APPENDIX – III

AGRICULTURE

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AGRICULTURE

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1. Kudu Dam Irrigation Project

1.1 Soils

1.1.1 Soil Survey

(1) Objective

The objective of the soil surveys was to identify existing soils, their extension and to classify the study area with irrigability.

(2) Field Work

The aerial photos taken at 1:50,000 in 1996 and were enlarged to a scale of 1:20,000 were used in the survey, which was carried out over the period of 7 December 1998 to 20 January 1999. Soils were examined by means of auger borings to a depth of 120 cm, hard weathering rock or impenetrable gravel, whichever was shallower. Some 350 auger observations were made in this survey. At each auger site, the following soil and land features were recorded.

- soil depth
- the nature of material limiting auger penetration if the auger was stopped before reaching 120 cm;
- the nature of soil horizons;
- soil texture of each soil horizon as determined by hand texture method;
- permeability characteristics;
- color of mottles if present;
- presence of gravel on soil surface or within the soil profile;
- presence of rock outcrops in the area represented by the auger;
- vegetation of the area in which the auger was sited;
- drainage characteristics of the soil as indicated by soil colour, presence of mottles, and/or iron manganese segregation.

The locations of these auger sites were recorded on the 1:20,000 aerial photos. On the basis of these observations, the soils occurring in the study area were classified into soil categories. Boundaries of each of soil categories were delineated on the 1:20,000 photos.

Eighty-one (81) soil pits were dug in representative locations in the survey area to typify the different soil types that had been identified and mapped. These pits were subjected to full pedological descriptions.

It must be pointed out that in this soil survey, emphasis was placed on the mapping of potentially irrigable soils. Areas that comprised non-irrigable soils were not mapped.

(3) Laboratory Soil Analysis

In this soil survey, 187 soil samples were collected from some of the 81 pits. These were submitted and analyzed at the laboratories of the Chemistry and Soil Research Institute, Harare for chemical and physical analysis.

(4) Soil and Land Classification and Mapping

The soils of the study area were classified according to the Zimbabwean soil classification system[1]. This classification system was devised by local pedologists and is different from soil classification systems used elsewhere in the world. At present, this system is only used in Zimbabwe. To assist readers who are unfamiliar with the local classification system, correlation was made with other international soil classification systems such as the United States Department of Agriculture (USDA) Soil Taxonomy system; and the FAO system, which is the basis of the legend of the soil map of the world. Each of the 81 soil pits has been classified according to three systems. Similarly, each of the soil categories that were distinguished was also classified according to the three systems. The 1:20,000 soil maps were digitized using PC ARC INFO and reprinted at the required scale of 1:50,000.

1.1.2 Survey Results

(1) Soils

(a) Previous Soil Studies and Reports

There are the following six previous studies of soils in the proposed irrigation development area for Kudu Dam. Most of these studies were localised and associated with feasibility studies for small to medium dams and similarly small to medium sized irrigation schemes. The reports and maps from these previous studies were studied prior to field work for the soils.

i) The national soil map of Zimbabwe at a scale of 1:1,000,000 and the accompanying handbook entiled "a guide to the soils of Zimbabwe", 1978

ii) A series of feasibility studies for irrigation development by a dam on the Mtanke area and by a dam site on the Seki river, early 1980s.

iii) The soils report in the area between the Gwanyika and Mutannke rivers, Gokwe Communal Lands. Chemistry and Soil Research Institute, Harare, 1988

iv) A report on the soils of Umniati Ranches between the Kudu dam site and Sanyati irrigation estate, Gatooma district, Chemistry and Soil Research Institute, Harare, 1982

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[1] Thompson and Purves 1978a, A guide to the soils of Zimbabwe, Zimbabwe agriculture journal technical handbook No3.

v) A supplementary report on the soils of ARDA's Sanyati estate, Chemistry and Soil Research Institute, Harare, 1982

vi) The master plan study on the Lower Munyati basin agricultural development, JICA, 1995

(b) General Description of Soils of the Study Area

There is a strong relationship between soils and geology in the survey area. The parent materials have influenced much of the soils physical and chemical characteristics. The lower Munyati Basin is a "low leaching" environment because of the low effective rainfall it receives. Most soils in the survey area are derived from Karoo sediments. Other parent materials include mafic rocks (i.e schists, dolerites, basaltic greenstones and andesitic metasediments) and alluvial materials deposited by Munyati river and its tributaries.

(c) Soil Categories

Nineteen (19) soil categories were distinguished and mapped for the study area. Phases of some of these categories were also distinguished. The main features of each of these soil categories and their phases are presented in the following table.

Identified Soil Series in the Study Area

Soil Categories	Soil Group	Effective Depth,cm	Average Texture	Drainage	Slope %	Erosion	Irrigability	Mottles
1a	Fersiallitic	150	mLS over SaCL/SaC	well	flat	slight sheet ero.	class B	
1b	Fersiallitic	150	mLS over SaCL/SaC	well	2-3	moderate sheet ero.	class B	
1c	Fersiallitic	120+	mSaL over mSaCL	moderate well	flat	slight sheet ero.	class B with some D	
1d	Siallitic	120+	f-mLS to SaC	moderate well	flat		class B	
1e	Fersiallitic	120+	light to medium	moderate poor	flat		class C	
1f	Fersiallitic	120+	mLS or SaL to SaCL	poor	flat		class D	exist
1g	Fersiallitic	120+	mLS to clay	poor			class D	exist
2	Weakly Fersiallitic	120+	mLS/mSaL	moderate well	flat to gen. undulating	slight sheet ero.	class B	
3	Siallitic	120+	mLS over SaCL/mSaC	well	flat to gen. undulating		depend on chemistry	
4a	Siallitic	60-100	clay	well	flat	slight sheet ero.	class B	
4b	Siallitic	120+	clay	poor	flat	slight	class B/C	
5	Fersiallitic	60+	clay	moderate well	flat	no	class B/C	
6	Vertisol	120	clay	poor	flat	no	class D	
7a	Lithosol	60-120+	clay	well	flat	slight sheet ero.	class B/A	
7b	Siallitic	40-120	mSaCL over mSaC	well	flat		class B with some C	
7c	Fersiallitic	40-60	clay	well	flat to gen. undulating		class B	
7d	Siallitic	25-40	clay loam	well		slight sheet ero.	class C/D	
8a	Fersiallitic	150+	mLS over SaC to clay	well	flat		class B	
8b	Siallitic	120+	mSaL over mSaC to C	moderate well	gently undulating	slight sheet ero.	class B/C	
8c		150+	mLS over SaL	well	flat		class B	
9	Fersiallitic	120+	f-mSaCL over f-mSaCL	well	flat	gully erosion	class B	
10	Fersiallitic	120+	mSaCL to C	well to mode. well	flat		class B	
11	Fersiallitic	120+	m-cS to LS	moderate well	flat to gen. sloping		class B/C	
12	Fersiallitic	120+	f-m SaL over SaCL to SaC	mod. Well mod. poor	flat		class B/C	exist
13	Siallitic	60	f-m SaCL over f-m SaC to C	well	flat	slight sheet ero.	class B	
14	Siallitic	120+	LS to SaL	well	flat		class A/B	
15		120+	coarse sand	well	flat	gully and rill erosion	class B/C	
16	Fersiallitic	120+	clay	mode. well	flat		class C	
17	Siallitic	120+	fSaL over f SaCL	well	flat to gen. undulating		class B	
18	Fersiallitic	140+	m-cSaL over SaCL	well	flat	slight rill	class B	
19	Fersiallitic	120+	m-f SaL over SaCL to C	moderate	gently undulating		class C/B	

The study area was assessed for their suitability for irrigation using the current Zimbabwean system devised by Thompson and Purves[2]. According to this system, the irrigability of a soil is determined by considering:

- soil group
- soil texture
- effective soil depth;
- max. surface depth of medium to coarse grained sand and loamy sand
- permeability
- the topography of the land on which the soil is situated;

[2] Thompson and Purves 1978b, The assessment of the suitability of soils for irrigation. Zimbabwe agricultural journal 76: 123-126

- drainage expressed by the existence of mottles.

The detailed criteria for the land classification for irrigation are given in the following tables.

Land Suitability for Irrigation

	Irrigability Class	Profile Irrigable Values	Topography
A	Suitable for irrigation without special practices	More than 90 % are 1, remainder mainly 2	Less than 2 % uniform slopes.
B	Suitable for irrigation with special practices	More than 80 % are 2, or better	Less than 5 % slope relatively uniform, or less than 3 %, if slope is not uniform.
C	Very ristricted suitable for irrigation	More than 80 % are 3	Less than 8 % slope.
S	Excessively pervious sand of very restricted suitability	More than 80 % are 4.	Less than 8 % slope.
D	Unsuitable for normal irrigati	Other areas	

Source: Rhodesia agri. J. Vol. 76(3)

Profile irrigation values were determined in the following tables.

Irrigation Value for Profiles without Sharp Change in Permeability

Irrigation Value	Soil Group	Average Soil Texture	Soil Min. Effective Depth(cm)	Max. Surface Depth of Medium to Coarse Grained Sand and Loamy Sand(cm)
1	Siallitic	*clay to sandy clay loam	120	10
		*sandy loam	150	10
	Fersialliric	*clay to sandy clay loam	120	10
		*sandy loam	150	10
2	Siallitic	*heavy clay	45	40
		*clay to sandy clay loam	50	40
		*sandy loam	60	40
		*very fine grained micaceous sand and loamy sand	90	40
	Ferrallitic	*clay to sandy clay loam	90	40
		*sandy loam	120	40
	Fersialliric	*clay to sandy clay loam	60	40
		*sandy loam	75	40
		*very fine grained micaceous sand and loamy sand	90	40
3	All soils	*heavy clay	20	90
		*clay to sandy clay loam	30	90
		*sandy loam	40	90
		*very fine grained micaceous sand and loamy sand	40	90
		*medium to coarse grained sands and loamy sands	50	90
4	All soils	*medium to coarse grained sands and loamy sands	180	no direct limitation

Source: Rhodesia agri. J. Vol. 76(3)

Irrigation Value for Profiles with the Restricted Permeability of 0-2 mm/hr

Irrigation Value	Soil Group	Average Soil Texture	Soil Min. Effective Depth(cm)	Max. Surface Depth of Medium to Coarse Grained Sand and Loamy Sand(cm)
1	Siallitic	*clay to sandy clay loam	150	10
		*sandy loam	180	10
	Fersialliric	*clay to sandy clay loam	180	10
		*sandy loam	180	10
2	Siallitic	*heavy clay	30	40
		*clay to sandy loam	90	40
		*very fine grained micaceous loamy sand	150	40
	Ferrallitic	*clay to sandy loam	150	40
	Fersialliric	*clay to sandy loam	120	40
		*very fine grained micaceous loamy sand	150	40
3	All soils	*heavy clay	20	90
		*clay to sandy loam	30	90
		*very fine grained micaceous loamy sand	40	90
		*loamy sand to coarse grained sand	50	90
4	All soils	*loamy sand to coarse grained sand	180	no direct limitations

Source: Rhodesia agri. J. Vol. 76(3)

Irrigation Value for Profiles with the Restricted Permeability of 2-5 mm/hr

Irrigation Value	Soil Group	Average Soil Texture	Soil Min. Effective Depth(cm)	Max. Surface Depth of Medium to Coarse Grained Sand and Loamy Sand(cm)
1	Siallitic	*clay to sandy clay loam	90	10
		*sandy loam	180	10
	Fersialliric	*clay to sandy clay loam	120	10
		*sandy loam	180	10
2	Siallitic	*clay to sandy clay loam	30	40
		*sandy loam	60	40
		*very fine grained micaceous sand	90	40
	Ferrallitic	*clay to sandy clay loam	60	40
		*sandy loam	90	40
	Fersialliric	*clay to sandy clay loam	40	40
		*sandy loam	60	40
		*very fine grained micaceous loamy sand	90	40
3	All soils	all texture		90
4	All soils	*coarse grained sands	180	no direct limitations

Source: Rhodesia agri. J. Vol. 76(3)

Irrigation Value for Relatively Impermeable Profiles, Sodic

Irrigation Value	Soil Group	Average Soil Texture	Soil Min. Effective Depth(cm)	Max. Surface Depth of Medium to Coarse Grained Sand and Loamy Sand(cm)
2	Siallitic	*heavy clay	90	40
		*clay to sandy loam	150	40
	Fersialliric	*clay to sandy loam	150	40
3	All soils	*heavy clay	40	90
		*loamy sand to coarse grained sand	60	90

Source: Rhodesia agri. J. Vol. 76(3)

Irrigation Value for Profiles with Red-Yellow Mottles

Irrigation Value	Soil Group	Average Soil Texture	Soil Min. Effective Depth(cm)	Max. Surface Depth of Medium to Coarse Grained Sand and Loamy Sand(cm)
1	Siallitic	*clay to sandy clay loam	180	10
	Fersialliric	*clay to sandy clay loam	180	10
2	Siallitic	*heavy clay	180	40
		*clay to very fine micaceous loamy sand	90	40
	Fersialliric	*clay to very fine micaceous loamy sand	90	40
3	All soils	no direct limitations	no limits	90
4	All soils	*coarse grained sand	180	no direct limitations

Source: Rhodesia agri. J. Vol. 76(3)

(d) Soil Mapping Unit

It was not always possible to accurately delineate homogeneous areas of the different soil types at the soil mapping scale used and the auger density that was achieved in this survey. It was more practical to delineate and map associations of the soil types. Thus, the soil mapping units consisting of associations of soil categories were defined and used on the soil maps. Characteristics of the soil mapping units are presented in the following table. Parent materials largely divide the mapping units.

Soil Mapping Units

Unit	Soil Categories		Irrigability		Remarks
	Dominant	Minor	Dominant	Minor	
1) Karoo Sediment Origin					
Q1	1a	3	B		
Q2	1a	3	B/C		gently undulating
Q3	1d	3	B		
Q4	2/3		B		
Q5	1c		B	C/D	patchy sodic soil
Q6	3		B/D		sodic at lower parts
Q7	1e	1f	C	D	
Q8	1f/1g		D		
Q9	8a	8c	B/C		
Q10	8b		B/C		
Q11	9	10	A/B		
Q12	10		B		
Q13	11		B/C		shallow and gravely at the slope
Q14	12		B/C		shallow and gravely at the slope
Q15	15		B/C		
Q16	19		C/B		
2) Mafic Parent Materials					
M1	4a	4c	B	C & D	
M2	4c		B/D	D	stones and boulders at the surface
M3	6	5	C	D	
M4	7a	4c	B/A	unarable soil	
M5	5		B		stony and sheet erosion at the surface
M6	7c, 7d		B	C, D	stones and boulders at the surface
M7	7c, 8d		D		extremely shallow, boulders
3) Alluvial Origin					
A1	14		C		
A2	16	17	C		
A3	18		B/C		
4) Conglomerate Origin					
C1	13		B		

Soil maps are given in the attached Fig. 1. Land suitability maps for irrigation are shown in Fig. 2. Aerial extents of land by irrigability are summarized in the next table. Irrigable area, which defined as A/B, B, B/C and C amounts to 23,004 ha.

Irrigable Land by Mapping Unit and Irrigable Class

(ha)

Mapping	Irrigation Class						
Unit	A/B	B	B/C	C	C/D	D	TOTAL
Q1		2,898					2,898
Q2			290				290
Q3		1,624					1,624
Q4		1,030					1,030
Q5		931					931
Q6		37					37
Q7		2,117					2,117
Q7a		298					298
Q8						533	533
Q9	1,309						1,309
Q10			111				111
Q11	1,191						1,191
Q12		163					163
Q13			376				376
Q14			131				131
Q15			1,093				1,093
Q16			315				315
M1		353					353
M2			136				136
M3					390		390
M4	1,163						1,163
M5		272					272
M6		704					704
M7						126	126
A1			536				536
A2				536			536
A3			1,696				1,696
C1		153					153
D1	3,446						3,446
Q11/M3			95				95
TOTAL	7,109	10,580	4,779	536	390	659	24,053

1.2 Present Condition of Agriculture

1.2.1 General

The main sources of data on the present agriculture in the study area are the sub-contracted household survey to the local consultant and the supplemental farm survey carried out by the present study team. The numbers of samples randomly selected are respectively 357 and 57 farm households. The aerial distribution of the samples in the sub-contracted survey is shown in the next table. In the supplemental survey at least one sample per village in the study area was selected.

Distribution of Sample Households

District	Ward	Village/Vidco	Sample No.
Gokwe North	Makore 1 (Ward 11)	Chiringakudenga	18
		Kagwegwe	34
		Kuedza	10
		Kushinga	14
	Makore 2 (Ward 12)	Nyamazangwe	12
Sub Total			88
Gokwe South	Chisina 1	Chiridzangoma	18
		Mudzongwe	9
	Chisina 2	Batanai Pamwe	19
		Kubatana	28
		Mhungwe	16
Sub Total			90
Kadoma	Ward 17	Village 13	6
		Village 14	2
		Village 15	7
	Ward 20	Makwechere (Vidco 20)	15
	Ward 21	Mbaba (Vidco 13)	16
		Sungaidzisimbe (Vidco 22)	17
	Ward 22	Chimbadze (Vidco 5)	24
		Mbuyanehande (Vidco 6)	15
	Ward 23	Mujiba (Vidco 2)	16
		Munyaka (Vidco 37)	16
	Ward 24	Chisungano (Vidco 40)	15
		Musonza (Vidco 39)	15
		Tawiriana (Vidco 28)	15
Sub Total			179
Total			357

Source: Present JICA study team

1.2.2 Land Use and Landholding

The present land use of the study area was identified through the interpretation of the SPOT image, the aerial photos taken 1996 dry season and some ground checks. The area can be categorized into four land uses, i.e. bush areas, cultivation areas, residential areas and rivers. The extents of respective land uses are as follows :

Present Land Use in the Study Area

1.	Bush	38,300ha
2.	Cultivated areas	39,800ha
3.	Residential areas	3,900ha
4.	Rivers	800ha
	Total	82,800ha

The present landholding of farm households was identified based upon the supplemental farm survey by the present study team. The average landholding is 5.09 ha per household. There are some fallow land, rent-out land, rent-in land

and share cropped land. Total area cultivated is estimated at 4.91 ha as shown in the next table.

Landholding Size

Items	Area (ha)
Area owned	5.09
Area not cultivated	0.27
Arable area	4.82
Area rented out	0.03
Area share-cropped-out	0.03
Area rented in	0.15
Area share-cropped-in	0.00
Total area cultivated	4.91

Source: Supplemental survey

According to the questionnaire survey on damages to farm area in the last 10 years, most damage is caused by drought, and nearly 90% of the households reported that they occasionally or regularly suffered from drought. Their damaged area is 3.94 ha on average. Thus, it can be said that about 79% of the average farm land have suffered from drought with a certain frequency. Other damage to farms were top soil erosion and floods/ water logging which were experienced occasionally or regularly by 32% and 30% of the households, respectively. Problems reported by wild animals are not very significant in the area.

1.2.3 Crop Yields and Crop Production

The crop production trends in the related districts from 1989/90 to 1997/98 are given in the next table. Kadoma district has higher yields probably due to the inclusion of farmers who grow maize as a cash crop with more fertilizer. The average yield of maize in Kadoma district from 1995/96 to 1997/98 was 2.3 ton/ha, while, that in Gokwe district was 1.1 ton/ha. The figures in Gokwe would reflect more real situations in the study area because of its similar climate and soil conditions. Maize yields in Gokwe, which represent the yields in the study area, have fluctuated significantly as shown in the following figure. There are no consistent trends in crop yields due to sporadic rainfall under no irrigation.

Crop Yields in Related Districts

Season	Kadoma (ton/ha)	Gokwe (ton/ha)	Kwekwe (ton/ha)	Season	Kadoma (ton/ha)	Gokwe (ton/ha)	Kwekwe (ton/ha)
	Maize				Peanuts		
90/91	-	0.45	0.79	90/91	-	0.38	0.28
91/92	0.40	0.09	0.00	91/92	0.30	0.02	0.20
92/93	1.80	1.73	1.01	92/93	0.70	0.73	1.16
93/94	1.90	1.18	1.41	93/94	0.90	0.31	0.52
94/95	0.30	0.05	0.20	94/95	0.27	0.07	0.30
95/96	2.25	1.07	1.40	95/96	1.25	0.67	0.80
96/97	2.38	1.24	0.90	96/97	1.25	0.59	0.64
97/98	2.25	1.09	0.39	97/98	0.80	1.00	0.73
	Cotton				Sorghum		
90/91		0.48	0.85	90/91	-	0.34	0.45
91/92	0.50	0.11	0.20	91/92	0.60	0.16	2.00
92/93	1.03	0.84	1.16	92/93	0.90	1.29	0.83
93/94	1.06	0.67	1.00	93/94	1.20	0.63	0.82
94/95	0.35	0.08	0.18	94/95	0.25	0.10	0.10
95/96	1.20	0.81	0.96	95/96	1.00	0.53	0.60
96/97	1.00	0.83	0.60	96/97	1.00	1.00	0.49
97/98	1.30	-	-	97/98	1.30	1.45	0.52

Source :AGRITEX

1.2.4 Cropping Pattern and Farming Practices

The present cropping pattern in the study area is a single cropping in the rainy season per year. There is no working irrigation system in the area except three small systems with the total irrigated area of 80 ha. The typical cropping pattern of a household consists of maize of 1.99 ha, cotton of 2.52 ha, groundnuts of 0.31 ha and others of 0.11 ha as shown in the next table.

Present Cropping Pattern

Crops	Area(ha)	Area/household	%
Maize	111.5	1.99	40.43
Sorghum	2.25	0.04	0.82
Millet	2	0.04	0.73
Groundnuts	17.15	0.31	6.22
Cotton	141.3	2.52	51.23
Sunflower	1.8	0.03	0.65
Total	275.80	4.93	100.00

Remark: The average cultivated area is not necessarily corresponding to the cultivated area calculated in the preceding table due to omitting blank data.

Source: Supplemental household survey

The cropping calendars practiced in the study area are shown in Fig. 3. The

farm inputs and crop yields in the 1997/98 cropping season were surveyed in detail in the supplemental household survey. The results are shown in the next table.

Farm Inputs and Yields by Crop

	Maize	Sorghum	Millet	Peanuts	Cotton	Sunflower	Average
Chemical fertilizers(kg/ha	113	0	0	79	131	56	118
Organic fertilizer(kg/ha)	413	0	0	123	62	5,889	241
Insecticide(litre/ha)	0	0	0	0	1	0	1
Production(kg/ha)	1,017	356	200	951	855	1,258	908

Source: Supplemental household survey

Farmers apply organic fertilizers more than chemical fertilizers to maize and groundnuts. While, cotton growing is relied upon more chemical fertilizers than organic fertilizers. No fertilizers are applied to sorghum and millet.

The draft power shortage is one of the significant problems in the study area. The farm survey showed 33.3 % of the respondents replied there were occasional draft power shortage, while 22.8 % replied often shortage. The shortage causes reduction in the planted area and lower yield due to the late planting.

Draft Power Shortage

Draft Power Shortage	No. of cases	%
No shortage	25	43.9
Occasionally shortage	19	33.3
Often shortage	13	22.8
Total	57	100.0

Source: Supplemental household survey

Plowing is done by animal power in most cases. The ownership of tractor was reported only one case out of 57 respondents. The available animal power is 4 cattle and 0.21 donkeys per household with an average land holding size of 5.09 ha.

Present Condition of Draft Animal of a Household

(Unit: head)

	Cattle	Donkey
Bullocks	1.84	0.14
Other Adult Used for Draft	2.16	0.07
Other Adult Not Used for Draft	2.05	0.04
Young	1.56	0.04

Source: Supplemental household survey

Not all of the farmers own ploughs. Some 12.3 % of farmers do not own plough. They have to hire plough or to do custom plowing.

Ownership of Plough

Ownership	No. of households	%
Not owned	7	12.3
Fully owned	48	84.2
Partly owned	2	3.5
Total	57	100.0

Source: Supplemental household survey

The costs of plowing are Z$ 515 for the draft animal and Z$ 600 for tractors per ha. There seems to be little difference in the costs, because deep plowing is not practiced in the study area and effects of the shallow plowing have no difference between animal plowing and tractor plowing.

Costs of Plowing

	Z$/ha
Draft animal	515
Tractor	600

Source: Supplemental household survey

The post-harvesting activities such as maize shelling are done. Seventy two percent of farmers use the threshing sticks for the maize shelling.

Maize Shelling Method

	No. of cases	%
Own modern machine	1	1.8
Hired modern machine	5	8.8
Hand	28	49.1
Hired labor, women	16	28.1
Hired labor, men	16	28.1
Family, women	43	75.4
Family, men	34	59.6
Threshing sticks	41	71.9

Source: Supplemental household survey

The labor shortage is observed in the study area. Only 14 % of respondents replied that they don't employ laborers for farming. Land preparation and cotton picking are the typical practices where hired laborers are used.

Employment of Laborers

	No. of cases	%
Employ men only	1	1.8
Employ women only	3	5.3
Employ men and women	45	78.9
No employ	8	14.0
Total	57	100.0

Source: Supplemental household survey

The labor charges in the study area are Z$ 32 for man and Z$ 36 for women without meal per day.

Labor Charge without Meal

	Z$/day
Male	32
Female	36

Source: Supplemental household survey

1.3 Agricultural Development Plan

1.3.1 Land Use and Land Allocation

The future land use in the project area was so planned as to promote the irrigation agriculture in accordance with the strategies mentioned in the preceding section. The land suitable to the irrigation agriculture was selected from the viewpoint of land suitability for irrigation as well as the proposed canal layout. The bush area of 1,451 ha will be changed to the irrigated cultivated area. The rainfed arable area of 13,049 ha will be irrigated by the project. In total an area of 14,500 ha will be used for irrigation agriculture. The detail of the land use was given in the next table.

Future Land Use Plan

(ha)

Present Land Use		Future Land Use	
1. Bush	38,300	1. Bush	36,849
		2. Irrigated area	1,451
2. Cultivated area	39,800	3. Rainfed cultivated area	26,751
		4. Irrigated area	13,049
3. Residential area	3,900	5. Residential area	3,900
4. Rivers	800	6. River	800
Total	82,800	Total	82,800

According to the regulation on land use for agriculture, farmers have to surrender their land to the government when their land become irrigable. This system is to lesson impartiality in income caused by the introduction of irrigation water. Land to be irrigated is re-allocated. There are some of the guidelines in the re-

allocation of irrigated land.

(1) People affected by the project get priority.

(2) People should realize a net return to farmers; minimum Z$1500 per month. This means the minimum land allocation for present time is 0.5 ha.

(3) If farmer is not displaced by the project and he wants to join scheme he must be an active farmer. He must be either master farmer or member of a known farmer group under training. The master farm certificates are issued by Agritex after two years of training.

(4) The community through the local authority should be involved in the selection of farmers and the land allocation.

(5) The local people in consultation wit relevant government departments will determine the actual land allocation to farmers in each scheme.

The following are the examples of land allocation in existing irrigation system.

- Old schemes before 1980: 0.1 ha to 1.0 ha, 1.0ha for full time farmers
- New schemes after 1980: part time farmers;0.5 ha, full time farmers;1.0ha to 2.5 ha. Mamina scheme;2.5 ha, Mushandike scheme;1.5 ha, Hama Mavhaire schemes; 1.0 ha.

According to the district administrator for Gokwe south, he will apply 1ha for irrigated agriculture. Taking into account of this local policy on the land allocation and applying the principle to benefit as many farmers as possible, in the present project, the land re-allocation of 1ha per household will be applied to full time farmers.

1.3.2 Proposed Cropping System

The proposed cropping system were determined taking into account the following factors.

(1) Subsistence requirements of foods such as maize and groundnuts.

(2) Available family labor for farming.

(3) Profitability of a crop per ha.

(4) Marketability of a crop, especially for export crops.

(5) Irrigation water balance.

The following 12 crops were studied, i.e. maize, groundnuts, cotton, tomatoes, cabbage, paprika, baby corn, paddy, tobacco, wheat, dry beans and sugar cane. Among them, sugar cane was omitted because it is climatically unsuitable to the area. The study area is too low in temperature to grow sugar cane economically. Sugar cane is proposed by the government for the south-eastern low land areas, where high temperature is available. Tobacco was also excluded due to its poor

market prospects such as strong health consciousness against smoking, which results in declining demands in tobacco in the country. Paddy rice was also excluded because it is a new crop and farmers in the project area too conservative to accept it, and the technical support system for rice development is totally absent.

The subsistence requirements of food crops were projected based on the per-capita consumption surveyed in the farm household survey by the present study team. Per-capita requirements of maize and groundnuts were estimated respectively at 136 kg and 16.8 kg per year. The minimum planted areas for maize and groundnuts were estimated respectively at 0.16 ha and 0.05 ha per household as shown in the next table.

Subsistent Requirements of Crops

Crops	Percapita consumption kg/year	Family size persons	Annual consumption kg/year	Yields ton/ha	Land required ha
Maize	136	7.1	966	6	0.16
Groundnuts	16.8	7.1	119	2.5	0.05

The available family labor was estimated by month for a average farm family size with 7.1 members. Rainy days were excluded from workable days. Two persons were assumed to be schooling children and one person to be pre-school child. The remaining members, 4.1 persons, would be available for farming.

Workable Labor per Month

	Workable days, mean	Available family labor, man-days
Jan	21.7	89
Feb	20.2	82
Mar	27.4	112
Apr	28.1	115
May	30.7	125
Jun	30	122
Jul	31	126
Aug	30.9	126
Sep	29.9	122
Oct	29.6	121
Nov	25.7	105
Dec	23.1	94

7.1 persons in total
2 persons for animal care taking and cooking
80 % of the remaining labor is available for farr

The labor requirements of each farming practices in 9 crops were estimated monthly, and the results were presented in Table 1.

The future crop yields with project were estimated taking account the crop records in the existing irrigation areas as shown in the following table;

Crop Yields in the Existing Irrigation Areas

Crops	Yields (ton/ha)
Maize	5.8
Wheat	5.2
Cotton	2.4
Groundnuts	2.7

Source : The Agricultural Sector of Zimbabwe
Statiscal Bulletin – 2000

The target yields of crops were set as follows:

Target Yields of Crops

Crops	Yields (ton/ha)
Maize	6.0
Cotton	2.5
Groundnuts	2.5
Wheat	4.2
Tomatoes	75.0
Cabbage	50.0
Dry beans	2.0
Paprika	3.0
Baby corn	1.0

The crop yields in the without-project condition were projected taking the average figures for the available data in Gokwe district, mostly last 8 years. Because, crop yields fluctuates dramatically by frequent droughts and Gokwe has similar climatic and soil conditions as the project area and without large commercial farms, which tend to produce higher yields than communal farmers.

Projected Crop Yields in Without-project Condition

Crops	Yields (ton/ha)
Maize	0.8
Cotton	0.6
Groundnuts	0.5

The profitability of a crop was estimated making a typical crop budget, which included costs and return with breakdowns of farm inputs such as labor, fertilizers and chemicals. Crop budgets were made for the with-project and without-project conditions. The details of the crop budgets are presented in Tables 2 and 3. Cropping calendars follows basically the existing ones.

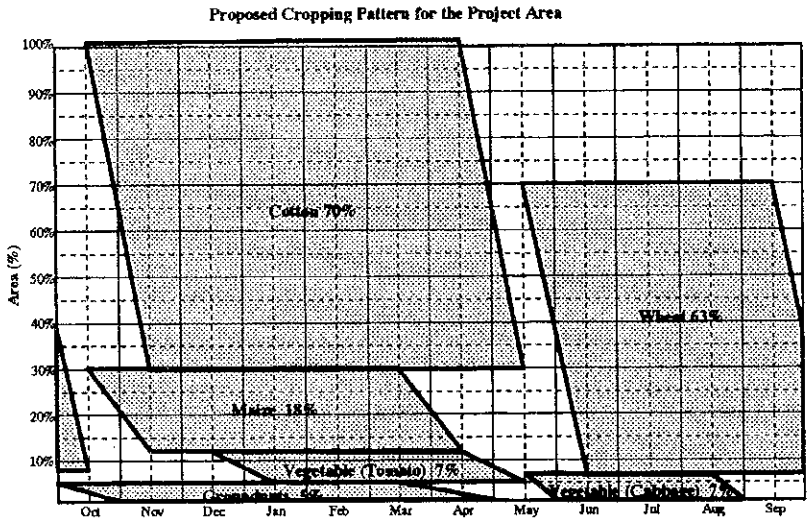
Marketability of crops was studied. The maximum planted area of exportable crops, i.e. vegetables, was planned as 2,500 ha at the year of 2010. This area corresponds to 7 % of the total irrigated area per crop. Two cropping of vegetables were planned. The minimum cotton area was set at 50% , which was equal to the present cropping ratio for cotton, to minimize market disturbance by

changing the cropping pattern.

The optimum combination of crops to produce maximum return were worked out using linear programming under the limitation of monthly available family labor, the maximum planted area to vegetables, the minimum areas for maize and groundnuts, and the minimum planted area for cotton. The solution was as follows:

- Maize: 18%
- Cotton: 70%
- Groundnuts:5%
- Wheat: 93%
- Vegetables: 7% for the summer and the winter seasons.

Irrigation water balance was studied for the solution. Due to the water shortage in the winter season, wheat area was decreased to 63 %. The proposed cropping pattern summarized in the next figure.



It should be noted for further consideration to the above copping pattern that in the light of a recent growing tendency of dry beans in small holders' irrigation schemes, there is a potential to introduce dry beans also to the proposed cropping pattern, giving a certain part of the cropping area allotted for wheat.

2. Nyarupakwe Pilot Project

2.1 Present Condition of Agriculture

2.1.1 General

Main sources of data and information on agriculture in the Nyarupakwe area were farm interview surveys done by the agronomist team from 29 to 30 March and from 10 to 12 April 2000. Sixteen samples in total, eight for the pilot area and eight for the surrounding area were selected randomly from the total households of 102 in Magonyo and Hlamba villages.

2.1.2. Present Land Use and Landholding

Most of arable land is cultivated or under fallow. Non-arable land is in steep slopes or in poor soils such as sodic soils, and is jointly utilized for grazing. The area is communal land and the government allocated land to farmers. There is no land ownership for farmers. Selling, buying and mortgaging of land is not allowed. Temporal land use right has been given to them. The land use right can be inherited to male offsprings in most cases. There are neither formal surveys nor land registrations of land plots. There is no guaranteed land use right for land users. When the present land use is changed from rainfed land to irrigated land, for example, usufruct has to be returned to the government.

Landholding ranges from 4 to 17 ha per household. The average landholding size per household is 7.8 ha for the two villages, 8.2 ha for the pilot area and 7.3 ha for the surrounding area. Within the total landholding, there are fallow areas of 1 ha for the two villages, 1.3 ha for the pilot area and 0.7 ha for the surrounding area. Fallow is caused mainly by the lack of draft power. No share cropping system is observed in the area. There is rent-in area of 0.1 ha per household for the pilot area and 0.06 ha for the two villages. The total cultivated area is calculated at 6.9 ha per household for the two villages, 7 ha for the pilot area and 6.7 ha for the surrounding area.

There are communal grazing areas forthe villagers. A household has grazing land of 25.5 ha shared with 29.6 farms on an average for the 2 villages and 23.4 ha shared with 35.5 farms for the pilot area. Utilization of the grazing land tend to favor farms with lager herds. One sixth of the farms in the 2 villages has neither cattle nor goats.

2.1.3 Soils and Land Capability

As shown in the interim report, the targeted irrigation area in Nyarupakwe is under the soil-mapping unit of Q1. Soils under Q1 are composed mainly of soils of category 1a. Category 1a soils are well drained, deep (more than 150 cm), dark reddish brown to reddish brown, light to medium textured (medium loamy sands over medium sandy clay loam) soils occurring on flat to almost flat terrain. Parent materials are quaternary fluvial deposits from various sand stones.

Topology is almost flat. Irrigability is mainly class B, downgraded because of the light surface horizon. The class c is defined as being suitable for irrigation with special precautions and practices. Sustained productivity is attainable with good management and maximum efficiency in the use of irrigation water, but risks are higher than with Class A owing to moderate soil and/or topographic limitations.

2.1.4 Demography

Hlamba village consists of a single tribe, namely Kalanga tribe. While, Magonyo village consists of several tribes, namely from the dominant ones, Zezuru, Venda, Ndebele, Karanga, Kalanga, Tonga and Changani.

Average family sizes are 9.7 members for the two villages, 9.8 members for the pilot area and 9.6 members for the surrounding area. Age of the interviewees, most of which are household heads, are from 33 to 82 years old. An average age of the household in the two villages is 52 .4 years old. Twenty-five percent of the households are female-headed under polygamy. In a female-headed household, decision-making on expenditure and crop husbandry are made by the husband staying outside of that household.

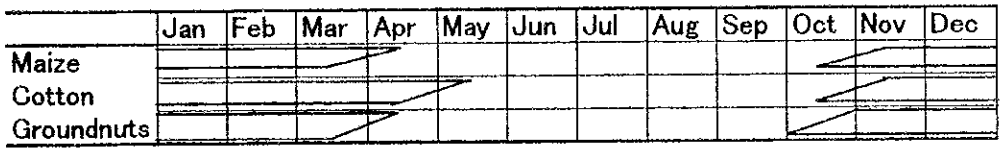
Educational backgrounds of the interviewees are rather high. Twenty-five percent of them are collage graduates, who settled in this area after the retirement from public offices. Thirty-eight percent of the households have not finished the primary schools. Illiteracy rate of the respondents is 25 %. Seventy-five percent can read leaflets from extension workers. There is no difference in literacy rate between sex. The main source of agricultural information is government extension workers covering 69 % of the respondents followed by their parents covering 19 % of the respondents. AFC, Cotton Company, radio/television and NGOs play no significant role in the extension of agricultural information to farmers in the pilot area and its surrounding area. Farmers have no experience in irrigation agriculture or agribusiness, so they have no knowledge on irrigated crops or marketing of produce besides of Sanyati or Gokwe markets. They are just producers of crops. Marketing has been managed by the cotton company, AGRITEX, etc.

2.1.5 Crop Production

Crops grown mainly in the pilot area and its surrounding area are cotton, maize and groundnuts. Sunflower and sorghum are also grown, but their acreage is negligibly small. Their distribution in the pilot area are cotton; 63.1 %, maize; 25.6 % and groundnuts & others; 11.3 %. Those in the two villages are respectively, 55.8, 34.6 and 9.6%.

The present cropping is done in the wet season. No crop is grown in the dry season except for small-irrigated vegetable gardens near homesteads. There are no substantial perennial crops grown in the pilot area. Crop calendar is shown in the next figure.

Present Cropping Calendar



Crop yields in the normal season are presented in the next table.

Crop Yields in Normal Season

(Unit : ton/ha)

Crop	Two Villages	Pilot irrigation Area
Maize	0.87	0.90
Cotton	0.95	1.00
Groundnuts	0.60	0.80

Crop yields are very low due to low inputs of chemical fertilizers, unfavorable soil conditions and the unstable rainfall pattern. Fertilizer application rates are shown in the next table.

Fertilizer Application, kg/ha

		Two Villages	Pilot Area
Maize	Chemical Fertilizer	67	32
	Manure	560	1007
Cotton	Chemical Fertilizer	122	109
	Manure	292	445
Groundnuts	Chemical Fertilizer	0	0
	Manure	0	0

Draft power shortage is one of the significant problems in the two villages. Seventy-six percent of the respondents reported the shortage in draft power, namely, 38 % experienced often and 38 % occasionally experienced. Cotton cultivation suffers most from the shortage in draft power because cotton is the main crop covering 55.8 % of the total planted area in the two villages. Available draft animal are 2.2 head per ha. Twenty-five percent of farmers have no draft animal. There are no agricultural tractors owned by the farmers.

2.2. Agricultural Development Plan

2.2.1 Strategy for the Pilot Project

Purposes of the pilot project are ; (i) to identify hidden problems and constraints in planned development approaches and plans in the master plan stipulated in the interim report, (ii) to modify the approaches and the plans according to the improved trials, and (iii) to demonstrate the performance of the pilot project to concerned people.

Top-down or blue print approaches have been applied in vein in the country. The JICA study team has made an optimized crop development plan for the Kudu Dam. But this plan is only effective in particular marketing and socio-economic conditions in a particular year. Technical assistance will not continue forever. Economic conditions would endlessly change. Therefore farmers in the pilot area will have to make themselves the optimum farm operation plans adaptable to the particular economic condition without much supports from the government.

Participatory or process-oriented approaches have been applied from the present planning stage of the pilot project. Sustainability, which would be the ultimate objective of the project, will be improved through empowerment of farmers. Empowerment is defined as a process of supporting farmers in discovering and building their individual and collective strength, through which they could study and analyze their situation and organize themselves to transform their situation. This process will not develop themselves. So, a NGO as catalyst has been incorporated in the process from the planning stage. The NGO will extend necessary assistance for the farmers in the pilot area in fields of technologies, genetic resources, organization setup and marketing information.

In the course of the pilot project including the present planning stage, practical procedures and guidelines will be developed with consensus among the stakeholders on the land and water redistribution, on monetary and physical obligations in the construction, on the operation of the project, on appropriate technological packages for crop and animal husbandry, on appropriate project organization and on monitoring and evaluation of the project performance.

2.2.2 Crop Production Plan

The following recommended cropping pattern in the interim report was evaluated in the intention survey of the farmers by the present study team. Fifty-seven percent of the farmers selected cotton as the 1st priority crop in the irrigation followed by maize. Forty-three percent of the farmers selected maize as the 2nd important crops followed by vegetables. As the winter crop priority was given to vegetables and wheat. Individual cropping patterns would be different farmer by farmer according to the specific landholding, labor availability and crop favor, etc. But, given the subsistence orientation and need for each income it is likely that, on average, a cropping pattern similar to that proposed in the whole Kudu Dam Irrigation Project would emerge.

2.2.3 Target Yield of Crop

The future crop yields with project were estimated taking account the crop records in the existing irrigation areas as shown in the following table;

Crop Yields in the Existing Irrigation Areas

Crops	Yields (ton/ha)
Maize	5.8
Wheat	5.2
Cotton	2.4
Groundnuts	2.7

Source : The Agricultural Sector of Zimbabwe
Statiscal Bulletin – 2000

The target yields of crops were set as follows:

Target Yields of Crops

Crops	Yields (ton/ha)
Maize	6.0
Cotton	2.5
Groundnuts	2.5
Wheat	4.2
Tomatoes	75.0
Cabbage	50.0
Dry beans	2.0
Paprika	3.0
Baby corn	1.0

TABLES

Table 1 Monthly Labor Requirements of Crops

(man-day/ha)

Crops	Practices	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Family labor balancing														
Maize	Plowing/harrowing										0.4	0.4		0.8
	Seeding										2.2	2.2		4.4
	Top dressing,1	1											1	2.0
	Weeding	5.7	5.6	5.6								5.6		22.5
	Spraying	2	1.9											3.9
	Irrigation	2	2	2							2	2	2	12.0
	Harvesting			5	5									10.0
	Threshing					7.5	7.5							15.0
	Sub-total	**10.7**	**9.5**	**12.6**	**5.0**	**7.5**	**7.5**	**0.0**	**0.0**	**0.0**	**4.6**	**10.2**	**3.0**	**70.6**
Cotton	Plowing/harrowing										0.4	0.4		0.8
	Seeding										1.5	1.5		3.0
	Basal dressing										1.5	1.5		3.0
	Top dressing,1												1.5	1.5
	Weeding	6	6	6	6								6	30.0
	Spraying	2	2	2	2	1.6					2	2	2	15.6
	Irrigation	2	2	2	2	2					2	2	2	16.0
	Sub-total	**8.0**	**8.0**	**8.0**	**8.0**	**1.6**	**0.0**	**0.0**	**0.0**	**0.0**	**5.4**	**5.4**	**9.5**	**53.9**
Groundnuts	Plowing/harrowing										0.7			0.7
	Seeding										7.2			7.2
	Basal dressing										0.41			0.41
	Weeding	5	4.5									5	5	19.5
	Irrigation	2	2								2	2	2	10.0
	Spraying	2.9	3									2.9	2.9	11.7
	Harvesting			3	3									6.0
	Shelling					15	14							29.0
	Sub-total	**9.9**	**9.5**	**3.0**	**3.0**	**15.0**	**14.0**	**0.0**	**0.0**	**0.0**	**10.3**	**9.9**	**9.9**	**84.51**
Wheat	Plowing/harrowing					0.8								0.8
	Seeding					0.5								0.5
	Basal dressing					1								1.0
	1st top dressing						0.5							0.5
	Weeding						15	15	15					45.0
	Irrigation					2	2	2	2					8.0
	Spraying						3.9	3.9						7.8
	Harvesting									10				10.0
	Drying									10				10.0
	Threshing										12			12.0
	Sub-total	**0.0**	**0.0**	**0.0**	**0.0**	**4.3**	**21.4**	**20.9**	**17.0**	**20.0**	**12.0**	**0.0**	**0.0**	**95.6**
Tomato	Plowing	0.20	0.17											0.37
	Harrowing	0.15	0.15										0.3	0.6
	Transpranting												15.8	15.8
	Basal dressing												3.7	3.7
	1st top dressing	10.9												10.9
	Weeding	8	8	8	1.3									25.3
	Spraying	7.8	7.8	7.8										23.4
	Irrigation	3	3	3	2									11.0
	Harvesting			67.5	67.5									135.0
	Sub-total	**30.1**	**19.1**	**86.3**	**70.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**19.8**	**226.07**
Cabbage	Plowing			0.1	0.1	0.1								0.3
	Harrowing			0.1	0.1	0.1								0.3
	Seeding		1	1	0.8									2.8
	Transpranting			23.2	23.2	23.2								69.6
	Basal dressing			0.4	0.4	0.3								1.1
	1st top dressing				3	3	2.9							8.9
	Weeding			5	5	5	5	4.6						24.6
	Irrigation		3	3	3	3	3	2						17.0
	Spraying			5.9	5.9	5.9	5.7							23.4
	Harvesting					14	14	14.6						42.6
	Sub-total	**0.0**	**4.0**	**38.7**	**41.5**	**54.6**	**30.6**	**21.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**190.6**
Paprika	Plowing/harrowing											0.8		0.8
	Seeding											4.5		4.5
	Basal dressing											2		2.0
	1st top dressing												2.0	2.0
	2nd top dressing		2										2.0	4.0
	Weeding	5.6	5.6	5.7									5.6	22.5
	Irrigation	3	3	2								3	3	14.0
	Spraying		3.9										3.9	7.8
	Harvesting			15	15									30.0
	Sub-total	**8.6**	**14.5**	**22.7**	**15.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.3**	**16.5**	**87.6**
Dry beans	Plowing/harrowing											0.8		0.8
	Seeding											4.5		4.5
	Basal dressing											2		2.0
	1st top dressing												2.0	2.0
	Weeding	7	8.5										7	22.5
	Spraying	3.9	3.9									3.9	3.9	15.6
	Irrigation	2	2									2	2	8.0
	Harvesting			10	12									22.0
	Sub-total	**12.9**	**14.4**	**10.0**	**12.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**13.2**	**14.9**	**77.4**
Baby corn	Plowing/harrowing										0.4	0.4		0.8
	Seeding										2.2	2.2		4.4
	Top dressing	1											1	2.0
	Weeding	5.7	5.6	5.6								5.6		22.5
	Spraying	2	1.9											3.9
	Irrigation	2	2	2							2	2	2	12.0
	Harvesting			5	5									10.0
	Threshing					7.5	7.5							15.0
	Sub-total	**10.7**	**9.5**	**12.6**	**5.0**	**7.5**	**7.5**	**0.0**	**0.0**	**0.0**	**4.6**	**10.2**	**3.0**	**70.6**

Table 2 Financial Crop Budget Without Project Condition (1/3 : Maize)

(uint:kg,man-day, Z$

Particulars	Materials			Labor			Animal/Machine			Total	
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	Remarks
1. Production Cost											
1)Land preparation											
-Plowing				0.8	38.5	30.8	1.6	546	874	904.4	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding	25	28.50	713	4.48	38.5	172				885	
4) Transplanting, if any											
5)Fertilizing											
-Basal Compound D	40	7.90	316							316	
-Top/side dressing											
1st Ammonium Nitrat	40	8.30	332	1.5	38.50	57.8				389.8	
6)Earthing											
7)Weeding				22.5	38.50	866	0.3	833	250	1116	
8)Spraying of agrochemical											
-Thiodan	1.6	402	643	1.56	38.50	60.1				703.3	
9)Irrigating											
10)Harvesting											
-Harvesting				1.6	38.50	61.6				61.6	
-Drying											
-Threshing				2.4	38.50	92.4				92.4	
-Hauling											
11)Miscellaneous Bags(piece)	16	7.80	125							124.8	
Bag transport	16	####	176							176	
2. Others											
3)Administration costs											
Total			2305			1341			1124	4769	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	0.80	Z$ 6400 /ton	Z$ 5120 /ha

4. Net Income

Z$ 351 /ha

Table 2 Financial Crop Budget Without Project Condition (2/3 : Cotton)

(unit: kg, man-day,Z$)

Particulars	Materials			Labor			Animal/Machine			Total	
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	Remarks
1. Production Cost											
1)Land preparation											
-Plowing				0.4	38.5	15.4	1.6	546.0	873.6	889.0	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding	25.0	16.70	417.5	6.0	38.5	231.0				648.5	
4) Transplanting, if any											
5)Fertilizing											
-Basal Compound L	60.0	13.10	786.0			0.0				786.0	labor incl.
-Top/side dressing											
1st Ammonium Nitrate	30.0	8.30	249.0	1.0	38.5	38.5				287.5	
6)Earthing											
7)Weeding			0.0	30.0	38.50	1155	0.45	833.0	374.9	1529.9	
8)Spraying of agrochemical											
-Marshal(litre)	0.3	552	165.5	4.7	38.50	181.0				346.4	
-Carbryl	1.2	375	450.0	4.7	38.50	181.0				631.0	
-Synthetic Pyretheroid(litre)	0.6	619	371.3	4.7	38.50	181.0				552.2	
9)Irrigating											
10)Harvesting											
-Harvesting (z$/kg)			0.0	600	0.45	270.0				270.0	
-Hauling											
11)Miscellaneous bags,bale	3.6	60.00	216.0							216.0	
transport/bale	3.6	160.0	576.0							576.0	
2. Others											
3)Administration costs											
Total			3231			2253			1248	6732	

3. Gross Income	Unit yield (kg/ha)	Unit Price	Gross Income
	600	Z$ 14.9 /kg	Z$ 8940

4. Net Income

Z$ 2208 /ha

Table 2 Financial Crop Budget Without Project Condition (3/3 : Groudnuts)

(unit: kg, man-day,Z$)

Particulars	Materials			Labor			Animal/Machine			Total	
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	Remarks
1. Production Cost											
1)Land preparation											
-Plowing				0.4	38.5	15.4	1.6	546	873.6	889.0	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding kg	100.0	35.00	3500	7.2	38.5	277				3777.2	
4) Transplanting, if any											
5)Fertilizing											
-Basal Gypsum, kg	50.0	2.10	105	0.41	38.5	15.79				120.8	
-Top/side dressing											
6)Earthing											
7)Weeding				19.5	38.5	750.8	1.70	833	1416	2166.9	
8)Spraying of agrochemical											
9)Irrigating											
10)Harvesting				3.0	38.5	115.5				115.5	
-Harvesting (z$/kg)											
-Drying											
-Shelling				15.0	38.5	577.5				577.5	
-Hauling											
11)Miscellaneous bags,bale											
transport/bale											
2. Others											
Total			3605			1752			2290	7647	

3. Gross Income	Unit yield (kg/ha)	Unit Price	Gross Income
	500	Z$ 10.0 /kg	Z$ 5000

4. Net Income

Z$ (2647) /ha

Table 3 Financial Crop Budget With Project Condition (1/9 : Maize)

(uint:kg,man-day, Z$)

Particulars	Materials			Labor			Animal/Machine			Total	Remarks
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	
1. Production Cost											
1)Land preparation											
-Plowing				0.8	38.5	31	1.6	546	874	905	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding	25	28.5	712.5	4.4	38.5	169				882	
4) Transplanting, if any											
5)Fertilizing											
-Basal Compound D	450	7.9	3555							3555	
-Top/side dressing											
1st Ammonium Nitrat	500	8.3	4150	2.0	38.5	77				4227	
6)Earthing											
7)Weeding				22.5	38.5	866	0.3	833	250	1116	
8)Spraying of agrochemical											
-Thiodan	4	402	1608	3.9	38.5	150				1758	
-(specify)											
-(specify)											
9)Water Charge/Irrigating	4	310	1240	12.0	38.5	462				1702	
10)Harvesting											
-Harvesting				10.0	38.5	385				385	
-Drying											
-Threshing				15.0	38.5	578				578	
-Hauling											
11)Miscellaneous Bags(piece)	100	7.8	780							780	
Bag transport	14	11.0	154							154	
2. Others											
3)Administration costs											
Total			12200			####			1124	16042	

3. Gross Income — Unit yield (ton/ha): 6.0 — Unit Price: Z$ 6.4 /kg — Gross Income: Z$ 38400

4. Net Income

Z$ 22358 /ha

Table 3 Financial Crop Budget With Project Condition (2/9 : Cotton)

(unit: kg, man-day,Z$)

Particulars	Materials Qty	Price	Value	Labor Qty	Price	Value	Animal/Machine Qty	Price	Value	Total Value	Remarks
1. Production Cost											
1)Land preparation											
-Plowing				0.8	38.5	31	1.6	546	874	905	Ox drawn
2) Nursery preparation											
3)Seeding											
-Seeding	25.0	16.7	418	3.0	38.5	115				533	
4) Transplanting, if any											
5)Fertilizing											
-Basal Compound L	250.0	13.1	3275	3.0	38.5	115				3390	
-Top/side dressing											
1st Ammonium Nitrate	100.0	8.3	830	1.5	38.5	58				888	
6)Earthing											
7)Weeding				30.0	38.5	1155	0.45	833	375	1530	
8)Spraying of agrochemical											
-Marshal(litre)	0.5	552.0	276	7.8	38.5	300				576	
-Carbryl	2.0	375.0	750	3.9	38.5	150				900	
-Synthetic Pyretheroid(litre)	1.0	619.0	619	3.9	38.5	150				769	
9)Water Charge/Irrigating	4.0	310.0	1240	16.0	38.50	616				1856	
10)Harvesting											
-Harvesting (z$/kg)				2500	0.45	1125				1125	
11)Miscellaneous bags,bale	9.0	30.0	270							270	
transport/bale	14.0	160.0	2240							2240	
2. Others											
3)Administration costs											
Total			9918			3815			1249	14982	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	2.5	Z$ 14.9 /kg	Z$ 37250

4. Net Income

Z$ 22268 /ha

Table 3 Financial Crop Budget With Project Condition (3/9 : Groundnuts)

(unit: kg, man-day,Z$)

Particulars	Materials			Labor			Animal/Machine			Total	Remarks
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	
1. Production Cost											
1)Land preparation											
-Plowing				0.4	38.5	15	1.6	546	874	889	
-Harrowing				0.3	38.5	11				11	
-Seeding kg	100.0	35.0	3500	7.2	38.5	277				3777	
4) Transplanting, if any											
5)Fertilizing											
-Basal S.S.P	300.0	11.7	3510							3510	labor catered
-Top/side dressing											
1st Gypsum	100.0	2.1	210	0.41	38.5	16				226	
6)Earthing											
7)Weeding				19.5	38.5	751	1.70	833	1416	2167	
8)Spraying of agrochemical											
-Innoculant bottle	2.0	10.0	20	3.9	38.5	150				170	
-Dimethoate litre	0.9	225.0	202	3.9	38.5	150				352	
-Thiram, 80WP bag	0.1	105.0	10	3.9	38.5	150				160	
9)Water Charge/Irrigating	4.0	310.0	1240	10.0	38.5	385				1625	
10)Harvesting											
-Harvesting (z$/kg)				6.0	38.5	231				231	
-Drying											
-Shelling				29.0	38.5	1117				1117	
-Hauling											
11)Miscellaneous packing, bag	50.0	7.8	390							390	
transport	14.0	11.0	154							154	
2. Others											
3)Administration costs											
Total			9236			3253			2290	14779	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	2.5	Z$ 10.0 /kg	Z$ 25000

4. Net Income

Z$ 10221 /ha

Table 3 Financial Crop Budget With Project Condition (4/9 : Wheat)

(unit: kg, man-day,Z$)

Particulars		Materials Qty	Price	Value	Labor Qty	Price	Value	Animal/Machine Qty	Price	Value	Total Value	Remarks
1. Production Cost												
1)Land preparation												
-Plowing					0.8	38.5	31	1.6	546	874	905	
2) Nursery preparation												
3)Seeding												
-Seed preparation												
-Seeding		130.0	18.0	2340	0.5	38.5	19				2359	
4) Transplanting, if any												
-Transplating												
5)Fertilizing												
-Basal	Compound D	550.0	7.9	4345	1.0	38.5	39				4384	
-Top/side dressing												
1st	Ammonium nitrate	400.0	8.3	3320	0.5	38.5	19				3339	
	Muriate of Potash	100.0	11.6	1160							1160	
6)Earthing												
7)Weeding					45.0	38.5	1733				1733	
8)Spraying of agrochemical												
-Demeton-S-Methyl 25EC		0.4	163.8	66	3.9	38.5	150				216	
-Aldrin		2.0	354.0	708	3.9	38.5	150				858	
9)Water Charge/Irrigating		4.0	310.0	1240	8.0	38.5	308				1548	
10)Harvesting												
-Harvesting	(z$/kg)				10.0	38.5	385				385	
-Threshing					12.0	38.5	462				462	
-Drying					10.0	38.5	385				385	
11)Miscellaneous	packing, bag	42.0	7.8	328							328	
	transport	1180	0.18	212							212	
2. Others												
3)Administration costs												
	Total			13719			3681			874	18274	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	4.2	Z$ 7.6 /kg	Z$ 31920

4. Net Income

Z$ 13646 /ha

Table 3 Financial Crop Budget With Project Condition (5/9 : Tomato)

(unit: kg, man-day,Z$)

Particulars		Materials Qty	Price	Value	Labor Qty	Price	Value	Animal/Machine Qty	Price	Value	Total Value	Remarks
1. Production Cost												
1)Land preparation												
-Plowing					0.37	38.5	14	26.0	22.0	572	586	
-Harrowing					0.3	38.5	12	9.5	22.0	209	221	
2) Nursery preparation												
3)Seeding												
-Seed preparation												
-Seeding		0.15	5530	829							829	
4) Transplanting, if any												
-Transplating					15.8	38.5	608	12.3	10.0	123	731	
5)Fertilizing												
-Basal	Compound S	800.0	12.8	10240	3.70	38.5	142	0.5	10.0	5	10387	
	Pottasium sulphate	1000	17.7	17700							17700	
	Lime	1000	2.1	2100							2100	
-Top/side dressing												
1st	Ammonium nitrate	100.0	8.3	830	10.9	38.5	420	1.65	10.0	16	1266	
	K2O											
6)Earthing												
7)Weeding					25.3	38.5	974				974	
8)Spraying of agrochemical												
-Mancozeb 80 WP		15.0	367.0	5505	7.8	38.5	300				5805	
-Makathion 25WP		2.0	477.0	954	7.8	38.5	300				1254	
-Carbaryl		0.8	375.0	300	7.8	38.5	300				600	
9)Water Charge/Irrigating		6.0	310.0	1860	11.0	38.5	424	4.4	10.0	44	2328	
10)Harvesting												
-Harvesting	(z$/kg)				135	38.5	5198				5198	
-Threshing												
-Drying												
11)Miscellaneous	packing, bag	42.0	11.0	462							462	
	transport	75000	0.37	27750							27750	
2. Others												
3)Administration costs												
	Total			68530			8692			969	78191	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	75.0	Z$ 3.8 /kg	Z$ 285000

4. Net Income

Z$ 206809 /ha

Table 3 Financial Crop Budget With Project Condition (6/9 : Cabbage)

(unit: kg, man-day,Z$)

Particulars	Materials			Labor			Animal/Machine			Total	Remarks
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	
1. Production Cost											
1)Land preparation											
-Plowing				0.3	38.5	12	28.6	22.0	629	641	
-Harrowing				0.3	38.5	12	10.5	22.0	231	243	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding	0.45	1500	675	2.8	38.5	108				783	
4) Transplanting, if any											
-Transplating				69.6	38.5	2680				2680	
5)Fertilizing											
-Basal Compound S	1000	12.80	12800	1.1	38.5	42	9.9	10.0	99	12941	
-Top/side dressing											
1st Ammonium nitrate	200.0	8.30	1660	8.9	38.5	343	1.65	10.0	16	2019	
6)Earthing											
7)Weeding				24.6	38.5	947				947	
8)Spraying of agrochemical											
-Mancozeb 80 WP	0.85	367	312	7.8	38.5	300				612	
-Dimethoate	2.5	225	562	7.8	38.5	300				862	
-Cosan WP	4.5	140	630	7.8	38.5	300				930	
9)Water Charge/Irrigating	10.0	310	3100	17.0	38.5	655				3755	
10)Harvesting											
-Harvesting (z$/kg)				42.6	38.5	1640				1640	
11)Miscellaneous											
transport	50	600	30000							30000	
2. Others											
3)Administration costs											
Total			49739			7339			975	58053	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	50.0	Z$ 3.0 /kg	Z$ 150000

4. Net Income

Z$ 91947 /ha

Table 3 Financial Crop Budget With Project Condition (7/9 : Drybeans)

(unit: kg, man-day,Z$)

Particulars	Materials			Labor			Animal/Machine			Total	Remarks
	Qty	Price	Value	Qty	Price	Value	Qty	Price	Value	Value	
1. Production Cost											
1)Land preparation											
-Plowing				0.8	38.5	31	1.6	546	874	905	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding	100	72.0	7200	4.5	38.5	173				7373	
4) Transplanting, if any											
5)Fertilizing											
-Basal Compound D	500	7.9	3950	2.0	38.5	77				4027	
-Top/side dressing											
1st Ammonium nitrate	100.0	8.3	830	2.0	38.5	77				907	
6)Earthing											
7)Weeding				22.5	38.5	866	0.3	833	250	1116	
8)Spraying of agrochemical											
-Carbyrl 85WP	1.00	375.0	375	3.9	38.5	150				525	
-Malathion 50 EC	1.25	108.0	135	3.9	38.5	150				285	
-Benomyl 50WP	1.5	138.6	208	3.9	38.5	150				358	
-Dicofol,25% WP	1.0	215.0	215	3.9	38.5	150				365	
9)Water Charge/Irrigating	4.0	310.0	1240	8.0	38.5	308				1548	
10)Harvesting											
-Harvesting (z$/kg)				10.0	38.5	385				385	
-Threshing				10.0	38.5	385				385	
-Drying				2.0	38.5	77				77	
11)Miscellaneous transport to market	20	11.0	220							220	
bags	20	7.8	156							156	
2. Others											
3)Administration costs											
Total			14529			2979			1124	18632	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	2.0	Z$ 20.0 /kg	Z$ 40000

4. Net Income

Z$ 21368 /ha

Table 3 Financial Crop Budget With Project Condition (8/9 : Paprika)

(unit: kg, man-day,Z$)

Particulars	Materials Qty	Materials Price	Materials Value	Labor Qty	Labor Price	Labor Value	Animal/Machine Qty	Animal/Machine Price	Animal/Machine Value	Total Value	Remarks
1. Production Cost											
1)Land preparation											
-Plowing				0.8	38.5	31	1.6	546	874	905	
2) Nursery preparation											
3)Seeding											
-Seed preparation											
-Seeding	10.0	84.0	840	4.5	38.5	173				1013	
4) Transplanting, if any											
5)Fertilizing											
-Basal Compound D	750.0	7.9	5925	2.0	38.5	77				6002	
-Top/side dressing											
1st Ammonium nitrate	75.0	8.3	623	2.0	38.5	77				700	
2st Ammonium nitrate	75.0	8.3	623	4.0	38.5	154				777	
6)Earthing											
7)Weeding				22.5	38.5	866	0.3	833	250	1116	
8)Spraying of agrochemical											
-Carbyrl 85WP	30.0	375.0	11250	3.9	38.5	150				11400	
-Dithane M4S	48.0	260.0	12480	3.9	38.5	150				12630	
9)Water Charge/Irrigating	4.0	310.0	1240	14.0	38.5	539				1779	
10)Harvesting											
-Harvesting (z$/kg)				30.0	38.5	1155				1155	
-Threshing											
-Drying											
11)Miscellaneous transport to market	3.0	250.0	750							750	
bags	30.0	7.8	234							234	
2. Others marketing costs, 13% of gross income										11700	
1)Interests											
2)Tax											
3)Administration costs											
Total			33965			3372			1124	50161	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	3.0	Z$ 30.0 /kg	Z$ 90000

4. Net Income

Z$ 39839 /ha

Table 3 Financial Crop Budget With Project Condition (9/9 : Babycorn)

(uint:kg,man-day, Z$)

Particulars		Materials Qty	Price	Value	Labor Qty	Price	Value	Animal/Machine Qty	Price	Value	Total Value	Remarks
1. Production Cost												
1)Land preparation												
-Plowing					0.8	38.5	31	1.6	546	874	905	
2) Nursery preparation												
3)Seeding												
-Seed preparation												
-Seeding		40.0	151.0	6040	4.5	38.5	169				6209	
4) Transplanting, if any												
5)Fertilizing												
-Basal	Compound D	600.0	7.9	4740							4740	
	Manure											
-Top/side dressing												
1st	Ammonium Nitrate	300.0	8.3	2490	2.0	38.5	77				2567	
	Muriate of potash	50.0	11.6	580							580	
	K2O											
6)Earthing												
7)Weeding					22.5	38.5	866	0.3	833	250	1116	
8)Spraying of agrochemical												
-Thiodan, 1%		14.0	402.0	5628	3.9	38.5	150				5778	
-Atrazin, litre		2.0	203.7	407	3.9	38.5	150				557	
-Lasso, litre		3.5	236.3	826	3.9	38.5	150				976	
9)Water Charge/Irrigating		3.2	310.0	992	12.0	38.5	462				1454	
10)Harvesting												
-Harvesting					10.0	38.5	385				385	
11)Miscellaneous												
	Transport to market	1.0	250.0	250							250	
2. Others												
1)Marketing cost	10% of gross income										6000	
Total				21953			2440			1124	31517	

3. Gross Income	Unit yield (ton/ha)	Unit Price	Gross Income
	1.0	Z$ 60 /kg	Z$ 60000

4. Net Income

Z$ 28483 /ha

FIGURES

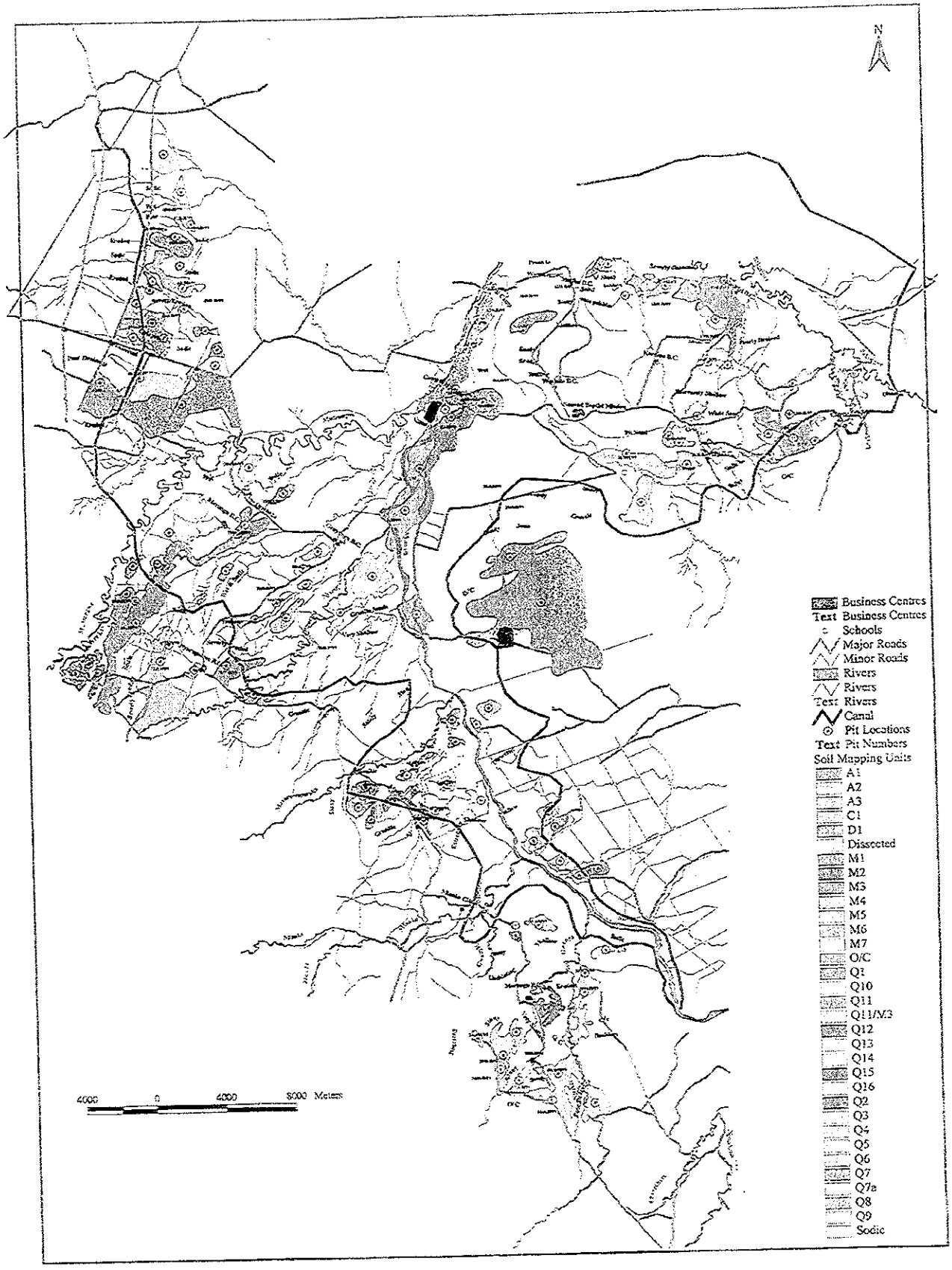


Fig. 1 Soil Map

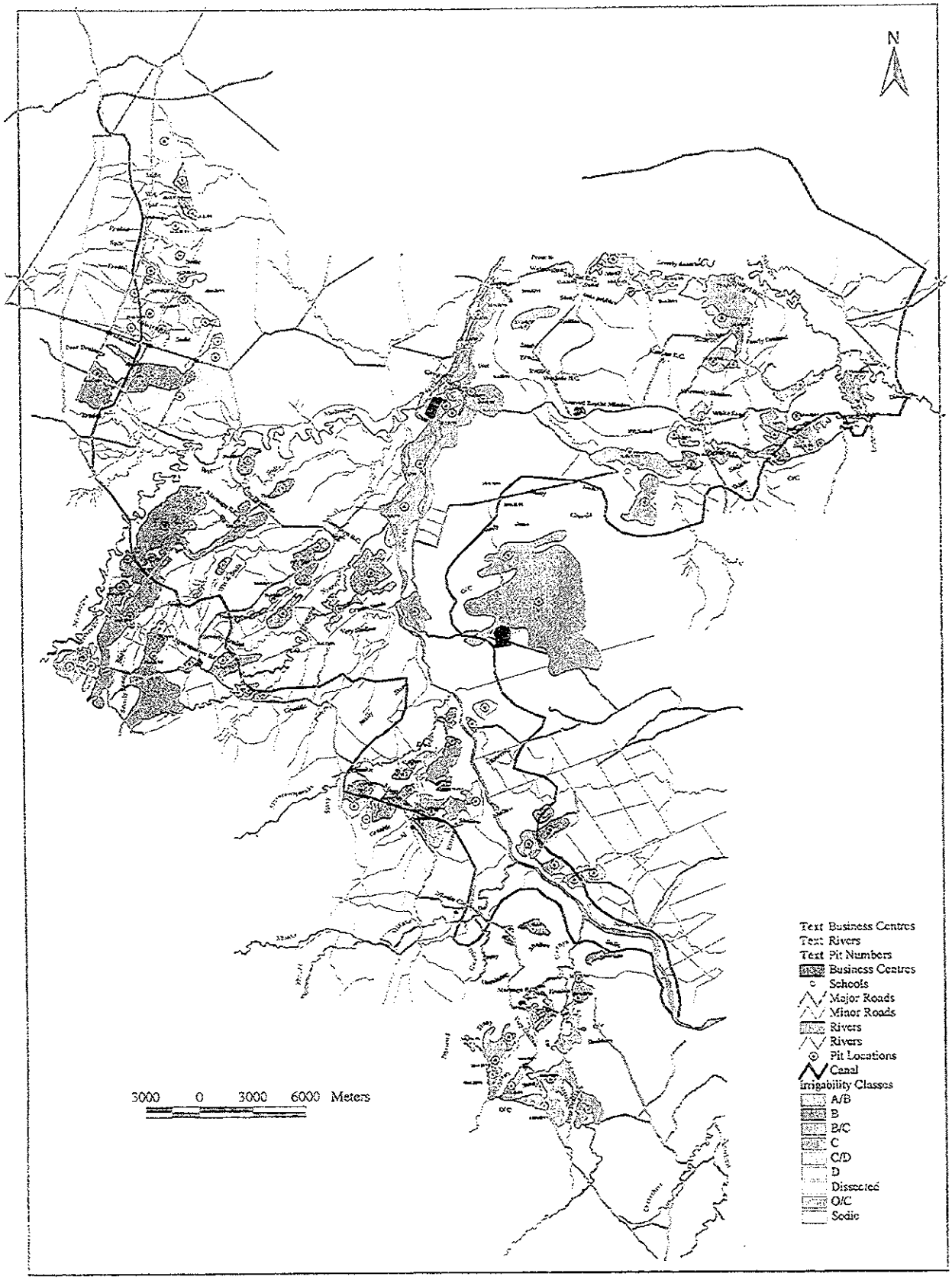
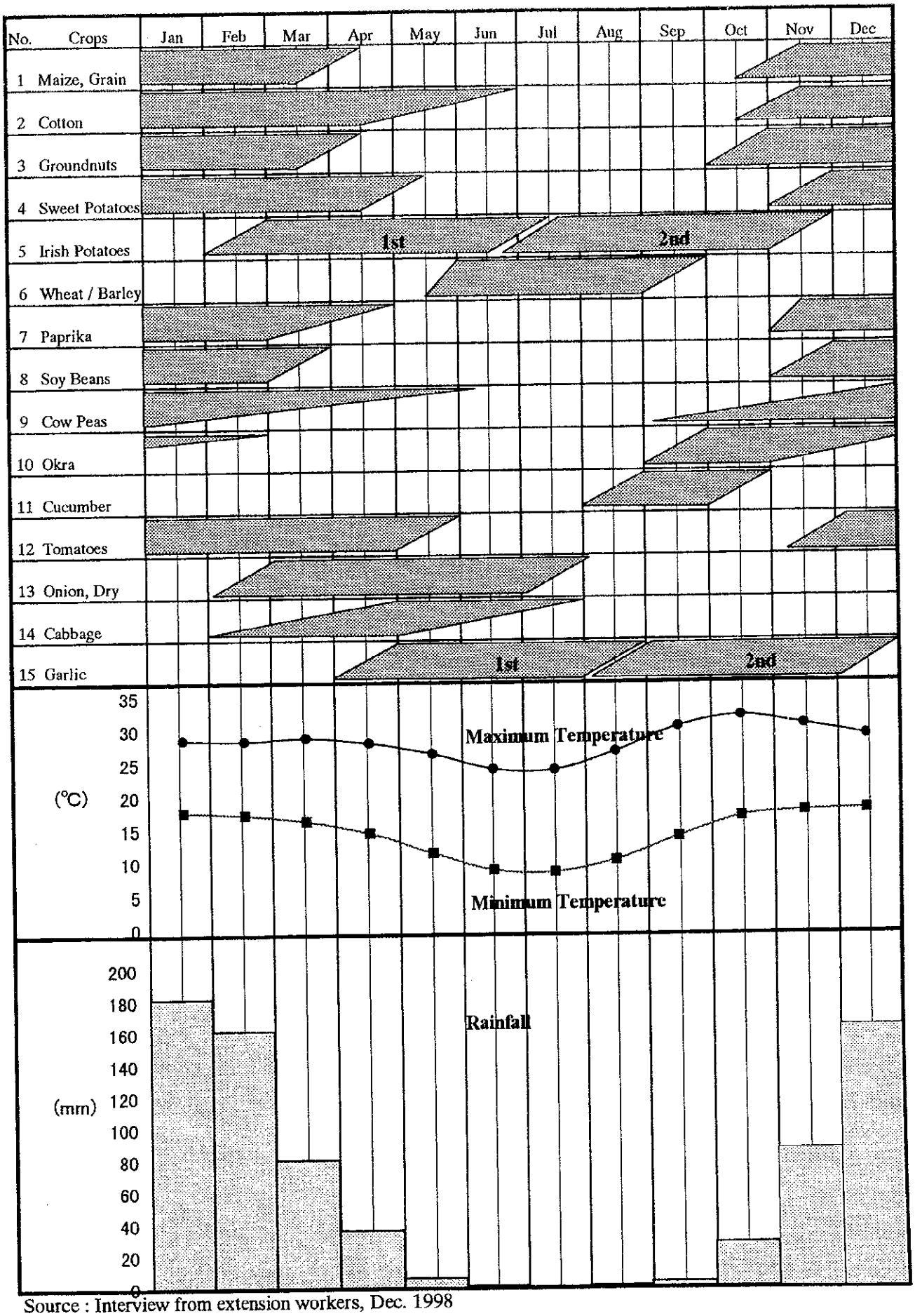


Fig. 2 Land Classification Map

Fig. 3 Present Cropping Pattern



Source : Interview from extension workers, Dec. 1998