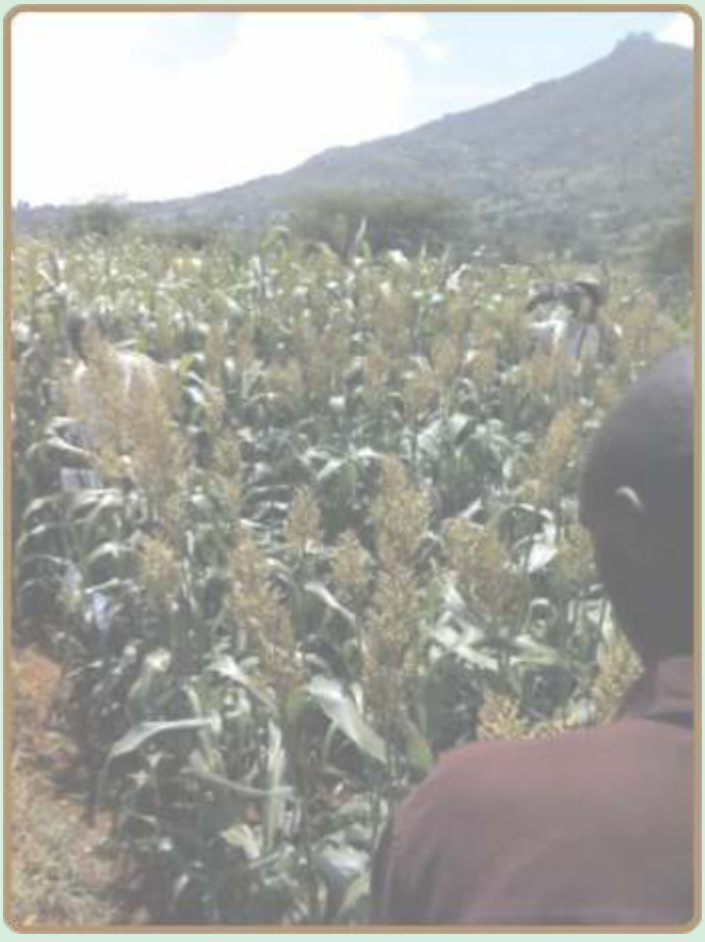
ADAPTING TO DROUGHT CAUSED BY CLIMATE CHANGE



ALRMP - II

CENTRE FOR SCIENCE AND TECHNOLOGY INNOVATIONS
A UNESCO Associated Centre

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A FARMERS' HANDBOOK

ADAPTING TO DROUGHT CAUSED BY CLIMATE CHANGE

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SPONSORS

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FOREWORD

The Sakai Drought Resilience Project was carried out in Sakai Sub-location, Kisau Division, from 2006 to 2010. It was developed to reduce risk and vulnerability to drought caused by climate change through the implementation of participatory activities that promoted sustainable climate adaptation strategies. The project had three objectives, namely to: increase household food security through enhanced livelihood resilience and reduced vulnerability to drought; reduce poverty through improved livelihoods; and facilitate integration of adaptation to climate change into policy development and planning.

Because of the reliance of the community of Sakai on rain-fed agriculture, the project was designed to achieve its objectives in part by showing how the effective use of downscaled weather and seasonal climate information could be used to determine appropriate agricultural activities for the local area. Before the project, no guidelines existed to assist the farmers of Sakai and other arid and semi-arid areas of Kenya in making decisions on the production of crops and livestock on the basis of the amount and the timing of rainfall. This document - *A Farmers' Handbook* - addresses this gap. Produced as part of the Sakai Drought Resilience Project, it provides guidelines for farming decisions based on seasonal weather forecasts. The guidelines are intended to be used within the Sakai farming community as well as other areas with similar agro-ecological and livelihood characteristics.

I would like to express my sincere gratitude to the Global Environment Facility (GEF) and the governments of the Netherlands and Norway who generously provided funding for this Handbook. This project would not have been possible without the initiative of the United Nations Environment Programme (UNEP) which developed and provided technical oversight of the regional project through which this pilot project was carried out. The regional project was called "Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa." It promoted integrating considerations of vulnerability and adaptation to climate change into sustainable development plans and planning processes at the field and policy level in Kenya, Mozambique and Rwanda.

The International Institute for Sustainable Development and the African Centre for Technology Studies played an active role in the management of this project. Their technical support is appreciated.

I would also like to extend my sincere appreciation to our close partners, the Arid Lands Resource Management Project, as well as to members of the Sakai pilot project.
It is my sincere hope that this Handbook will be valuable in encouraging the Sakai community and the other people in the arid and semi-arid lands of Kenya to adapt to drought caused by climate change.

Prof. Shem Wandiga FRSC
Managing Trustee, Centre for Science and Technology Innovation (CSTI)

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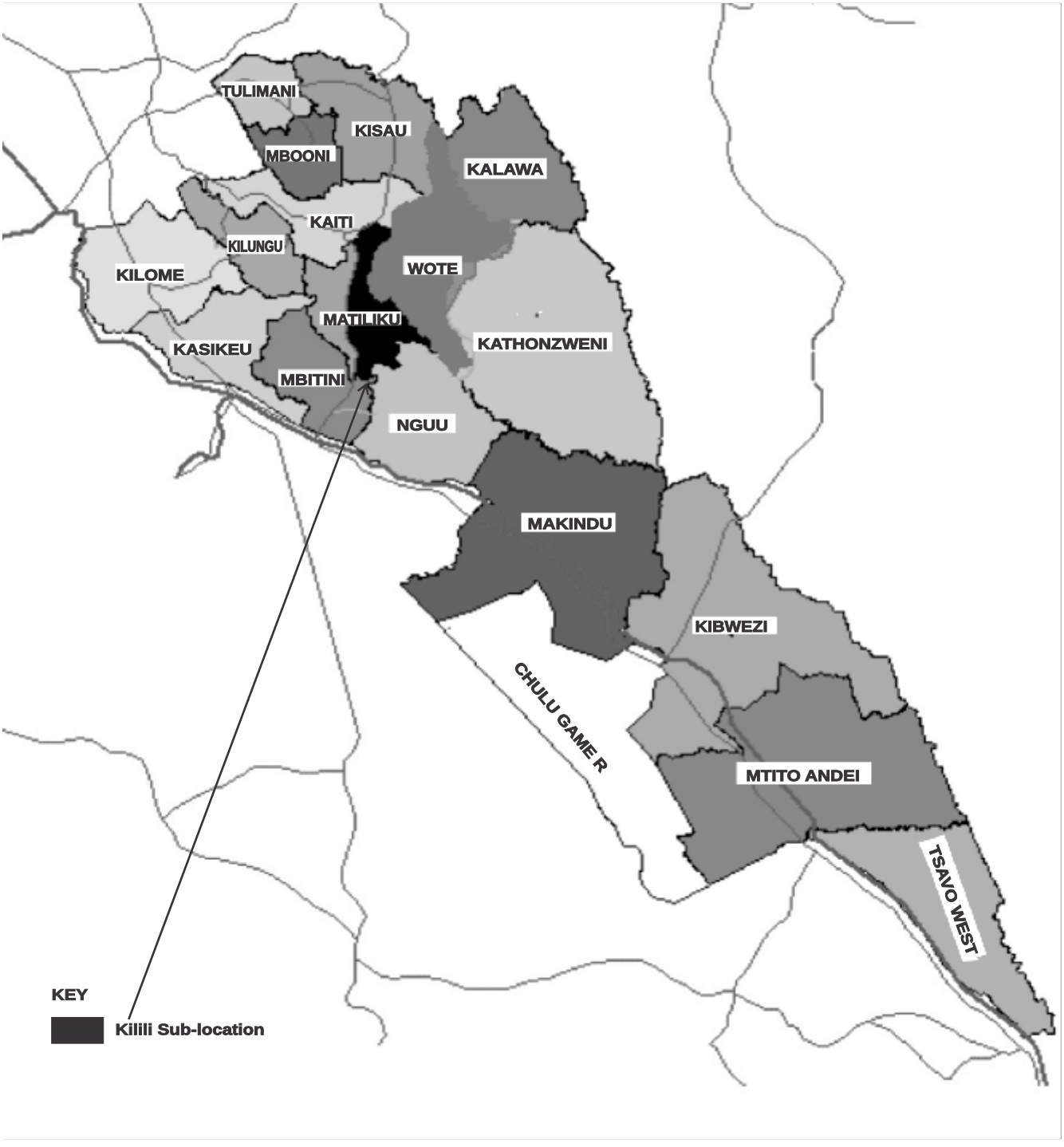
INTRODUCTION

Sakai Sub-location is situated in Waia Location, Kisau Division, Mbooni East District. Mbooni East District was carved out of the former Makueni District (Figure 1). It consists of five villages, namely, Kathamba, Kiteani, Linga, Muiu and Nthongoni. The area is situated 20 km from Wote town, the Makueni District Headquarters, along the Wote-Tawa-Machakos road. It falls within the agro-ecological zone LM4 (Lower Midland Zone 4), also referred to as the Marginal Cotton Zone. Sakai Sub-location has an area of approximately 24.5 km^2 and a population of 4,866 people according to the 2008 population projections.

The climate of Sakai is characterized by long (mid- to late March to mid-May) and short (late October to late December) rainfall seasons, interspersed with two dry seasons, that is, the short dry season (January to mid-March) and the long dry season (mid-May to mid-October. The short rains tend to be more reliable, contributing about 60% of the annual rainfall and enabling about 70% of the total crop production in Sakai. The rains in both seasons are poorly distributed making frequent droughts the major hazard experienced in the area. Food insecurity caused by these droughts has forced and is still forcing the affected communities to increasingly rely on relief food.

Figure 1: Map of Greater Makueni District, including East Mbooni District



Source: Survey of Kenya, 2005

SEASONAL CALENDARS

In an area such as Sakai where the seasons are usually short and rainfall is low and erratic, timely land preparation and planting is crucial for successful crop production. In Sakai, the timing of these activities has traditionally been determined on the basis of seasonal calendars. The annual timing of rain-fed agricultural and livestock activities usually undertaken in Sakai is shown in Figures 2 and 3. The crop production calendar (Figure 2) shows when activities such as land preparation, planting, weeding and harvesting take place. The livestock production calendar (Figure 3) shows the timing of activities such as pasture establishment, reseeding, haymaking, de-worming and vaccinating take place. Minor irrigation activities, especially for vegetable growing, are also undertaken in Sakai. However, these activities are not highlighted in Figure 2. They are carried out during the dry seasons of January to mid-March and mid-May to mid-October. Farmers plant vegetables during the rains and supplement their growth with irrigation water during the dry seasons.

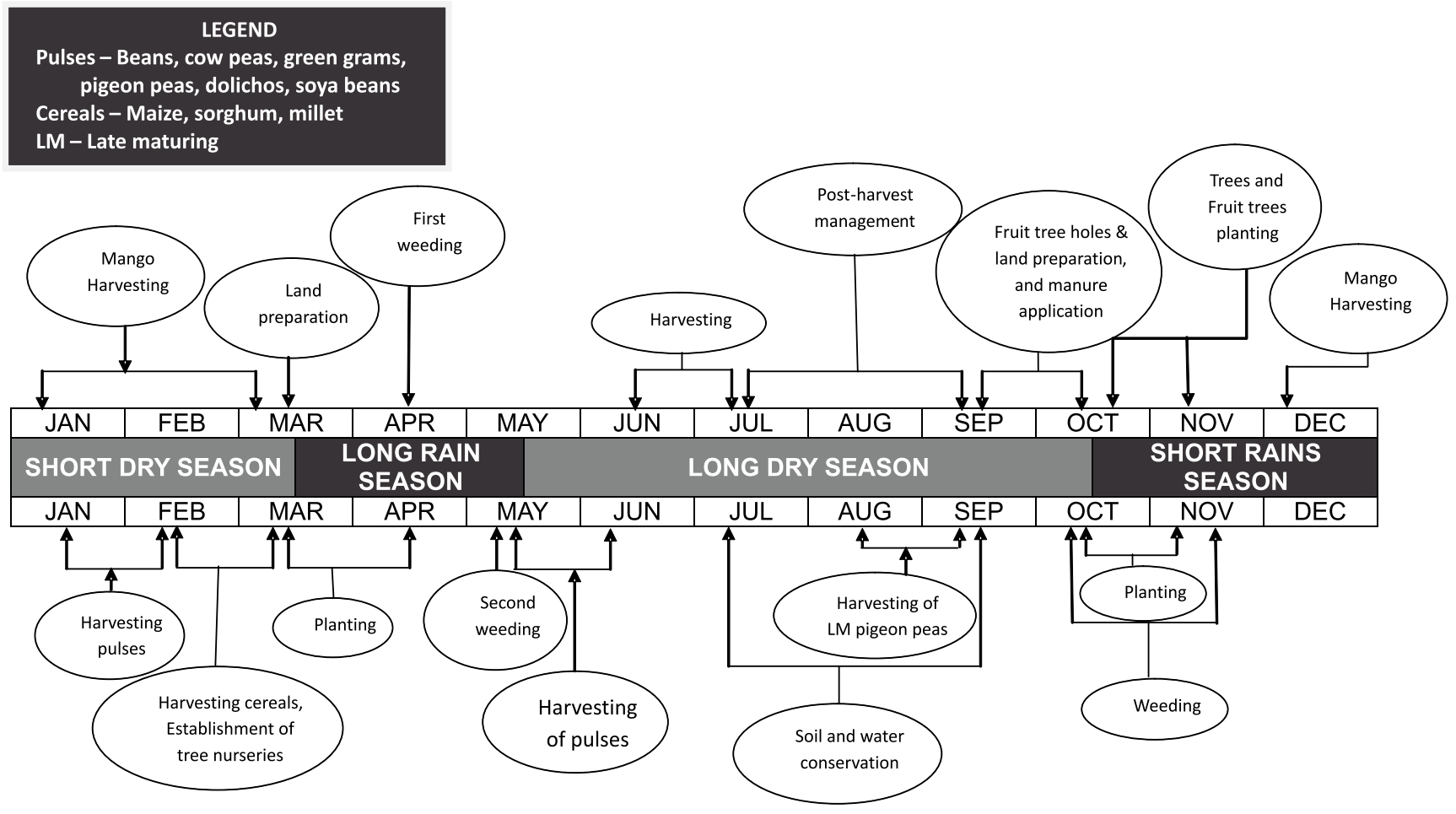
Traditionally, carrying out of these activities was fixed and automatically triggered only by the dates within the provided seasonal calendars. These dates were determined on the basis of Sakai's historic climate—or the long-term average weather conditions in the region. However, average conditions do not account for the variability of weather conditions from day to day and from season to season. Moreover, due to climate change, weather patterns are changing and historical information is used less and less to accurately predict the future.

As a consequence of current uncertainty regarding the arrival of the rains, most farmers in Sakai undertake late land preparation. This usually occurs at the onset of the rains resulting in late planting. Late planting leads to late harvesting of the crop which in turn could lead to post-harvest losses and the outbreak of *Aflotoxicosis* particularly if the crop is harvested and stored when wet (i.e., when its moisture content is still high) due to the onset of the next rainy season.

The late planting of crops also adversely affects livestock production since farmers always prioritize cropping activities at the onset of the rains. This practice ultimately leads to delayed undertaking of livestock activities. Moreover, the late planting of crops leads to late maturity and loss of crop residue which impacts negatively on the availability of livestock feed at the beginning of the March-May rainy season.

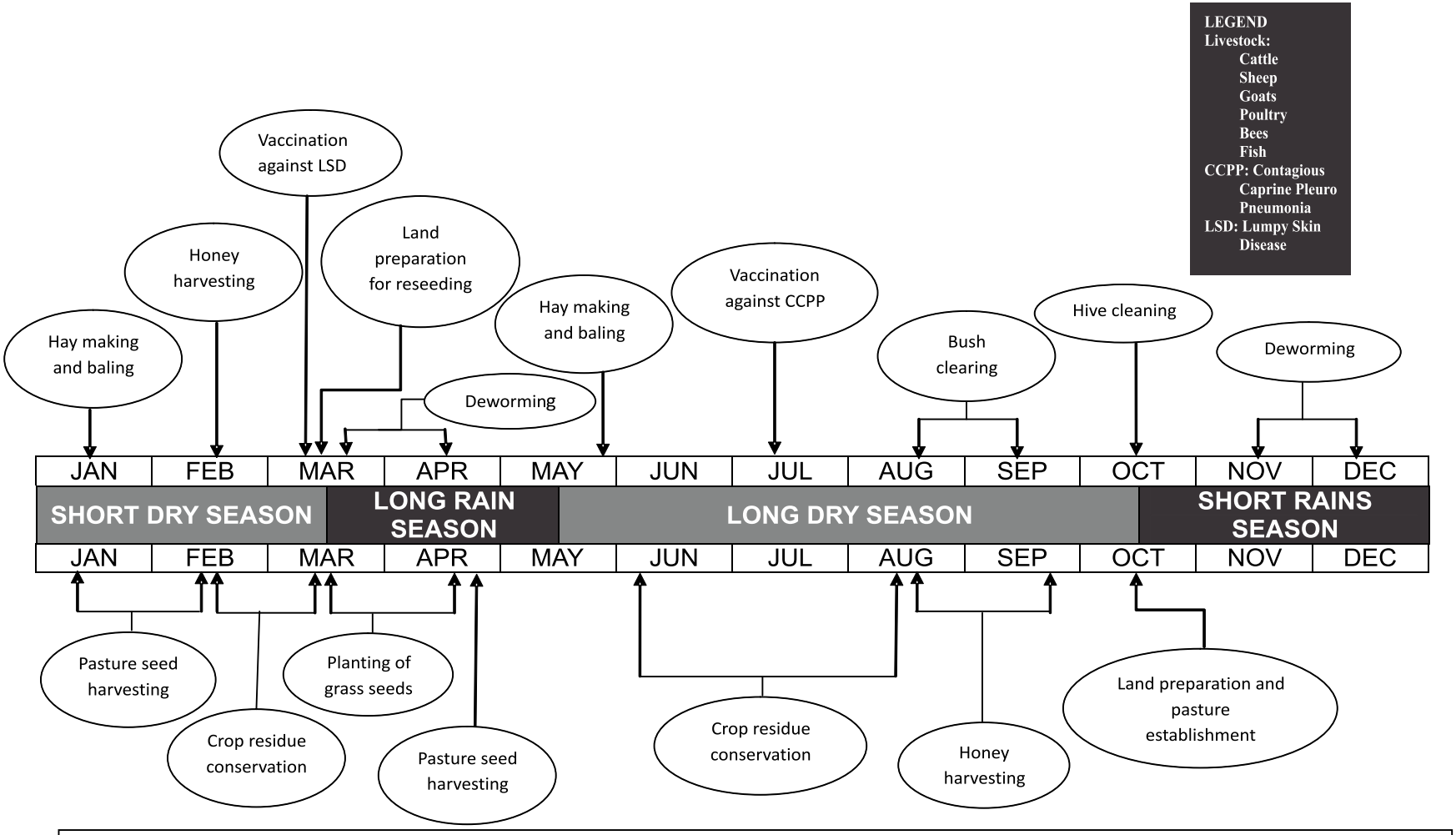
This Farmers Handbook seeks to improve the seasonal crop and livestock production calendar by enabling the triggering of events not on the basis of average historical climate conditions but on seasonal weather forecasts. Demonstrations have shown that farmers who rely on seasonal weather forecasts to decide on when to undertake early land preparation and plant one week before the onset of the rainy season get better yields than those farmers who plant just at or after the onset of the rains.

FIGURE 2: RAINFED CROP PRODUCTION CALENDAR



The timing of activities in this calendar is currently fixed. For example, land preparation automatically occurs in mid-March for the March – May season. However, with enhanced use of weather information to plan agricultural activities, the timing of activities is expected to be flexible. Actions are taken depending on the information provided by the seasonal rainfall forecasts.

FIGURE 3: RAINFED LIVESTOCK PRODUCTION



The timing of activities in this calendar is currently fixed. For example, land preparation for re-seeding automatically occurs in mid-March. However, with enhanced use of weather information in planning of agricultural activities in the area, the timing of activities is expected to be flexible. Actions taken will depend on the information provided by the seasonal rainfall forecasts.

A GUIDE TO THE FARMERS' HANDBOOK

This Handbook is designed to provide farmers with guidance on how to use seasonal forecasts provided by the Kenya Meteorological Department (KMD) to determine the seeds to plant, the time to plant and the depth and spacing of seeds.

Before the start of each rainy season, the KMD issues forecasts of the most probable rainfall situation for the region. These forecasts are shared with farmers directly through TV, radio, newspapers and press releases, or indirectly through local extension officers. The KMD and relevant Ministries, such as the Ministry of State for Development of Northern Kenya and Other Arid Lands, are continuously working to improve the quality of the seasonal forecasts and how they are shared with farmers.

The seasonal forecasts provided by the KMD usually state that the amount of rainfall will be: *above normal to normal, normal to above normal, normal to below normal* and *below normal to normal*. Upon receiving this information, farmers are advised to consult the Tables contained in the remainder of this Handbook as indicated below:
Each of the Tables provides advice on appropriate agronomic practice. Farmers are advised to select the right data and apply agronomic practices corresponding to the situation as suggested in the Table.

Please note the guidance provided at the top of each Table regards the portion of land to be planted following the information therein and the information contained in any additional Tables. Farmers are advised to follow this guidance in order to reduce their risk if the seasonal forecast turns out to be inaccurate.

KMD Forecast	Handbook Classification	Table to Consult	
		Oct – Dec Season	March-May Season
Above-Normal to Normal	Above-Normal	Table 2	Table 5
Normal to Above-Normal	Normal	Table 1	Table 4
Normal to Below- Normal			
Below- Normal to Normal	Below-Normal	Table 3	Table 6

OCTOBER - DECEMBER SEASON FORECASTS

Table 1: 'Normal' October - December Forecast

Plant 60% of the farm with the recommended crops in this table and 40% of the farm with crops recommended in Table 3.

CROP			PLANTING DATE	PLANTING DEPTH	SPACING
CEREALS	**MAIZE**	KCB DLC1 Local *(Kinyanya)*	One week before rain onset	8 cm	90cm x 30cm
	SORGHUM	KARI – M1 Gadam Seredo	One week before rain onset	5 cm	60cm x 20cm
	MILLET	(KPM2, KPM3, KPM1)	One week before rain onset	5 cm	60cm x 15cm
		Finger millet (KFM1), Proso Millet			30cm x 10cm
PASTURES		Boma Rhodes	One week before rain onset	1 cm	Broad cast or drilling (30x continuous)
		Nappier	At rain onset	5 cm Sandy loam (5-7 cm`)	90cm x 60cm, (60x60x60 cm size of the hole Tumbukiza) Intra/Interpit dist. 60 – 90cm
		Eragrostis superba	One week before rain onset	1 cm (pound the awn)	Broad cast
		Cenchrus ciliaris	One week before rain onset	1 cm	Broad cast
PULSES		**Cowpeas** K80, KVU – 271, M 66, Local *Ndamba)* KVU 419 Ken kunde	At rain onset	4 – 5 cm	60cm x 20cm (3-4 seeds per hole; thin to 2 later)
		Green grams N 26; N 22	At rain onset	4 – 5 cm	45cm x 15cm
		Pigeon peas Early maturing (Mbaazi 1); Medium (Kat 60/8); Late maturing (Mbaazi 2) Local *(Kionza)*	At rain onset	4 – 5 cm	50cm x 10cm 75cm x 50cm 100cm x 50cm 120cm x 60cm
		Beans KatB1, KatX68, KatX56, KatB9, GLP92 *Katumbuka)* GLP1004 *mwezi moja* *(Mwei umwe)*	At rain onset	4 – 5 cm	45cm x 20cm
DOLICHOS Lablab		**KatDL1002** (Black *Mbumbu or Nzavi*) KatDL1009	At rain onset	5 – 7 cm	100cm x 50cm
ROOTS AND TUBERS		**Cassava** KME – 1 KME – 61 Mucericeri	At rain onset	5 – 20 cm	100cm x 100cm
		Sweet potatoes KSP 20 KSP 11 CIP 420009	At rain onset	4 – 6 cm	75cm x 50cm
OIL CROPS		**Soya beans** EAI 3600	At rain onset	3 cm	45cm x 10cm
		Groundnuts Red Valencia	At rain onset	6 cm	45cm x 10cm

Table 2: 'Above Normal' October - December Forecast

Plant 50% of the farm with crops recommended in this Table and 50% with crops recommended in Table 1.

CROP			PLANTING DATE	PLANTING DEPTH	SPACING
CEREALS	MAIZE	DH01 DH02 DH04 DUMA 43 Pioneer 3253 PANA 67M Dekalb (DK8031)	One week before rain onset	8 cm	90cm x 30cm
	SORGHUM	KARI - M1 Gadam Seredo Serena	One week before rain onset	5 cm	60cm x 20cm
	MILLET	KPM1 KPM2 KPM3 KATFM1 KAT Proso	One week before rain onset	1 cm	60cm x 15cm 30cm x 10cm
PASTURES		Boma Rhodes	One week before rain onset	1 cm	Broad cast
		Nappier	At rain onset	5 cm	60cm x 60cm Tumbukiza
		Eragroslis Superba	One week before rain onset	1 cm	Broad cast
		Cenchrus ciliaris	One week before rain onset	1 cm	Broad cast
PULSES		**Cow peas** M 66 Green grams Pigeon peas Mbaazi 2 Kat 60/8	As recommended in Table 3		
		Beans KatB9 KatX56 KatX69 GLP77 (*Kakunzu*) GLP 2 (Nyayo)	At the rain onset	3 cm	60cm x 20cm
DOLICHOS Lablab		KatDL1002 (black *Mbumbu* or *Nzavi*)	At rain onset	3 cm	100cm x 50cm
ROOTS AND TUBERS		Cassava KME – 1 KME – 61 Mucericeri	At rain onset	20 cm	100cm x 100cm
		Sweet potatoes - KSP 20 - KSP 11 - CIP 420009	At rain onset	3 cm	100cm x 30cm
OIL CROPS		Soya beans EAI 3600	At rain onset	3 cm	45cm x 10cm
		Groundnuts Red Valencia	At rain onset	6 cm	45cm x 10cm

Table 3: 'Below Normal' October - December Forecast

Plant 80% of the crops recommended in this Table and 20% of the crops in Table 1.

CROP			SOIL TYPE	PLANTING DATE	PLANTING DEPTH	SPACING
CEREALS	MAIZE	Not recommended				
	SORGHUM	Gadam				
	MILLET	Pearl millet KPM2 KPM3 KPM1	Deep red soils	*One week before rain onset	1 cm	60cm x 15cm
		Finger millet (Kat pro -1)				30cm x 10cm
PASTURES		Eragrostis Superba		*One week before onset	1 cm	Broad cast
		Cenchrus ciliaris		*One week before onset	1 cm	Broad cast
		Boma Rhodes		*One week before onset	1 cm	Broad cast
PULSES		Cow peas K80		At the rain onset	4 cm	60 x 20 cm
		Green grams N26		At rain onset	4 cm	45 x 15 cm
		Pigeon peas Not recommended				
		Beans KatB1				
DOLICHOS Lablab		Not recommended				
ROOTS AND TUBERS		Cassava Not recommended				
		Sweet potatoes Not recommended				
OIL CROPS		Not recommended				

MARCH - MAY SEASON FORECASTS

Table 4: 'Normal' March - May Forecast

Plant 80% of the farm with the crops recommended in this Table and 20% of crops from Table 6.

CROP			PLANTING DATE	PLANTING DEPTH	SPACING
CEREALS	MAIZE	Not recommended			
	SORGHUM	Gadam			
	MILLET	Pearl millet KPM2 KPM3 KPM1	One week before rain onset	1 cm	60cm x 15cm
		Finger millet (Kat pro -1)			30cm x 10cm
PASTURES		Not recommended but leave farms fallow for regeneration			
PULSES		Cow peas K 80	At the rain onset	4cm	60cm x 20cm
		Green grams N 26	At rain onset	4 cm	45cm x 15cm
		Pigeon peas Not recommended			
		Beans KatB1			
DOLICHOS Lablab		Not recommended			
ROOTS AND TUBERS		Cassava Not recommended			
		Sweet potatoes Not recommended			
OIL CROPS		Not recommended			

Table 5: 'Above-Normal' March - May Forecast

Plant 60% of the farm with the crops in this Table and 40% of the crops in Table 4.

CROP			PLANTING DATE	PLANTING DEPTH	SPACING
CEREALS	MAIZE	KCB DLC1 Local (Kinyanya) DH01 DH02	*One week before rain onset	8 cm	90cm x 30cm
	SORGHUM	KARI - M1	*One week before rain onset	5 cm	60cm x 20cm
		Gadam			
	MILLET	Pearl millet KPM2 KPM3 KPM1	*One week before rain onset	1 cm	60cm x 15cm
		Finger millet (Kat pro -1)			30cm x 10cm
PASTURES		Boma Rhodes	1 week before onset	1 cm	Broad cast
		Nappier	At rain onset	5 cm	90cm x 60cm
		Eragroslis Superba	1 week before onset	1 cm	Broad cast
		Cenchrus ciliaris	1 week before onset	1 cm	Broad cast
PULSES		**Cow peas** K 80 KVU – 27-1 M 66 Local (Ndamba) KVU - 419 Ken kunde	At the rain onset	4cm	60cm x 20cm
		Green grams N 26 N 22	At rain onset	4 cm	45cm x 15cm
		Pigeon peas Early maturing (*Mbaazi* 1) Kat60/8	At rain onset	4 cm	-50cm x 10cm
		Beans KatB1 KatX68 KatX56 KatB9 GLP92 (*Katumbuka*) *Mwezi moja- (mwei umwe*)	At the rain onset	3 cm	45cm x 20cm
DOLICHOS Lablab		KatDL1002 (black *Mbumbu or Nzavi*)	At rain onset	3 cm	100cm x 50cm
OIL CROPS		**Soya beans** EAI 3600	At rain onset	3 cm	45cm x 10cm
		Groundnuts Red Valencia	At rain onset	6 cm	45cm x 10cm

Table 6: 'Below - Normal' March – May Forecast

Plant cow peas (K80), beans (KATB1) and maintain Ratoon sorghum crop.

CROP			**PLANTING DATE**	**PLANTING DEPTH**	**SPACING**
CEREALS	SORGHUM (Ratoon)	Gadam, Seredo, Serena, KARI M1	One week before rain onset	5 cm	60cm x 20cm
PULSES		Cow peas - K 80	At the rain onset	4cm	60cm x 20cm
		Beans - KATB1			

ADDITIONAL GUIDANCE ON CROP PRODUCTION

Land preparation

Land preparation should be done at least two weeks before the onset of the rain season. Tilling of the land should involve deep digging using oxen or hoes to break the hard pan. Land preparation also includes preparing furrows for manure or planting. These land preparation activities should be carried out in such a way as to conserve water such as by preparing shallow ridges to capture water between rows and, depending on the crop to be planted, preparing basins for water retention. Furthermore, soil and water conservation structures should be repaired or constructed as part of land preparation.

Farmyard manure

Apply well-decomposed manure on the furrows and mix it well with the soil before planting. Observe the recommended rates of farmyard manure application in sandy soils and other types of soil as follows:

- Sandy soils = 5 tons per acre
- Other soil types = 3 tons per acre.

Fertilizers

Farmers are advised to get in touch with the local agricultural extension officers for guidance on the selection and use of appropriate fertilizers for planting and top-dressing.

Pests and disease control

The recommended pests and disease management should be adhered to and, if necessary, farmers should seek assistance from extension officers. This should be a continuous exercise.

Weeding

The first weeding operation should be done within the first two weeks of crop emergence. It is recommended that the second weeding take place two weeks after the first one and should incorporate earthing-up and ridge formation where appropriate.

Crop rotation

Farmers should always practice crop rotation. For instance, cereals should be rotated with pulses and oil crops. This practice maintains fertility levels in the soil and breaks pest and disease cycles.

ADDITIONAL ADVICE ON POST HARVEST MANAGEMENT

Farmers should utilize the post-harvest technologies recommended below when harvesting and preparing crops for the market:

Shelling

Hand shelling results in a lower percentage of broken grains (maize) as compared to mechanized shelling. However, where mechanical shelling has to be done, correct calibration needs to be observed.

Grading

Grading takes into account the separation of good grains from the broken ones, grains damaged by pests, foreign material and discoloured grains (due to weather, rodent attacks and fermentation). In addition, shrivelled grains with papery skin and decaying kernels are undesirable. Grain dusting should also be undertaken in order to improve grain quality and also to avoid damage by pests. Some of the current recommended grain dusts include *Sumi combi, Spintor dust, Super grain dust, Actellic super*, and *Skana dust*. It is important that only recommended pesticides for control of storage pests are used.

Packaging

In order to maintain the grain quality for as long as possible, mouldy bags should not be used. Moreover, avoid using propylene or plastic polythene bags for storage beyond one month. Use bags made of sisal, jute or bags made from a combination of natural fibres. Old stock should never be mixed with fresh harvest and bags and other storage containers should be treated with insecticides and fungicides before use. In addition, worn out or damaged bags should be repaired to avoid the spilling of grains. Unshelled produce should never be stored.

Best storage practices

Best storage practices should be observed in order to avoid damage by insects, rodents and moulds ('*mbuuka*'), and thereby maintaining quality. The storage location should be dry, cool, well ventilated and free of insects, birds and rodents. The produce should never be stored in the bedroom or on the floor. The use of wooden pallets (10 cm high) is recommended. Bags should never be stacked next to walls; rather, there should be a space of at least one meter between the wall and the bags. It is important that all pests,

especially weevils and the Larger Grain Borer (LGB), are properly controlled. It is recommended that the grain is churned frequently to break cells of moisture. Grain should also be checked for moisture condensation, heating, moulding, insect infestation and any other deterioration signs. When getting the grain out of the storage location for use, the principle of '*first in, first out*' needs to be observed. It is recommended that each household stores enough food for its use, which is equivalent to 135kg of maize and 45kg pulses per person per year.

Best transport practices

It is important that best transport practices are observed to enable the delivery of grain with the same quality as when it was loaded. Issues to be strictly observed include: using clean transport; avoiding mixing grains with other products or luggage; maintaining clean, cool and dry conditions during transits; covering the produce with water-proof sheets; and avoiding the spilling of grains during loading and unloading.