and statement are statement.	وه المراقعة والمراقعة

Lab. No.	Field No.	Desit, em.		Textu		Texture	pH,	i:I in			Free Feg Og		
			> 2	2-0.2	0.8-0.08	0.05-	<0.002		H20	KCI	NoF	%	%
877	A-17-1			-	1324	£:6	60.0	<u>.</u>	5.30				
848	A-17-1				36.4	39.6	240		6.35				
899	A-17-2				34.4	29.6	16.0	SL	6.00				
900	A-17-3				62.4	17.6	20.0	SCL	3.85				
Parks de la Spelling anné de la companie de la comp	-					e meddigweddiaeth is nit nyth o'r syfr e chindheatyn mae'n Consequent							

Lab. No. Field N		Dapih, cm.	Exchangeables, milliemrivalent / 100 gm soll										
	Field No.		Na	к	Co	Мо	AI+H	Al	Н	Sum	C.E.C.	C.E.C. Det.	Saturat.
697	A-17-1		0.217	0.064	8	2 miles	properties announce de la company de la comp		, the control of the	en e		19:0	
ष्ठ०क	ATT-I		0.325	0.416	31	enter i se	1900 - 1919 Hospito - Jappieč sila silani 10-10 - 10 Million ani K. ilijapiesitnija an	к — қорғалд теп ж ақ арам анау д фо рму. - 1 м ж а ра 1873 ж ануы ны 1884 ж. Қаза торы	erromanisterromation references			23.2	
899	A-17-2		0.217	0.256	20	10	e resulte de la calenda como por actual de la como como como como como como como com	n englis de pendinali aproblem en enco				28.8	
900	A-17-3		0.217	0.128	16		in a site handeret i kongelegen och	i — 50 k a ce rmanya ng me k 1 0 baga ma	te e e en e	n en		18.0	
The State of the S				e-dag ibbaggapyening anappagaet, an	ter tage gate distance from the control of the cont	e victoria e esperar in considera e e e e e e e e e e e e e e e e e e	Sirahilih segan dan melantukan me	erran variation experimental and all of the second			en e		

Lab. No.	Field No.	Depth,	Org.C	Tot. N	c/N	0. M %	Avail. P ₂ O ₅ ppm	Avail. K ppm	Batur.	Fleid coracity %	RW.P	Avaitable H ₂ O %	
89F	A-17-1			0.182	-	5.244	0.04						
वयष्ट	AHH			0.224		Ean-6	24			ing a stranger of the decided Making winner			
219	A-H-2	ļ		0.252		3.14	1:0	e de la companya de l	en de un anadestronisticativas.				
900	A-17-3			0.21		5.196	1.2.						
						or a gentler des construeções despesadores.							
Billion d'alles ap lices de la greco done a deprendença sion	Dote	1				i Chief of	Lab	A TOTAL AND A STATE OF THE STAT	and the state of t				_

Landscape Unit No: Rn²g/1

Geomorphology : Hilly plains comprised of undulating plains

and low plateaux with a substantial porpor-

tion of low to moderate relief hills -

western highlands.

Total Area : (km²)

Remarks Landscape Unit: In southern Kefa this unit extends into

drier elimates and soils grade to chronic

cambisols.

Significant Land Facet: Undulating plains and low plateaux

Soil Management Unit No: 8

Area (%) km

Geology : Gneisses, granites and associated felsic

materials

Slope range (%): 2 - 8

Soil

FAO classification : Dystric nitosols

Colour : Dard reddish brown to dark red

Texture : Clay to clay loam

Drainage class : Well

Rock outcrop : None

Surface stones : Fairly stony

Effective depth (cm) : >150

pH : < 5.5

OM (%) : 3-10

CEC (me/100g) : 35-70

Avail P (PPM) : <5

Dominant vegetation and/or land use: Most commonly shrubbed grassland

with peasant and nomadic livestock grazing and browing rainfed state farm cultivation of cereals and pulses at Nekemte. Intensive rainfed peasant cultivation and open woodland in

western Welega.

Remarks: (Significant Land Facet)

Landscape Unit No. Rng²/2

Geomorphology

See above

:

Total Area (km²)

See above

Remarks (Landscape Unit)

Significant Land Facet:

Rolling plains and low plateaux

Soil management Unit No. 60

Ceology

Chelsses, granites and associated felsic

materials

Slope range (%)

8 - 16

Soils:

FAO classification

: Dystric nitosols

Colour (moist)

: Dark reddish brown to dark red

Texture

: Clay to clay loam

Drainage class

: Well

Rock outcrop

: None

Surface stones

: Fairly stony

Effective depth (cm)

; > 150

рН

: < 5.5

OM (%)

1 3 - 10

CEC (me/100g)

35 - 70

Avail. P. (PPM)

: **<**5

Dominant Vetetation and/or land use: Most commonly shrubbed grassland with peasant and nomadic livestock grazing and browsing; intensive rainfed peasant cultivation and open woodland in western Welega.

Remarks (Significant Land Facet).

Assosa 3

Landscape Unit No. Rng²/3

Geomorphology

: See above

Total Area (km²)

: See above

Remarks (Landscape Unit)

: See above

Significant Land Facet:

: Low to moderate relief hills

Soil Management Unit No.

: 71

Area (%)

: (km²)

Geology

: Gneisses, granites and associated felsic

materials

Slope range (%)

: 16 - 30

Soils:

FAO classification

: Arthic acrisols

Colour (moist)

: Reddish brown to dark red

Texture

: Clay to sandy clay loam

Drainage

: Well

Rock outcrop

: Fairly rocky

Surface stones

: Stony

Effective depth (cm)

: 100 - 150

рΗ

:< 5.5

OM (%)

: 3 - 10

CEC (me/100g)

: 10 - 35

Avail. P (PPM)

: <5

Dominant Vegetation and/or land use: Most commonly shrubbed grassland

with peasant and nomadic livestock grazing and browsing. Intensive rainfed peasant cultivation and open woodland in western Welega.

Remarks (Significant Land Facet)

Dystric nitosols occur.

Assosa 4

Landscape Unit No: R9g¹/4

Geomorphology : Hilly terrain of moderate to high relief

with a substantial proportion of moderately sloping valleys interspersed throughout -

western highland.

Significant Land Facet : Moderate to high relief hills

Soil Management Unit No.: 113

Area (%) : km²

Geology : Gneisses, granites and associated felsic

materials.

Slope range (%) : 30 - 50

Soils:

FAO classification : Orthic acrisols

Colour : Reddish brown to dark red

Texture : Clay to sandy clay loam

Drainage class : Well

Rocky outcrop : Rocky

Surface stones | Stony

Effective depth (cm) : 50 - 100

pH : ₹5.5

OM (%) ; 3 - 10

CEC (me/100g) : 16 - 35

Avail. P. (PPM) :<5

Dominant Vetetation and/or Land Use: Shrubbed grassland with peasant livestock grazing and browsing.

Landscape Unit No.: Rng²/5

Geomorphology

: See above

Total Area (km²)

: See above

Remarks (Landscape Unit)

Significant Land Facet

: Small valleys

Soil Management Unit

Area (%)

 (km^2)

Geology

Gneisses, granites and associated felsic

materials

Slope range (%)

: 0 - 8

Soil:

FAO classification

: Dystric Nitsols

Colour

: Dark reddish brown to dark red

Texture

: Clay to clay loam

Drainage class

: Moderate to poor

Rock outcrop

: None

Surface stones

: None

Effective depth (cm)

: >150

рН

: <5.5

OM (%)

: 3 - 10

CEC (me/100g)

: 35 - 70

Avail. P (PPM)

: <5

Dominant Vegetation and/or Land use: Most commonly shrubbed grassland with peasant and nomadic livestock grazing and scattered scrub grass

vegetation and reverine trees.

Remarks (Significant Land Facet)