REPUBLIC OF KENYA

Ministry of Agriculture, Livestock, Fisheries and Cooperatives

CRAFT

Climate resilient value chains for improved livelihoods

Climate smart greengram training aid

Climate smart greengram training aid

REPUBLIC OF KENYA

Ministry of Agriculture, Livestock, Fisheries and Cooperatives

CRAFT

Climate resilient value chains for improved livelihoods

MALF&C 2020. Climate Smart Greengram *(Vigna radiata)* Training Aid (February 2020)

Copyright © 2020 Government of Kenya

Reproduction of this publication for educational or non-commercial purposes is authorized without written permission from the copyright holder, provided that the source is fully acknowledged. Reproduction of the publication for resale or other commercial purposes is however strictly prohibited, except with prior written permission from the copyright holder.

For further information, please contact

Principal Secretary
Ministry of Agriculture, Livestock, Fisheries and Cooperatives
Cathedral Road, Nairobi
P. O. Box 34188-00100 Kenya
Nairobi, Kenya
Telephone: +254-20-2718870
E-mail: psagriculture@kilimo.go.ke
www.kilimo.go.ke

Disclaimer: The mention of specific companies or products of manufacturers, whether or not these has been patented , does not imply endorsement or recommendation by the Ministry of Agriculture , Livestock and Fisheries in preference to others of a similar nature that are not mentioned.

PREFACE

The agricultural sector in Kenya and more so the Greengram farming has been facing a number of challenges ranging from increase production costs, prevalence of diseases and pests, inadequate credit, weather and climate changes, poor marketing infrastructure amongst others.

Recent climate change projections done by the SNV led - Climate Resilient Agri-business for Tomorrow (CRAFT) project shows that, during both the first (MAM) and second (OND) rainy seasons, temperature in the greengram growing areas of western and south-eastern Kenya is expected to rise by about 1.4°C to 1.8°C and 2.4°C to 2.8°C in the 2030s and 2050s respectively

The temperature increase, with the associated rainfall spatial-temporal changes will impact greatly on the greengram yields in Kenya, which currently ranges from 0.5 to 0.6 tons/ha against a global average yield of 0.73 t/ha, this is far below the potential of the crop (MoALF, 2016).

To address innovative and transformative measures are therefore urgently required to assist greengram value chain stakeholders to adapt and cope with effects of current and projected change in climate patterns.

The use of climate smart agriculture (CSA) practices, technologies and services have been identified as a viable approach to provide solutions towards increased agriculture sector productivity while addressing impacts of changing climate.

This Greengram *(Vigna radiata)* Training Aid compliments learning from the "Climate Smart Greengra*m (Vigna radiata)* Resource and Training Guide" recently developed by the Ministry of Agriculture, Livestock, Fisheries and Cooperatives early this year in partnership with SNV led-CRAFT (Climate Resilient Agribusiness for Tomorrow) Project, Agriculture and Food Authority (AFA), Kenya Agriculture and Livestock Research Institute (KALRO), and ACT among other stakeholders.

The training aids has been derived from the developed "Climate Smart Greengram *(Vigna radiata)* Resource and Training Guide" and has put a lot emphasis on hands-on practical training, imparting of skills and competencies needed for the specific training requirement needs for the greengram small holder farmers –men, women and youth.

The Training Aid should be used in conjunction with the Climate Smart Greengram Resource *(Vigna radiata)* Resource and Training Guide. Both are very valuable resources for state and non-state extension service providers.

.

ACKNOWLEDGEMENT

The Ministry of Agriculture, Livestock, Fisheries and Cooperatives do acknowledge the technical and financial support from the Climate Resilient Agribusiness for Tomorrow (CRAFT) project partners lead by Netherlands Development organization (SNV) and Climate Change Agriculture and Food Security (CCAFs) and the African Conservation Tillage Network (ACT), who were very instrumental in the development of the Greengram Training Aid.

Much appreciation goes to the technical team, which include SNV-Joseph Muhwanga, Joyce Mbingo and Oscar Nzoka from SNV; - John Recha, Joab Osumba and Teferi Demissiea from CCAFs; - Saidi Mkomwa, Peter Kuria and Weldone Mutai from ACT, while Paul Obusuru and Naomi Kihara from the Ministry of Agriculture, Livestock, Fisheries and Cooperatives. Gratitude also goes to Leonard Kubok, Elizabeth Langat and Milton Munialo all of Agriculture Food Authority.

I would also like to acknowledge input from KALRO especially contributions from Rael Karimi and Charles Bett.

Special thanks go to CRAFT project for supporting the development and printing of this valuable Training Aid.

CONTENTS

1 OUTLINE OF THE GREENGRAM TRAINING AID

This Training Aid document compliments learning from the "Climate Smart Greengram *(Vigna radiata)* Resource and Training Guide" published by the Ministry of Agriculture, Livestock, Fisheries and Co-operatives in February 2020 in partnership with SNV led - CRAFT (Climate Resilient Agribusiness for Tomorrow) Project, Agriculture and Food Authority (AFA), and Kenya Agricultural & Livestock Research Organization (KALRO) among other stakeholders. The learning approach places emphasis on hands-on practical training and imparting of skills needed for the specific trainees. .

The training aid is divided into three parts based on the nature of the content:

I. Brief Outline of the Training Aid
II. A Guide to the f acilitator
III. Training Sessions

1. Learning objectives
2. Learning activities and/or exercises
   a. Objectives
   b. Materials
   c. Time
   d. Methods/procedures
   e. Discussions points
3. Review questions

I. Brief Outline of the Training Aid

As one plan to use this Training Aid, it is necessary to understand the outline in order to structure the training accordingly. The outline segments highlight the content of the training aids and what one is expected to see in this guide. It also highlights to the trainer, what the teaching aids and lesson plans on greengram production are and what is contained in these parts of the training aid.

II. A Guide to the Facilitator

In facilitating training, it is essential to understand how adults learn, the role of the facilitator and participatory learning techniques that can be applied. Facilitators have an important task to deliver key messages which excites interest and enthusiasm among the target group to learn and make decisions that lead to positive actions. The Extension Worker/agent and the Lead Farmer are central to the Farmer to Farmer learning process and their role as Trainers/ Facilitators is critical in enhancing access to technical support to smallholder farmers for increased production and productivity. This section of the Training Aids provides a guide for these facilitators to conduct trainings that lead to positive change in farming practices and improve farmers' livelihoods.

III. Training Sessions

The teaching aids summarise the objectives to be achieved, befitting topics and sub-topics to be covered, materials required for the training, approaches and methods, the time requirements, and the tools to eventually assess or evaluate the effectiveness of the training. Other teaching aids include selected learning activities /exercises to impart skills and general awareness on the climate smart practices and technologies. The section is concluded by review questions, discussed in the plenary as a quick check that critical issues have been covered.

2 A GUIDE TO THE FACILITATOR

The following highlights are a guide for these facilitators to deliver trainings that lead to positive change in farming practices and improve farmers' livelihoods.

2.1. Adult Learning

The target audience (farmers) in trainings are adults (men and women) and youth with experience, knowledge and skills. Each adult and youth bring to the learning experience, preconceived thoughts and feelings that will be influenced by motivation, the amount of previous experience, the level of engagement in the learning process, and how the learning is applied. Learning something new is not just achieved in an instant. Referring back and making use of the knowledge and skill is the basis of the adult learning process. The new learning will have to be internalized (processed) by making it relevant to oneself. Only after this can the learning be applied when confronted with a similar situation. Remember the 20.40.80 principle of adult learning: Adults remember 20% of what they hear, 40% of what they hear and see, and 80% of what they hear, see, and do. It is advisable to use as much creativeness as possible.

2.2. The Role of the Facilitator

A facilitator is not an instructor and creates conditions for farmers (men, women, and youth) to learn by arranging opportunities for them to observe and interpret differences, to carry out simple tests and exercises, and through discussions. The facilitator encourages farmers to adopt an active role in the learning process through making use of participatory approaches which engage the participants as much as possible.

The main features of the attitude and role of a facilitator are:

- To listen to farmers (men, women, and youth) and respect their knowledge, experiences and perceptions,
- To give farmers the confidence to share their knowledge and experiences,
- To create suitable conditions and activities from which farmers can learn,
- To be responsive to farmers' needs and flexible in organizing the training,
- To increase farmers' knowledge, skills and problem-solving ability

2.3. Facilitation & Learning Techniques

Facilitation is a process which is driven by a Facilitator who manages a learning environment (conducive atmosphere); through exchange of ideas; which involves ANALYSIS (detailed scrutiny or examination of an issue of common interest); which should lead to change or development.

Facilitation may include the following:

i) **Plenary Introduction**
A plenary introduction is normally the first activity to start a new training session. Its' main objective is to introduce the subject and to familiarize the participants to some basic concepts by referring to familiar and related topics..

ii) **Brainstorming**
The main objective of a brainstorming session is to introduce new topics and to discover new ideas and responses very quickly by having the group describing the topic or idea by listing an exhaustive list of related characteristics and condition.

iii) **Small group discussions**
Instead of discussing one subject with the whole group, more subjects can be discussed by using small groups. The main objective is to give every participant a way to actively participate in the discussion.

iv) **Practical (field) activities**
To give participants the opportunity to go to the field and experience a new technology by watching and doing. The objective is to learn through practicing new practice..

v) **Plenary discussion / presentation**
The plenary discussion can follow directly after small group discussions but does not need to do so. The objective of the plenary discussion/presentation is to synthesize the ideas of the participants about a (new) topic or information that is discussed within the group. A training session using the method of plenary discussion may split up in small groups.

2.4. Training Materials

Such materials as markers, flip charts, masking tape, posters, training manual and a session guide for guidance during the training are needed for each session of the training. Fact sheets are particularly important especially if they are written in local language or dialect. Be prepared for illiteracy. And adapt training accordingly. The use of visual training aids such as pictures is also encouraged.

2.5. Training Evaluation Method

It is important to evaluate the training so that the facilitator is informed about the impact of the training in terms of knowledge retention. Different evaluation methods can be used e.g.:

- Pre- and post-tests
- Participants' feedback such as through recaps.
- Final training evaluation checklist

3 TRAINING AIDS AND EXERCISES

SESSION 1: OVERVIEW OF THE GREENGRAM SUBSECTOR

To prepare for the training, as a trainer, you should take time to read and understand the training content. Maintain interactive engagement with trainees throughout the session.

Learning objectives

At the end of the session the learner should be able to:

- Explain the importance of greengram, productivity and business potential
- Describe the constraints/limitations facing greengram value chain in Kenya
- Explain the Strength, Weakness, Opportunities and Threats (SWOT) of the greengram subsector in Kenya

Materials

Flip charts, marker pens, posters and flyers

Training Methodology

- Facilitation (group discussion, plenary presentation)
- Demonstrations, charts, visual aids/posters
- Case studies/Exercises

Duration

1 hour

Discussion points

Include the information below as you discuss with the farmers/trainees, ask as much as you can to open up for discussion.

Introduction

Greengram is an important pulses crop commonly grown and consumed in Kenya. It is believed to have originated from India and its cultivation has spread to several countries of Asia, Africa, and the Americas in the recent times. It is used in several food products, both as a whole seed and in processed form as an excellent source of high-quality protein with high digestibility. Greengram is considered to be hardiest among all pulse crops and can tolerate drought to a great extent. Hence, it is successfully grown in any adverse conditions and particularly in drought prone areas.

This session should cover the general overview of greengram subsector, importance and challenges facing its production along the value-chain. In addition, introduce aspects regarding global greengram production outlook, importance of greengram, Kenya's production status and the subsector constraints.

Production and consumption of Greengram in Kenya

Greengram is one of the most popular pulses commonly grown and consumed in Kenya in the arid and semi-arid lands (ASALs), for food and sale, with the bulk of the produce sold in local markets. It is a major income generating enterprise.

The major producing regions in Kenya include:

- Eastern: Kitui, Makueni, Tharaka Nithi, Machakos, Meru and Embu,
- Coast: Taita Taveta, Kilifi and Tana River,
- Nyanza: Migori, Busia and Homa Bay and
- Rift Valley: Kerio valley, Elgeyo Marakwet, Baringo and West Pokot.

The Eastern Region Counties are responsible for over 95% of national production, with at least 51% of the producers being women.

According to 2018 Kenya National Crop data, the total hectarage for greengram was 362,938 ha against the production of 206,619 metric tonnes (MT) translating to 570 kg/ha or 6 bags of 90 kg/ha. Figure 2 shows the potential greengram growing areas in Kenya.

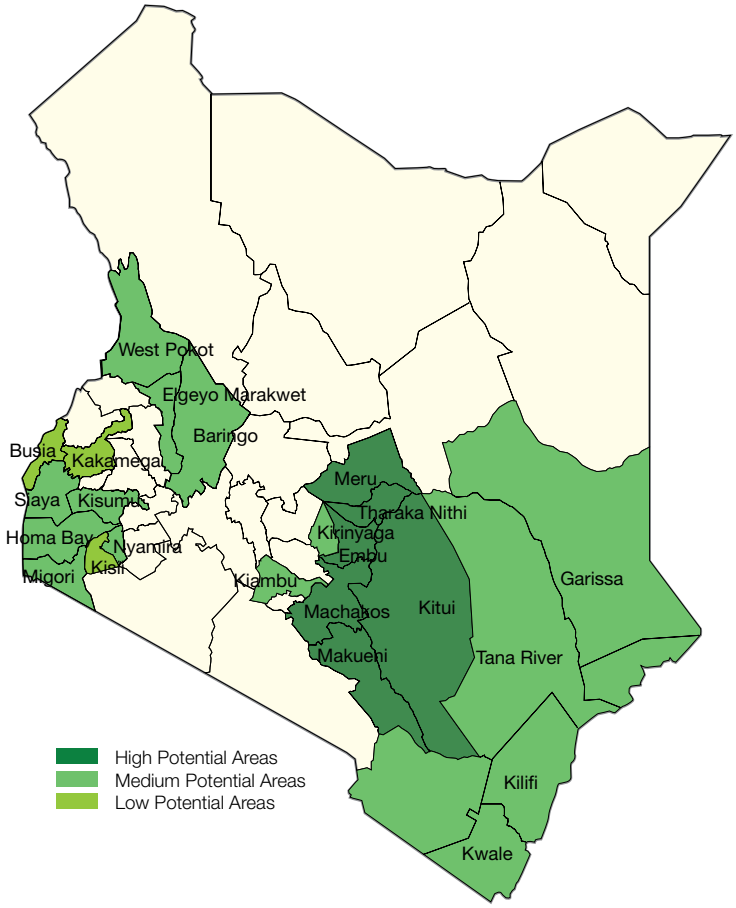


Figure 2: Greengram producing Counties in Kenya

Challenges facing greengram value chain in Kenya

Greengram yields have been declining from 460 kg/ha in 2010 to 380 kg/ha in 2013 in Kenya which is low than the global average yield of 730 kg/ha. The challenges that have impacted negatively to the greengram subsector include impact of climate change; land degradation; decreasing soil fertility; limited access to quality seeds; pest and disease prevalence; water scarcity; weed infestation; land size and fragmentation; unstructured marketing systems; post-harvest losses; inadequate primary processing technologies and services; and limited technical knowledge..-

Learning Exercises

Learning Exercise 1.1: Situation analysis with regard to greengram production

Learning objective

To capture the current situation of greengram production according to the participants

Materials

Flip charts, marker pens and two posters – Importance of greengram (Annex 1.1) and National production of greengram (Annex 1.2).

Training Methodology

1. Break the participants into groups
2. Provide each group with marker pen and flip charts
3. Assign each group to discuss the following issues using the posters in a question-posing mode, allowing participants to discuss and discover what they represent. The agreed responses should be captured in flip chart for plenary presentation: Ask participants
   - To indicate the highest, average and lowest greengram yields in their area.
   - To analyse the causes of low greengram yields and production,
   - To describe what can be done to improve the yields and production.
   - To list/map out the greengram growing areas in Kenya/their county
4. Afterwards, each group will present to the plenary for discussion and establishment of the situation on greengram production in their region
5. Summarize the discussion notes as situation analysis of greengram production in the region

Review Questions

1. Briefly describe greengram and state its importance to farming community
2. What is the value of greengram in human nutrition?
3. List five practices that contribute to farmer resilience and increased yields
4. Describe the challenges that greengram farmers face in Kenya

SESSION 2: CLIMATE CHANGE AND AGRICULTURE

To prepare for the training, as a trainer, you should take time to read and understand the training content. Maintain interactive engagement with trainees throughout the session.

Learning Objectives

By the end of this session the participants will be able to:

- Define climate change and explain its causes
- Describe the risks and opportunities resulting from climate change for greengram
- Explain how Kenya's variable climatic conditions affect greengram production and livelihood vulnerability to climate change
- Discuss the different climate projection scenarios and how these can be countered
- Describe different types of climate information for greengram and its importance in making farming decisions
- Describe the CSA practices and their potential to address the limitations in greengram production
- Explain the use of several CSA technologies, including rural communities' local knowledge, as strategies to deal with difficult weather conditions

Materials

Flip charts, marker pens, note books, posters, flyers

Training Methodology

- Facilitation (group discussion, brainstorming and plenary presentation)
- Demonstrations, charts, visual aids /posters
- Activities
- Case studies / practical exercises

Discussions points

Include the information below as you discuss with the farmers/trainees, ask as much as you can to open up for discussion.

Introduction

Agriculture is not only impacted upon by climate change but also contributes to the problem. The country's agriculture is predominantly rain-fed and therefore vulnerable to climate change particularly changes in temperature regimes and precipitation patterns, and extreme weather events. This leads to, among others, unsustainable land and agricultural water management. Innovative and transformative measures are therefore urgently required to assist stakeholders in the sector across the agricultural value chains to cope with effects of current and projected change in climate patterns. Climate smart agriculture (CSA) has been identified as a viable approach to provide solutions towards increased agriculture sector productivity while addressing impacts of changing climate

This session intends to expose learners to effects of climate change and appropriate climate information on greengram production and how this is important in decision making as regards to farm operations. It covers the climate change projections in Kenya, seasonal trends, effects of climate change in greengram production, use of climate information in decision making for farm operations, type of climate information for greengram production, climate smart agriculture practices in greengram production.

Climate Change

Climate change is any significant long-term change in the expected patterns of average weather of a region over a significant period of time. Current data demonstrates that human induced greenhouse gas (GHG) emissions, especially carbon dioxide, are causing an increase in global temperatures that creates changes in the earth's climate. Climate change has been attributed to:

i) Greenhouse gas emissions through burning fossil fuels, cutting down forests and farming activities. This leads to Global warming (The current global average temperature is 1°C higher than it was in the late 19th century

ii) Agriculture sector currently generates 19–29% of total GHG emissions. Ploughing activities, nitrogen based fertilizer manufacture and use, livestock production are major sources of this emission

iii) Deforestation reduces vegetation cover which provides carbon sink

iv) Industrialization significantly contributes to burning of fossil fuels which leads to increased emission of greenhouse gases.

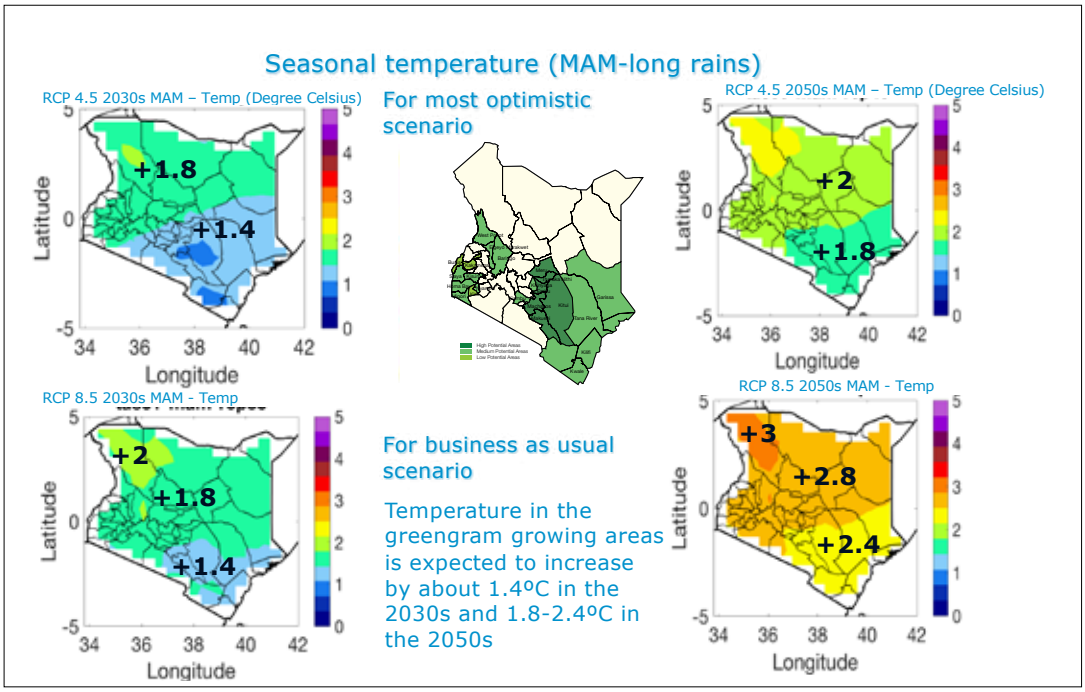
Climate change projection scenarios – Temperature, drought and precipitation

Climate projections done by the SNV led- Climate Resilient Agri-business for Tomorrow (CRAFT) project in 2020 in some of the greengram growing regions in Kenya (CRAFT projections, 2020) shows that:

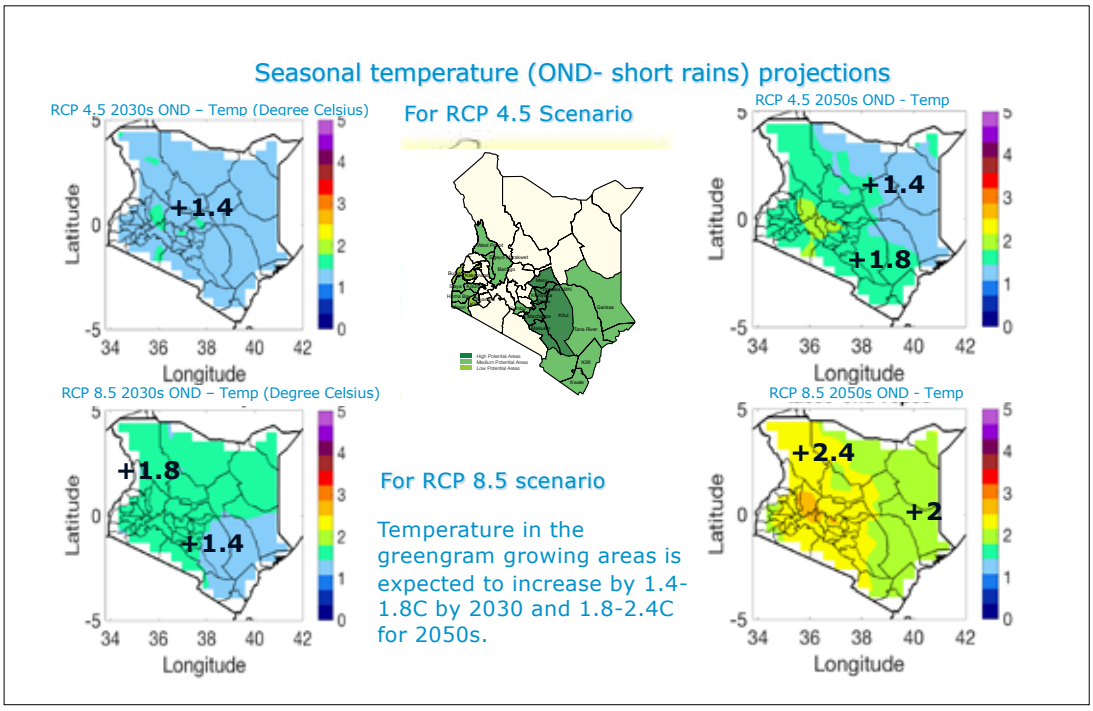
During both the first (MAM) and second (OND) rainy seasons, temperature in the greengram growing areas of western and south-eastern Kenya is expected to rise by about 1.4°C to 1.8°C and 2.4°C to 2.8°C in the 2030s and 2050s respectively for the business as usual scenario (see figures below).

The seasonal rainfall over the south-eastern greengram growing areas of the country is expected to increase in both the first and second rainy seasons in the 2030s and 2050s. Early onset and longer length of the growing period is anticipated in this region which favour the greengram agricultural activity in the region. On the other hand, the seasonal rainfall is expected to decline in the western greengram growing areas particularly in the first rainy season.

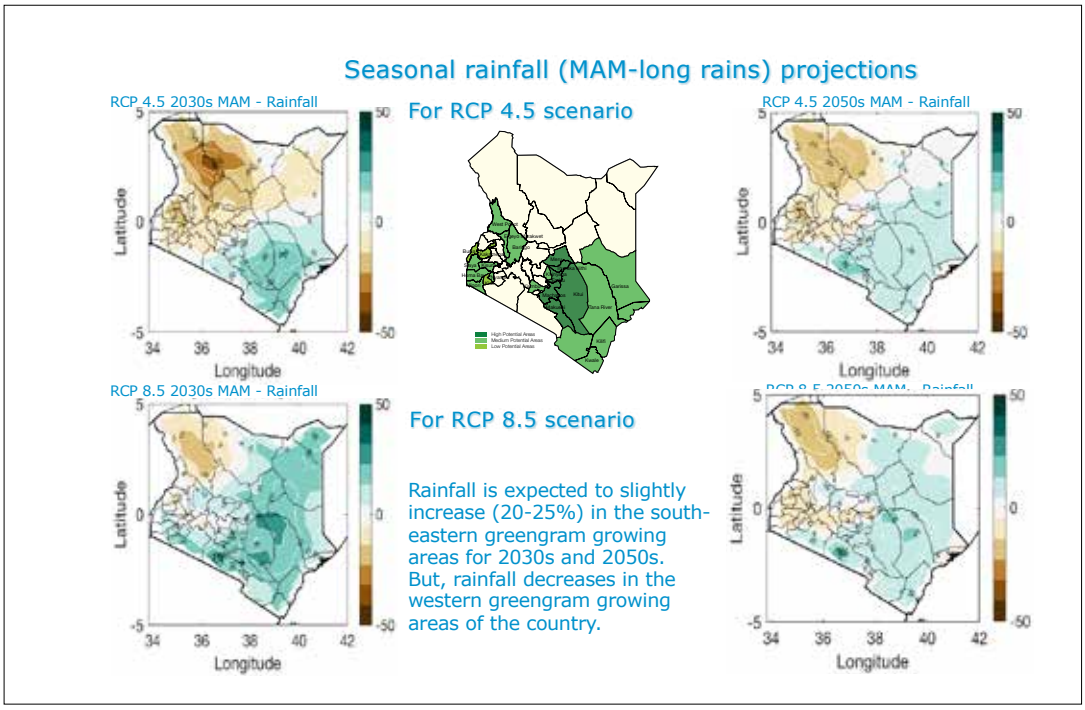
A delay in the onset and a decrease in the length of the growing period is anticipated in the western greengram growing areas of the country which will have a great impact on the agricultural activity of the region.



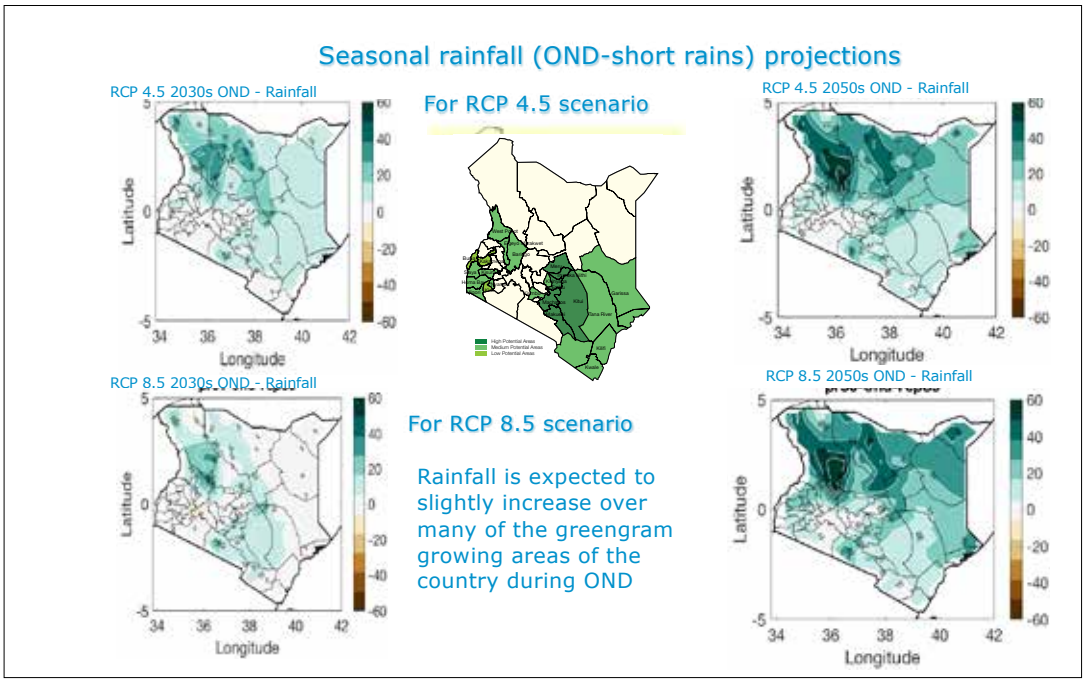
Projected seasonal mean changes in temperature-MAM-long rains- for 2030s (Left) and 2050s (Right) under the RCP 4.5 and RCP 8.5, relative to the reference period (1961-2005 (Source: CRAFT project 2020)



Seasonal temperature projection for the OND- short rain season for 2030 and 2050 under RCP 4.5 and RCP 8.5 (Source: CRAFT project 2020)



Projected seasonal mean changes in rainfall MAM-long rains -for 2030s (Left) and 2050s (Right) under the RCP 4.5 and RCP 8.5 (Source CRAFT 2020)



Projected seasonal mean changes in rainfall OND-long rains -for 2030s (Left) and 2050s (Right) under the RCP 4.5 and RCP 8.5 (Source CRAFT 2020).

Climate change risks and opportunities on greengram

Despite the greengram potential in Kenya, its production is greatly affected by climate change. Greengram value chain can be adapted to changes and variabilities in climate and make the production more resilient in semi-arid areas. The Flyer, Annex 2.1, summarizes some of the strategies across greengram value chain of adapting its production to changes and variabilities in climate in Makueni County. Climate change projections for Kenya shows increasing temperatures and more frequent climate shocks (droughts and floods).

Key climate information decisions

The most useful weather forecast information that can assist farmers in making decisions on greengram management include, onset date of the main rains; rainfall amount; cessation date of the main rains; temporal and spatial distribution of the main rains; timing and frequency of wet and dry spells. Table 1 below shows the key decision points impacted by climate information.

Table 1: Key decision points impacted by climate information

Key decision points	Key climate variable that informs the Decision
Sowing period	Onset of rainy season
Choosing of crops/crop variety	Total rainfall forecast and its intra-seasonal distribution
Irrigation management – in terms of timing of irrigation and quality of water to be applied	Total rainfall and its intra-seasonal distribution
Resource use allocation – both labour and finance	Total rainfall and its intra-seasonal distribution
Fertiliser application – the quantity and type of fertiliser as well as the timing of application of fertilisers on crops	Forecast of the distribution of rainfall across the crop growth stages
Timing of pesticides application	Wind direction, wind speed and distribution of rainfall across the crop growth stages
Time of harvest	Forecast of the distribution of rainfall during the crop maturation stage

Climate smart agriculture

CSA is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives in order to enhance the achievement of national food security and development goals namely, sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions.

CSA interventions that would increase productivity, resilience and mitigate climate change risks include retention of crop residues, mulching and crop rotation, making the soil resilient and becoming a carbon-sink; new improved seeds, drought-tolerant seeds, alley cropping, small-scale irrigation and/or production diversification, soil testing, using crop specific fertilizers among others (see Poster Annex 2.2). CSA increases the soil-carbon content, improves fertilizer and water-use efficiency as well as water-holding capacity, makes soils easy to work, and increases cost-benefit returns.

How CSA can mitigate the effects of climate change (ACT, 2012)

CSA constitutes a basket of sustainable practices that are applied in an integrated landscape approach, and that are coordinated across agricultural sectors, ensuring they capitalize on potential synergies, reducing trade-offs and optimizes the use of natural resources and ecosystem services. These practices include Choosing appropriate farm enterprises, Diversification of farm enterprises, Proper timing and application of farm operations, Soil and water conservation measures, Minimum soil disturbance or zero tillage, Permanent soil cover, Intercropping and crop rotation involving legumes, Farmyard manure use, Biogas production, Composting, Beekeeping to conserves the environment and Climate smart dairy production systems among others.

Learning Exercises

Learning Exercise 3.2A: Describing climate change, its impacts and its future

Learning objective

To describe climate smart agriculture

Materials

Flip charts, marker pens and a flyer (CRAFT climate change analysis)

Training Methodology

1. Break the participants into groups of 7-10.
2. Provide each group with marker pen and flip charts
3. Assign each group to discuss the following issues using the flyer in a question-posing mode, allowing participants to discuss and discover what they represent. The agreed responses should be captured in flip chart for plenary presentation: Ask participants
   - To describe what climate change is from their experiences
   - To state the three impacts of climate change on greengram production
   - To identify climate change risks and opportunities on greengram
   - To list key decision points in greengram production and link it to the climate variable that informs the decision
4. Afterwards, each group will present to the plenary for discussion and establishment of the impacts of climate change, risks associated with and opportunities for greengram production. identified technologies and needed climatic information
5. Summarize the discussion notes on climate change, its impacts and future effects

Learning Exercise 3.2B: Describing climate smart agriculture and how to prepare for difficult seasons as adaptation strategies

Learning objective

To describe climate smart agriculture

Materials

Flip charts, marker pens and a poster

Training Methodology

1. Break the participants into groups of 7-10.
2. Provide each group with marker pen and flip charts
3. Assign each group to discuss the following issues using the poster in a question-posing mode, allowing participants to discuss and discover what they represent. The agreed responses should be captured in flip chart for plenary presentation: Ask participants
   - To describe what CSA is from their experiences
   - To state the three pillars/principles of climate smart agriculture
   - To identify climate change risks and opportunities on greengram
   - To list impacts of climate Change to greengram production
4. Afterwards, each group will present to the plenary for discussion and establishment of the challenges and opportunities in greengram production, identified technologies and needed information
5. Summarize the discussion notes on climate smart agriculture

Review Questions

1. What is climate change and how does it affect greengram production?
2. What are the causes of climate change?
3. Describe the risks and opportunities resulting from climate change for greengram
4. How are the climate projections relevant to greengram farmers?
5. What climate information should greengram producing farmers require?
6. What is climate smart agriculture and why is it relevant to greengram farmers?
7. What CSA practices are useful to greengram farmers?
8. Describe different types of climate information for greengram and its importance in making farming decisions
9. Describe the CSA practices and their potential to address the limitations in greengram production

SESSION 3: CLIMATE SMART GREENGRAM PRODUCTION

To prepare for the training, as a trainer, you should take time to read and understand the training content. Maintain interactive engagement with trainees throughout the session.

Learning Objectives

By the end of this module the participants will be able to:

- Describe the ecological requirements and growth cycle of greengram
- Differentiate the greengram varieties and their attributes
- Define the characteristics of good greengram seeds for planting
- Enumerate CSA options suitable for land preparation, crop nutrition and field management for greengram production.
- Explain how greengram can fit into existing cropping system
- Explain the importance of early land preparation by managing cover crops, no residue burning and no-tillage. Highlight their advantages.
- Explain the various climate smart methods of planting greengram
- Demonstrate field management practices required for greengram
- Calculate amount of inputs required per unit area of greengram production

Materials

- Flip charts, marker pens, strings, measuring sticks, pegs, hand hoe, ripper (animal or tractor-drawn), planter (jab planter, tractor drawn planter), assorted green gram seeds

Training Methodology

- Facilitation (group discussion, brainstorming, plenary presentation)
- Demonstrations, charts, visual aids /posters
- Activities
- Case studies / practical exercises

Duration

6 hours

Discussion points

Include the information below as you discuss with the farmers, ask as much as you can to open up for discussion.

Introduction

The productivity of greengram in Kenya is still below its yield potential due to a number of constraints such as low yielding varieties, disease and insect pest problems, variable climatic and soil conditions, limited access to improved varieties, inadequate knowledge and poor crop management practices.

This session intends to expose learners to how some of these challenges can be addressed by providing information on improved varieties, seed sources and climate smart crop management practices aimed at increasing crop productivity. It focuses on climate smart and resilient greengram production. It covers ecological requirements, varieties and varietal selection and greengram cropping systems. It also captures climate smart land preparation, planting, crop nutrition, field management which includes crop protection.

Growth characteristics of greengram

Greengram is one of the most important legume crops in Kenya. It is a warm season annual, highly branched with trifoliate leaves. Mature pods are variable in colour up to 13 cm long, and contain 10 to 15 seeds. Greengram is self-pollinating. Mature seeds are green in colour. Greengram usually matures in 60 to 120 days depending on variety. The early maturing varieties can often produce before drought destroys the crop.

Activity 3.1

Ask participants to name the types of greengram varieties commonly grown in the area. What do they consider when choosing type/ variety to plant?

Greengram plant

Greengram varieties and sourcing

It is recommended that farmers use certified seed from accredited sources. Certified seeds are currently available with the approved agro-input dealers as well as the research stations that conduct seed bulking. When purchasing the seeds one needs to determine the best variety that suits the weather conditions, season and the market demand/target market. Other considerations are susceptibility to diseases and pests, planting method and the yield potential. Table 2 below shows the various varieties available in Kenya. .

Table 2: Greengram varieties and their attributes

Variety		Attributes
KAT N26 (Nylon)	 	• Adapted to ASAL areas of Kenya • Grains have shiny green colour. • Potential yield of 1000 -1500kg/ha • Medium seed size (4-5g/100 seeds) • Matures in 80-90 days, pods are black when dry and grains are shiny green in colour. • Has a determinate growth habit. Flowers are auxiliary on short peduncles and purple in colour • Flowers in 40-45 days
Ndengu tosha	 	• Large pod size • Grains have shiny green colour. • Mature in 65-75days, pods are black • Potential yield 1800-2300kgs/ha • Large seed size (6-7g/100 seeds) • Tolerant to major mung bean diseases
Biashara	 	• Large pod and grain size • Dry pods are brown in colour • Grains have shiny green colour. • Mature in 70-75days • Potential yield 1800-2100kgs/ha • Large seed size (8-10g/100 seeds) • Tolerant to aphids, resistant to yellow mosaic and moderately resistant to powdery mildew
Karembo	 	• Large pod size • Dry pods are brown in colour • Grains have shiny green colour. • Mature in 65-75days • Potential yield 1800-2100kgs/ha • Large seed size (8-10g/100 seeds) • Tolerant to major mung bean diseases
KS 20 (Uncle/ Makueni)	 	• Dull green in colour • Pod are cream in colour • Mature in 75-80days • Potential yield 1000-1200kgs/ha • Large seed size (6-7g/100 seeds) • Large pod and grain size • Non-stony seed • Pods turn brown when dry while grains are bigger in size compared to N26

Ecological requirements

Greengram is one of the most sustainable crops a farmer can grow in low rainfall areas. Table 3 shows a summary of the ecological requirements of greengram.

Table 3: Ecological requirement for greengram

Parameter	Greengram requirement
Soils (edaphic) requirements	• Grown on a wide range of soils including red laterite soils, black cotton soils and sandy soils. • Well-drained loamy to sandy loam. Not in saline or alkaline soil or waterlogged. • pH ranging from 5.5 to 7.5.
Altitude	• 0-1600m above sea level. Above 1800m, it has very poor pod set
Rainfall	• 350-650 mm rainfall, well distributed during the growing period of 60 - 90 days. • Too much rain or long dry spells reduce yields and causes flower abortion
Temperature	• A warm humid climate with temperature ranging from 25°C to 35°C

Greengram cropping systems

Greengram in Kenya can be grown either as a single crop (mono-cropping) or as an intercrop (mixed cropping) with other crops by small scale farmers. Intercropping plays an important role in sustainable agricultural system as it improves the productivity and stability of yield and helps in soil conservation

Climate smart greengram production

There are several other supportive climate smart practices that compliment land preparation activities. These include soil and water conservation structures, agroforestry, improved fallows with shrubs, cover crops and boundary tree lines for wind breaking. Soil and water conservation measures can be categorized as biological (cover crops, crop rotation, intercropping, mulching, residue retention) or physical conservation measures (infiltration ditches, water-retaining pits, contour bunds, grass strips, cut-off drains, broad beds and terraces).

Climate smart methods of land preparation

Climate smart land preparation practices avoids the detrimental effects caused by conventional tillage to the farmer, soil and environment (Table 4). They reduce the amount of tillage, or eliminate it altogether when seeds are planted directly into the soil.

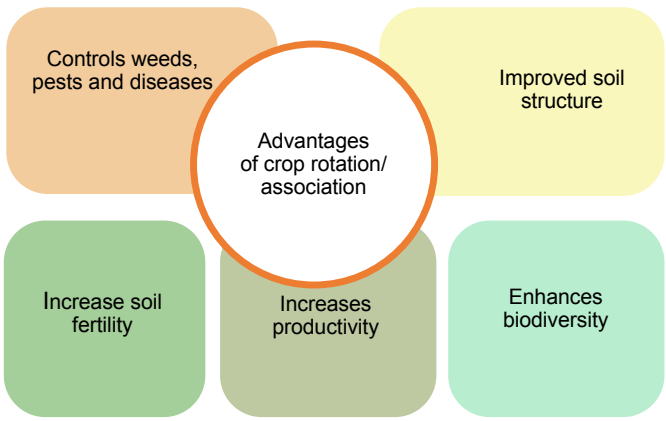


Table 4: Desired CSA practices compared to conventional tillage practices

✗ Undesired Conventional Practices	✓ Desired CSA Practices
Drudgery where manual ploughing is used	Saves labour and time
Excessive pulverization	Maintains soil structure
Presence of hardpans due to cultivation at the same depth	Ameliorates hard pans
Destruction of the soil flora and fauna through exposure to sunshine and rainfall	Increases biodiversity
Soil erosion through water and wind	Reduces water and wind erosion
Soil degradation through destruction of structure	Maintains soil structure, Improve soil quality
Nutrient leaching	Improves water holding capacity and nutrient retention
Cuts the amount of organic matter in the soil, so reducing soil fertility	Improves soil organic matter
Costs of fuel and labour increased	Reduced cost of fuel and labour by up to 40%
Contributes to greenhouse gas emission	Enhances carbon sequestration and reduces GHG emission

Farmers should avoid ploughing which leads to erosion and gully formation

Preferred tractor ripping (left) and undesired tractor ploughing (right)

The **climate smart methods of land preparation** include:

- **Weeds, cover crops and residue management**

  Minimum soil disturbance practices in CSA requires proper weed control which can be done or achieved through different methods depending on the intensity of weeds infestation. It can either be mechanical (shallow weeding), biological (mulching, cover crops or optimal plant spacing) or chemical weed control.

- **Planting basins**

  These are small pits/planting stations dug about15 cm wide, 30 cm long, and 15 cm deep – for planting different types of crops. Planting basins are dug using a hand hoe to loosen the soil and break up the hardpan. They are dug slightly deeper than the depth to which you normally hoe, so that they break through the hardpan

- **Ripping**

  Helps to break up surface crusts and opens a narrow slot or furrow in the soil, about 5–10 cm deep for planting. It involves the use of a ripper, a chisel-shaped implement pulled by animals or a tractor to loosen the soil

- **Subsoiling**

  Helps to break the hardpan and allows water to infiltrate easily into the soil. It involves the use of a subsoiler, a chisel-shaped implement designed to work at a depth of about 30 cm, just below the level of the hardpan.

Making planting basins with hand hoe

3-tine tractor ripper

Activity 3.2

Ask the participants to list down all the basal fertilizers, topdressing fertilizers and foliar fertilizers available in the local agro-vet shops. What is the composition of each of these fertilizers? The trainer should help them to understand the importance and when to use such fertilizers in relation to the soil condition and stage of crop growth. The facilitator should prepare a schedule/list of all available fertilizers and soil conditioners in the area/county relevant to greengram.

Nutritional requirement of greengram

It is important to carry out a soil testing to determine the status of the soil in terms of nutrient availability with respect to what greengram requires. However, in the absence of such analysis and during dry season cropping, basal application of 10 kg/ha of Nitrogen and 10 kg/ha of Phosphorous is necessary. Greengram obtains nitrogen through its symbiosis with the nitrogen-fixing bacteria in the roots. However, inoculation of the seed with Rhizobia before sowing is highly recommended in fields where greengram cultivation is taken up for the first time in order to increase nodulation and thus nitrogen fixation leading to 10-15% increase in yield, and also minimizes the use of nitrogenous fertilizers for the subsequent crop. If soil is of poor fertility, 10-12 tonnes/hectare of well decomposed farmyard manure should be applied.

Planting, spacing and seed rate

Planting should be done early to ensure the seeds germinate quickly and evenly. Farmers should be guided by the weather information/forecasts to decide when to plant. Spacing for pure stand greengram is 45cm by 15-20cm. One hectare of land will require 10 to 20 kg of seed for planting at a depth of 3-5cm. The correct plant density (25 plants/m2) is an important factor in maximizing yield of greengram.

When planting uncertified seeds seed dressing is important to control pests and diseases. Soak 1 kg of seed in 200 ml of water mixed with 3 ml of imidacloprid 17.8 SL or 5 g of Thiamethoxam 25 (both insecticides) for 45 minutes to one hour and dry the seed under shade. Shade dried seed should be treated with a fungicide (captan or thiram) at 3 g/kg seed or with a bioagent (trichoderma harzianum at 5-10 g/kg seed) against seed borne fungi followed by bio fertilizers (Rhizobium spp., AMF- Glomus spp./PSB-Pseudomonas spp. each at 30 g/kg seed), before sowing.

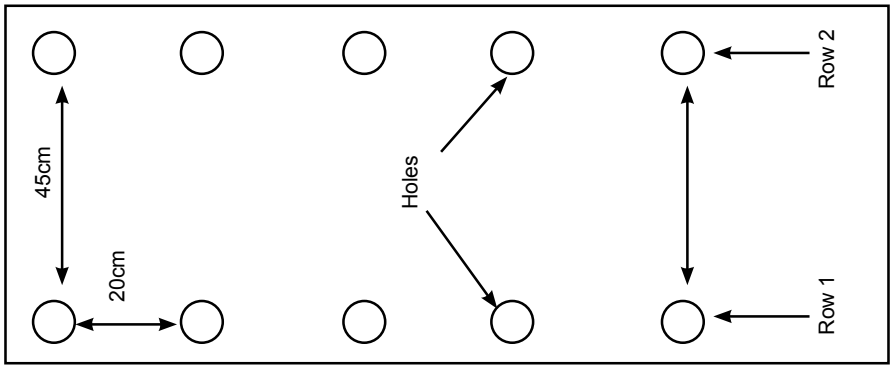


Illustration of between row and in-row spacing in planting.

The correct plant density is an important factor in maximising yield of greengram. It is also an important factor towards biological weeds suppression. To obtain the targeted density it is necessary not only to have quality sowing seed but also be able to accurately calculate seeding rates. It is recommended that the sowing rate is calculated using germination test results, seed count per kilogram, the target plant population and establishment

Animal drawn direct seeder (left) and tractor drawn seeder (right)

Calculating Seed Rate

Seed rate can be calculated using the equation:

$$\textbf{Seed Rate (kg/ha)} = \frac{\{\text{Target Plant/Density/ha}\}}{\{\text{Seed kg} \times \text{Germination \%} \times \text{Establishment \%}\}}$$

Example:
Target Plant Density = 250,000/ha (i.e. 25 plants per square metre)
Seeds/kg = 13,500
Germination rate = 95%
Establishment rate = 85%
Therefore, **Seed Rate (kg/ha)** = $\left\{\frac{250{,}000}{(13{,}500)\times(95/100)\times(85/100)}\right\}$ = **24kg/ha**

Field management

Field management begins with the sowing of seeds, continues with crop maintenance during growth and development and ends with crop harvest. Field management practices may be carried out manually or mechanically depending on the availability of equipment or service provider. Thinning is done within 2 weeks after emergence and when the soil is moist mainly at first weeding.

Weeding can be done manually or mechanically or by use of herbicides. Different tools for weeding are available to ensure minimal soil disturbance.

The use of integrated pest management (IPM) to reduce pest's population below the economic injury level is recommended. The major pests affecting greengram in Kenya are illustrated in Table 5 below.

Table 5: Greengram pest management and control *(NB: Capture the local name of these pests during the training)*

Type of Pest	Symptoms	Control Methods
Aphids *Soft bodied, green or black insect pests which suck plant sap)* 	• Affected plants stay short and twisted • Feeds on young plants, leaflets, stems and pods.  *Ladybird beetle feeding on aphid colonies* Excretion of honey dew leads to growth of sooty mould	• Plant early • Maintain weed free fields • Avoid excess use of nitrogen • Conserve natural enemies • Spray with Endosulfan, Imidacloprid, Lamda-cyhlothrin, Thiamethoxam, Acetamiprid • Spray foliar fertilizer (Sodium and Potassium system) to clean the sooty mould • Natural enemies such as green lacewings (Chrysopidae), ladybird beetles, minute pirate bug, syrphid fly, and parasitic wasps keep aphid populations in check in the field.
Bean Fly	Plants that have been attacked are yellow and may wilt.	• Use certified seed • Practice crop rotation • Spray with Thiophanate methyl or copper oxychloride • Seed dressing with Imidacloprid • Drench soil with Imidacloprid, Profesofos or Cypermethrin
Thrips *Threshold/EIL (4-6 thrips/ flower)* 	• Attacks plant petioles and leaves • Leaves have tiny holes surrounded by discoloured areas.	• Plough and harrow before planting. It can reduce subsequent thrips attacks by killing pupae in the soil. • Conserve natural enemies e.g. predatory bugs (Orius spp. and Anthocoris spp.) and predatory thrips. • Spray with bio-pesticides (e.g. Spinosad) or other insecticides (e.g. Endosulfan, lufenuron, Lambda-cyhalothrin)
Pod borers e.g. African bollworm *Threshold (3 larva/m^2)* 	• Feeds on leaves and bores into the pods to eat seeds • Scrapped leaves tissue • Damaged flower buds and flowers	• Dry grains to 12% moisture content (MC) prior to storage • Use improved storage structures • Spray with Dimethoate, Imidacloprid, Thiamethoxam, Lambda-cyhalothrin and Acetamiprid
Pod sucking bugs *(e.g. giant coreid bug, green stink bug)* *Threshold (3 larva/m^2)*	Cause necrosis, pod malformation, premature drying, formation of empty pods, shrivelling of seeds	  *Giant Coreid* *Stink bug* Spray with Imidacloprid 200g/l

Type of Pest	Symptoms	Control Methods
White flies 	• They suck plant sap leading to retarded growth • Attacked leaves become shrunk • secrete honeydew as they feed causing sooty mould	• Mount yellow sticky traps to trap adults- 4 traps/ 300m2 at 50cm above the ground. • Spray with pepper at rate of 30 chopped peppers put in 1 litre warm water. Soak for 1 day, dilute in 10 L water • Spray with Thiamethoxam, Fipronil, Lambda-cyhalothrin, etc. • Spray phosphorous pentoxide 100ml/20l to clean the sooty mould
Caterpillars/ Cutworms	Attacked leaves and pods are left with windows	• Alphacypermethrin or Fipronil • Dress seeds with Imidacloprid 600g/l
Foliage beetle 	They feed on young plants leading to defoliation	• Conduct deep ploughing. • Remove the plant debris and weeds from the field. • Application of neem seed kernel extract (5%) as a repellent for egg laying. • Spray with Thiamethoxam, Fipronil, Lambda-cyhalothrin, etc.
Weevils 	• They feed on stored grains • Start attacking the pod while crop is in the field • The larvae can stay undetected in the seed until the adult emerges. • Holes on stored grains	• Clean the store prior to storage e.g. boil used storage sacks in hot water and dry in the sun before reuse • Dress with Malathion, Pirimiphos-methyl, or Permethrin • Drying grain thoroughly (to about 12% MC) before storage • Store beans in air-tight containers if possible e.g. hermetic bags

Activity 3.3

Enquire from trainees the major green gram diseases in the area and how they manage them?

The most important greengram diseases in Kenya are illustrated in table 6 below.

Table 6: Greengram diseases, symptoms and potential control measures *(NB: Capture the local name of these diseases during the training*).

Disease	Symptoms	Control Measures
Powdery mildew 	• White patches appear on leaves and other green parts, which later become dull coloured. Infected plants have a greyish-white powdery growth on the surface of leaves, stems and pods • Caused by fungus *Podosphaera fusca* is a major disease of greengram causing severe yield loss.	• Sowing of resistant or moderately resistant varieties where available • Improve aeration by thinning or pruning some of the foliage. • Apply fungicides like Difenoconazole, or Sulphur. • Spray neem seed kernel extract @ 50 g/L or neem oil @ 20 ml/L or water soluble sulphur 80 WP @ 4 g/L or carbendazim 50 WP @ 1 g/L twice at 10 days' interval from initial disease appearance • Good agronomic practices such as control of volunteer seedlings and other host crops and weeds prior
Yellow mosaic virus 	• The leaves are mottled with yellow, white, and light and dark green spots, which appear to be elevated. This gives the leaves a blister-like appearance. • Small yellow specks along the veinlets of leaves which spread over the lamina to produce yellow mosaic symptoms the pods become thin and curl upwards.	• Plant resistant varieties • Spray with Benomyl or Copper oxychloride • Diseased plants should be rogued out to prevent further spread of the disease. • Use of disease free seeds • Control white flies
Common mosaic virus 	• Viral disease spread through infected seed and aphids • Cause yield loss of up to 90% • Favoured by temperature range 20-25°C • Leaf mottle	• Control aphid vectors
Rust 	• Caused by a fungus • It appears as circular reddish brown pustules • Less abundant on pods and stem	• Properly spacing plants to allow for air flow • Prevent infected plant tissues from rubbing against other plants. • Select rust-resistant varieties. • Pick off, remove and destroy infected leaves and remove all fallen debris. • *Bacillus subtilis*, *Bacillus* sp. and *Arthrobacter* sp. are used as biocontrol agents of rust. • Spray fungicides with the following active ingredients: triadimefon (0.02%), triadimenol (0.1%), tridemorph (0.07%), hexaconazole, maneb, tebuconazole, mancozeb+sulfur and chlorothalonil which are applied before flowering according to manufacturer's guidelines.

Disease	Symptoms	Control Measures
Bacterial blight 	• Leaves become yellow and fall prematurely	• Keep foliage dry and don't touch it when it's wet. • Don't wound the plants, as this is how the bacteria get inside. • Keep weeds and pests to a minimum. • Destroy affected plants. • Spray with Metalaxyl
Angular Leaf Spot 	• Fungal disease • Yield losses: up to 50% • Its development favoured by humid (wet) conditions • Mode of spread is through seed, plant debris mostly and wind-blown spores • Brown spot on the leaves	• Crop rotation • Use fungicides • Deep ploughing to destroy plant remains • Cultural practices- e.g. rotations to break the lifecycle of the pathogen

Learning Activities/Exercises

Learning Exercise 3.3A: Group Discussion: Understanding greengram requirements and varieties

Learning objective

To evaluate the understanding of participants on the crucial requirements for greengram production and varieties

Materials

Flip charts, marker pens and an assortment of good and bad greengram seeds/varieties.

Training Methodology

i) Break the participants into groups

ii) Provide each group with marker pen and flip charts

iii) Assign each group to discuss the following issues and capture the agreed responses in flip chart for plenary presentation. Ask participants
- To describe the ecological requirements of greengram
- To list the greengram varieties that are available in their locality
- To illustrate the characteristics of a good seed and list down what to consider ins selecting greengram seeds to plant

iv) Provide assorted greengram seeds and ask the participants to identify them and list down their attributes

v) Afterwards, each group will present to the plenary for discussion

vi) Summarize the discussion notes

Review Questions

1. What are the most popular varieties of greengram? Give reasons for each.
2. What are the major considerations when selecting the best variety of greengram for planting?
3. What are some of the characteristics of a good seed?
4. Describe the ecological requirement of greengram
5. List down the source of authentic greengram seeds in your region

Learning Exercise 3.3B: Effects of soil cover as practiced in CSA on soil loss and run-off demonstration

Learning objective

The objective of the demonstration includes:

1. To understand the function of soil cover.
2. To visualize the effect of rainfall on bare soil and covered soil.
3. To measure/observe the difference in water loss through runoff and water infiltration.
4. To understand the effect of soil, cover on water infiltration and erosion

Materials required and preparations:

To illustrate the effects of soil, cover on soil loss and water infiltration, a simple **runoff test** can be set up. The test should be preceded with a discussion on soil erosion processes using a poster illustrating that only 10-30% of the rainfall is useful for crop production under conventional tillage systems that leave bare soils.

Prepare two trays with soil, leaving one bare and on the other one covered with either grass or leaves.

This instrument can be used to demonstrate the importance of mulch in controlling run-off and direct raindrop impact on soil erosion

Other materials required:

- Watering can or suitable dispenser.
- Some support mechanism to adjust the slope of the tray.
- Containers, preferably glasses, to catch the run-off and clearly show differences in amounts.

Procedure of carrying out the test

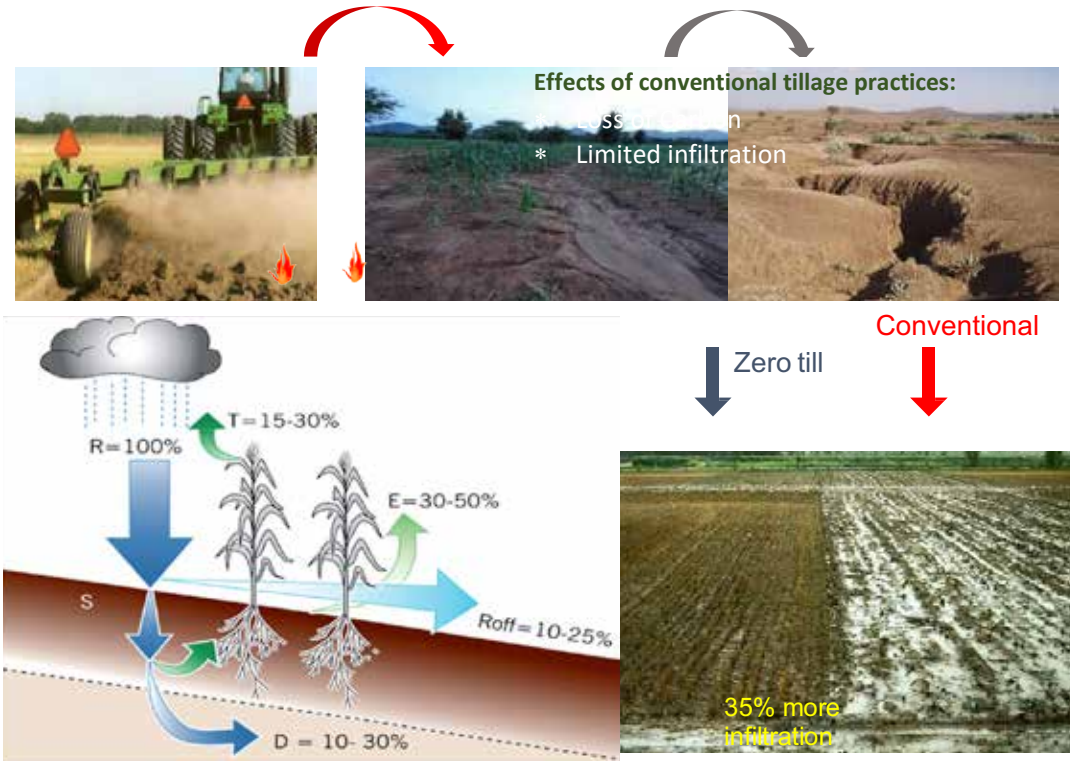
In this test, rainfall is simulated and rain droplets are allowed to fall on the different soil surfaces, covered and bare soil surface slope at the same inclined angle presenting the slope of a hill.

The steps:

1. Fill the watering can with water and start watering the box from about 50-100 cm above the box in a way that both “plots” receive the same amount of water.
2. Participants to observe the difference between the bare soil and the covered soil with respect to water splash, run-off and infiltration.
3. Measure the difference in runoff and soil loss between the two “plots”. Are there any signs of erosion?

Guiding questions for the learners to visualize

1. What process took place on the bare soil?
2. How was this avoided in the covered plot?
3. What does this mean for growing a crop on the two plots, in relation to water use efficiency?
4. Can you think of other measures to avoid soil erosion and water loss?



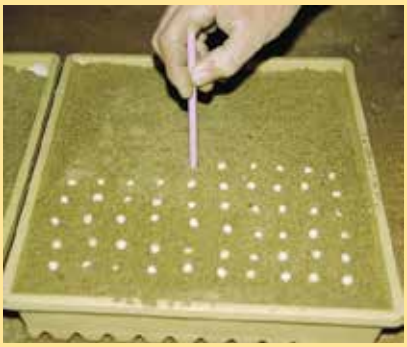
Learning Exercise 3.3C: Greengram home germination tests

Learning objective

To determine germination percentage of the greengram, a factor to use in calculating the seed rate.

Materials

- Flat tray about 30 cm square and 5 cm deep (a nursery seedling raising tray like the one shown is ideal).
- Single sheet of paper in the bottom to cover the drainage holes
- Clean sand, potting mix or freely draining soil. If you do not have a tray the test can be done in any sort of self-draining container or in a cool part of the garden.



Setting up a germination test in a seedling raising tray.

Method

1. Set up the testing tray as follows:
   - install a flat tray about 30 cm square and 5 cm deep.
   - put a single sheet of paper in the bottom to cover the drainage holes and
   - fill with clean sand, potting mix or freely draining soil.
2. Count out 100 greengram seeds (including damaged ones) and sow 10 rows of 10 seeds —the rows make it easier to count seedlings.
3. Sow the greengram seeds at normal seeding depth of 2-3 cm. Place the seeds on top of the sand or soil and push them in with a piece of dowel or a pencil and cover with a little more sand.
4. Gently water to keep moist (not wet). Over-watering will result in fungal growth on the seeds, causing possible seed rot, affecting normal germination. *If you do not have a tray, sow 100 seeds in rows in the garden at normal depth, carefully counting the number sown. Keep moist.*
5. The Seedlings should be counted after 7 to 10 days when the majority of seedlings are up. Do not wait until the late ones emerge–these are the damaged, weak ones. Only normal seedlings should be counted. Do not count badly diseased, discoloured or distorted seedlings or those missing a cotyledon.

Discussion points

What is the number seedling counts that were able to germinate? **Note that,** *the total number of normal, vigorous, healthy seedlings counted is equal to the germination percentage.*
A count of 83 – for example – means your germination percentage is 83%.

Learning Exercise 3.3D: Practical demonstration on hand hoe basins construction

Learning objective

To impart practical skills on hand hoe basin construction.

Materials

Hand hoe and planting lines

Method

- Mark out straight lines to mark the planting rows running across the slope on the contour.
- The spacing from one greengram row to another is the space between 2 lines, in this case 45 cm.
- Stretch strings across the field from the peg at one end to the corresponding peg at the other end to mark out the planting row where you will dig the basins.
- To measure the distance between the basins, use a measuring string, wire or chain marked at 20cm intervals. You can tie bottle caps or knots into the string to mark the basin spacing.
- Starting at the first knot at one end of the string, stand facing uphill and dig each basin about 15cm (or the length of your hand) long, 15cm wide, and 15cm deep. Keep the soil dug from the basin on the downslope side of the basin, to use for cover later on.
- When the basins for that row have been made use the sticks to measure the distance to the next row. Move the pegs and stretch out the string between them.
- Repeat the process of digging holes. The rows of basins can be in line with each other or staggered.

Remember: Ensure minimum soil disturbance by not tilling. Prepare basins precisely and to standard. Basins allow you to use the correct amounts of seed and fertilizer based on the established rates at the correct time. This avoids waste and saves money.

Learning Exercise 3.3E: Practical demonstration on hand jab planting

Learning objective

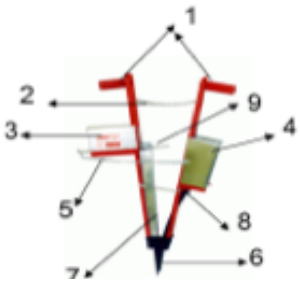
To impart practical skills on use and maintenance of hand jab planter.

Materials

Hand jab planter as detailed herein

INTRODUCTION

Hand-jab planters are popular amongst small-scale farmers. Some form the primary means of sowing seeds under no-tillage. Others are kept in reserve for filling in spaces in crops otherwise sown with openers in rows.
Hand-jabbers may have either separate hoppers for seed and fertilizer or one hopper for seed only.



1. Handles
2. Width control chain
3. Seed hopper
4. Fertilizer hopper
5. Seed/fertilizer regulator
6. Furrow opener
7. Seed pipe/tube
8. Fertilizer pipe/tube
9. Seed plate

PARTS DESCRIPTION

Item	Particulars	Function
1	Handle	Holding the implement in vertical position during planting
2	Width Control chain	Controls the opening width of the implement during operation
3	Seed hopper	Contains the planting seed
4	Fertilizer hopper	Contains the fertilizer
5	Seed/fertilizer regulator	Regulates the opening/closing of seed and fertilizer metering device
6	Furrow opener	Opens the planting furrow giving way for simultaneous dropping of seed and fertilizer
7	Seed pipe/tube	Channels/conveys the seed from the hopper to the furrow opener
8	Fertilizer pipe/tube	Channels/conveys the fertilizer from the hopper to the furrow opener
9	Seed plate	Facilitates the seed distribution mechanism

Parts and function descriptions of hand jab planter

Method

Hand-jab planters are popular amongst small-scale farmers for sowing seeds under no-tillage. The beak is meant to pierce unploughed soils covered with crop residues or mulch and meter seeds and fertiliser in one operation. Hand-jabbers may have either one hopper for seed only or separate hoppers for seed and fertilizer (as per the diagram on the right.

- The action of pulling the handles apart triggers the seeds/ fertilizer to be conveyed from the hopper to temporarily settle at the furrow opener (Beak). This action occurs simultaneously with piercing/punching the soil.
- The second action which occurs immediately after the first one is pulling the handles together. This action triggers the opening of the furrow opener (Beak) in order to deliver the seeds/ fertilizer in the created planting furrow. The action also triggers the closing of the seed/ fertilizer metering devices.
- These two actions are undertaken repeatedly and they have to be synchronized with the operators' footsteps in order to achieve the desired plant population.
- The operator will need to carefully listen to the dropping sounds made at every action to ascertain that indeed the implement is planting and there is no blockage.
- The operator will have to use his/her judgment of the weight to re-fill the seed/fertilizer hoppers accordingly when they are about to be emptied.
- Plates with different hole sizes are available according to the seed size.
- Seeding rates can be adjusted according to the number of holes in the seed plate that are exposed in the outlet.

Why jab planting?

- Part of the attraction of hand-jab planters is that they do not require access to animal or tractor power, are low cost, light and easy to operate, although some skill is required and for these reasons they are often used by women.
- Enormous labour is saved by the use of jab planter i.e. the work done by 3-4 people in conventional tillage is done by 1 person when jab planter is used.
- Jab planter is affordable and can be afforded by most smallholder farmers
- By planting seeds in unploughed mulch-covered fields, there is minimal soil disturbance so weed seed germination is minimized, resulting in easy hand hoeing/shallow weeding/hand uprooting of weeds between plants.
- The small size of the devices makes them suitable for operation on hilly, stony and stumpy areas and for intercropping and for planting in fallow areas.
- Seeds and fertilizer are dropped at some distance apart hence no chance of scotching unlike in smallholder conventional farming where both are mixed together in the same planting hole.

Review Questions

1. Outline the major advantages of using CSA practices in smallholder greengram production
2. Discuss the challenges that farmers in your area would face on switching to CSA practices in production of greengram
3. Differentiate between conventional methods and climate smart methods of land preparation in greengram production
4. What are the benefits and challenges associated with CA? What are the prerequisites when transiting to CA?
5. List different type of insect pests affecting greengram and suggest their control measures
6. What are common diseases affecting greengram in your region? How have you been able to manage them?
7. What is integrated pest management? List different methods of controlling insect pests
8. Outline how to calculate the seed rate for greengram seeding and adjust for germination percentage.

4 HARVESTING AND POST-HARVEST MANAGEMENT

To prepare for the training, as a trainer, you should take time to read and understand the training content. Maintain interactive engagement with trainees throughout the session.

Learning Exercise 3.3D: Practical demonstration on hand hoe basins construction	
	**Learning objective** By the end of this session the participants should be able to: • List and discuss the importance of proper post-harvest management for greengram. • Describe the entire post-harvest management process • Describe the requirements needed for proper storage and store management. • Describe the process of determining the right moisture content of grains at farm level • Define the major parameters of quality and list ways in which they can improve on grain quality to better access markets • Explain how warehouse receipt system works, it's benefits to smallholder farmers and how it can be used to increase credit access.
	**Materials** Flip charts, marker pens, note books, posters, flyers
	**Method** • Facilitation (group discussion, brainstorming, plenary presentation) • Demonstrations, charts, visual aids /posters • Activities • Case studies / practical exercises
	**Duration** 3.5 hours

Discussions points

Include the information below as you discuss with the farmers/trainees, ask as much as you can to open up for discussion.

Introduction

CSA offers an opportunity to encourage farmers to manage their farms as a business, rather than merely a way to feed their families. When a smallholder farmer achieving low yields applies CSA practices, yields and total production increases, and this raises the issue of labour required to harvest the crops and handle crops residues at the same time. Farmers have to therefore adopt harvesting techniques and methods that will handle increasing yields and crop residues for soil cover. Where yields are higher than usual, farmers need to prepare good storage facilities that are large enough to store the higher yields before sale.

This session provides summarized activities involved during harvesting and post-harvest management in greengram production. It covers the harvesting processes, post-harvest handling, grading and quality control, storage management, transportation and postharvest losses and utilization of greengram.

Harvesting greengram

The general practice in CSA is that farmers should leave crop residues on the ground during harvesting. After cleaning or processing the harvest, farmers should return any residue back on to the soil as mulch or make compost. Harvesting should commence when the pods turn from green to black (N26) or from green to yellowish for others. Physical maturity is when 95 per cent of the pods turn black. You can pick and dry individual pods or cut the stems of the plants about 10 cm high and dry it for about two days, then thresh and clean. The roots are left in the ground to add organic matter in the soil to improve the soil texture and structure.

Post-harvest management

Harvested pods should be dried for about 2-3 days then threshed, winnowed, sorted and graded ready for consumption, marketing or storage.

Use of tarpaulins (Left) is recommended during threshing to prevent contamination. Hermitic bags (Right) enable storage of greengram grains without use of storage pesticides.

Two methods to test the moisture content are the salt method and use of moisture meter. Store grains at the right moisture content of 12.5-13.5%. After cleaning greengram are graded according to the market standards. There are three grades of greengram, according to standard (CD-ARS 865:2012) developed by the African Organization for Standardization (ARS, 2014), summarized in Table 7.

After grading, greengram are packed in 50kg bags at farm level for storage and sale or in smaller packages of 1kg, 2kg, 5kg and 10kg or other appropriate package for sale.

Requirements to be fulfilled for safe storage of greengram include proper site selection, Appropriate size of storage structure with good ventilation, Clean storage structure, clean storage bags, use first-in-first-out policy, clean delivery vehicles, use of pallets, proper aeration and regular inspection.

Storage pests should be adequately controlled using integrated pest management that uses both chemical and nonchemical methods.

Always avoid post-harvest losses that occur during and after harvesting due to late harvest, insufficient drying, improper threshing, poor storage, poor packaging and extended storage due to low market prices, as much as possible. These include loss of weight, quality, nutritional content, and seed viability.

Table 7: Greengram specific grade requirements

Characteristics		Maximum limits			Method of test
		Grade 1	Grade 2	Grade 3	
Moisture % max m/m		14.0	14.0	14.0	ISO 24557
Purity % Max m/m		99.0	99.0	99.0	
Defective,% max m/m		2.0	4.0	6.0	
Immature grain % max m/m		2.0%	3.0	4.0	
Contrasting classes		0.5%	1.0	2.0	
Classes that blend max % m/m		5.0%	10.0	15.0	
Germination, excluding hard seeds		90%	n/a	n/a	
Sprout test		suitable	n/a	n/a	
Foreign material,% max m/m	Organic	0.65	0.65	0.65	ISO 605
	Inorganic	0.25	0.25	0.25	
	Filth	0.1	0.1	0.1	
Other edible grains % max m/m Any edible grain (including oilseeds) other than green-gram		0.1	0.5	3.0	
Inset/pest damaged % Max m/m, Grains per cent by count clean-cut weevil bored		1	2	3	
Total Aflatoxin (AFB1+AFG1+AFG2), ppb				10	ISO 16050
AflatoxinB1 only, ppb				5	
Fumonisin, ppm				2	AOAAC 2001.04

Different greengram recipes (Source:healthline.com; www./cookpad.com/ke/search/dengu)

Utilization of greengram

Greengram are consumed in a number of ways e.g. whole seeds may be boiled, fried alone or with meat/vegetables and eaten as a relish with thick maize porridge (ugali). The grains may also be split (dhal) by removing the seed coat through grinding and the split seeds may be eaten boiled or fried.

Greengram recipes are among the highly nutritious meals enjoyed in Kenyan homes. They are easily accessible and easy to prepare as well. Good nutrition is important for maintaining the immune system for good health.

Learning Activities/Exercises

Learning Exercise 3.4A: Video session: To understand the variety of greengram harvesting and post-harvest management techniques	
	Learning objective To understand the greengram harvesting techniques, methods and tools/equipment used
	Materials Multimedia projector, video player and video or link at on harvesting and storage of greengram.

Method

- Download and play the video to the learners, available on the link Title: Harvesting and storage of greengram. https://www.youtube.com/watch?v=SyH_WPrl76o .The video illustrates how harvesting, threshing and storage is best implemented by smallholder farmers

- Initiate a plenary discussion on the video after watching. Issues of emphasis in the discussion include:
  - ✓ Harvesting of pods only, leaving the plant standing. Ask, why is this important? How else could harvesting be done to achieve the same objectives?
  - ✓ Note the use of biological pesticides for greengram intended for home consumption. What are indigenous options?

Learning Exercise 3.4B: Checking the moisture content of threshed grain using salt method

Learning objective

Ensure grains have attained the correct and desired moisture content before they are stored to prevent spoilage

Materials

A clean, dry glass of about 750ml capacity with a cup that makes it airtight; and a cup of common salt 250-350g of the greengram to be tested.

Procedure

1. Dry salt will absorb moisture from the grain. This principle can be used to determine whether a cereal grain sample has moisture content wet basis of above or below 15%.
2. The salt must first be dried by spreading it out on some plastic sheeting in the hot sun and leaving it for at least 3 to 4 hours until it is hard. It should be turned at intervals during this time. It can also be dried in an oven.
3. The dry salt should be placed in a sealed container until it is ready for use.
4. The grain is tested by putting 160g of greengram into a bottle and add 8g of dry salt. The bottle should be closed tightly with the cap, shaken vigorously for 1 minute to mix the salt and grain, and then left for 15 minutes.
5. If the salt sticks to the side of the bottle, the moisture content wet basis of the grain is above about 15% and is not safe for storage and hence the farmer should consider re-drying of the grains. If the salt does not stick to the bottle, the moisture content is below 15% and the grain is safe for storage.

Learning Exercise 3.4C: understanding greengram grain quality and standards requirements and indicators in grading.

Learning objective

Ensure grains have attained the correct and desired moisture content before they are stored to prevent spoilage

Materials

To understand greengram grain quality and standards requirements and indicators in grading. The exercise will enable trainees to define the major parameters of quality and list ways in which they can improve on grain quality to better access markets.

Procedure

In a facilitated questions and answers session, probe the trainees to do the following:

1. Develop a list of the types of greengram that needs to be removed from the rest in a grading exercise. These should include removal of:
   - Foreign matter (biological and non-biological)
   - Broken and pest damaged grain
   - Rotten and diseased grains
   - Defective, discoloured, visibly infected with fungus or virus, insect damaged grains
   - Immature, shrivelled or stained grains
   - Filth or trash
   - Grains with mould
   - Other contaminants including toxic and noxious weeds
   - Grains having moisture content greater than 13%.
2. List down the specific greengram grade requirements as presented in table 7.

   Hold a conversation that concludes to how ungraded and rejected greengram are classified:

   - Ungraded greengram are those which do not fall within the requirements of grades 1,2 and 3 of this standard but meet the minimum requirements provided in the above table and are not rejected greengram
   - Reject greengram are grains which are musty, sour, materially weathered, infested with weevils, have commercially objectionable odour, contain insect webbing or filth, other foreign substances or which are otherwise of distinctly low quality.

Learning Exercise 3.4E: Proper greengram storage and storage pests' management

Learning objective

To identify storage pest management and describe the requirements needed for proper storage and store management

Materials

Flyer, flip charts and marker pens

Methods

Using the flyer and samples of insect pests, trainees will be guided to discuss and identify critical measure in greengram storage. These include:

- Proper drying of grains is very important to prevent the growth of and contamination with aflatoxins.
- Greengram beans are very susceptible to bean weevil attack and are best stored immediately after sun drying
- Ensure that the store is fumigated, well aerated, leak proof and not damp.
- Storage in airtight drums, tins or gunny bags and be kept in a clean, ventilated place.
- Botanical storage, mainly for home consumption, could be effected through mixing greengram with ash (effective against bruchid), treatment with sunflower oil or mixing with neem leaves.

  For chemical control, intended for bulky production or longer time storage, the grains should be dusted using the locally available and recommended chemicals. The manufacturers' application manuals should always be followed.

Review Questions

1. What are the harvesting techniques you use and the precautions they take while harvesting to ensure quality produce?
2. What precautions should be taken while harvesting to maintain the quality of produce?
3. What methods are used and precautions taken while drying, threshing and winnowing greengram.
4. What equipment (if any) do you use to dry, thresh and winnow greengram? Do you own the equipment or you hire? If hired are they economical and affordable?
5. Which methods to test the right moisture content of greengram grains before storage?

5 MARKETING AND MARKET DYNAMICS FOR GREENGRAM

To prepare for the training, as a trainer, you should take time to read and understand the training content. Maintain interactive engagement with trainees throughout the session.

Learning Exercise 3.3D: Practical demonstration on hand hoe basins construction	
	**Learning objective** By the end of this session the participants should be able to: • Describe the market approaches in greengram production • Discuss the markets, marketing information systems and their importance. • Outline how warehouse receipt systems work, their benefits to smallholder farmers and how they can be used to increase credit access. • Describe trade contracts, their importance in grain trade and how they can be used to enhance market access for smallholder farmers. • Explain the need for aggregation and group marketing, • Discuss how they can obtain market information. • Identify and access market for greengram.
	**Materials** Flip charts, Marker pens, Note books, posters, flyers
	**Method** • Facilitation (group discussion, brainstorming, plenary presentation) • Demonstrations, charts, visual aids /posters • Activities • Case studies / practical Exercises
	**Duration** 2.5 hours

Discussions points

Include the information below as you discuss with the farmers/trainees, ask as much as you can to open up for discussion.

Introduction

There are different ways and options to sell farm produce to buyers. These include selling directly to traders who visit farms during harvest time, selling in nearby local market, and selling directly to consumers and processors, cooperatives or aggregators. Farmers can also send or take their produce to a more distant market. In some counties, farmers may have relationships with traders who have provided them with some form of credit, and they must therefore sell at least part of their produce through them.

Market

A market is a physical or virtual designated space where sellers and buyers meet regularly for selling and buying of commodities and services. About 70% of the greengram produced in Kenya is marketed. Greengram can be value-added into quality seed, de-hulled, split grain or flour for market. Domestic trade is characterized by informality especially among retailers and some wholesalers with middlemen playing a major role of linking farmers to the big players such as exporters to farmers.

Marketing strategies

Greengram is a crop with existing and emerging market opportunities regionally and internationally especially in India. Smallholder farmers in Kenya are increasingly adopting collective marketing strategies and receiving higher prices for their output.

Examples of marketing strategies that can be adopted by farmers include:

- ***Aggregation and Group marketing:*** This approach encourages farmers to come together and consolidate their produce in order to have a bargaining power with the buyers. Most buyers also prefer to trade with farmers whose products are aggregated for the necessary volumes to be collected to reduce the consolidation/transportation costs. Smallholder farmers in Kenya are increasingly adopting collective marketing strategies and receiving higher prices for their output. Educating farmers to understand how markets work, how they can earn more money through collective action and how to put these ideas into practice may require the organization of many group meetings, training sessions and marketing.
- ***Warehouse receipt system (WRS):*** WRS is a method of trading with grain, which allows the commodity to be deposited in a certified warehouse. The depositor can then decide to immediately sell the grain or store it while awaiting a better price. The following details shall be included on each warehouse receipt: Name and ID of depositor; Contact details; Warehouse name, location and certification number; Date of deposit; Commodity deposited; Grade deposited; Quantity - net and gross weight; and Date until which storage has been paid.
- ***Market contracting:*** Drawing marketing/trade contracts is becoming increasingly popular between farmers and the private sector. Major reasons for this are: avoiding risks, securing supply and markets, accessing finance and sharing information. The main elements of trade contracts vary depending on the type of contract. Some of the key features are:
    - Quality or grade of grain delivery or to be delivered
    - Location of delivery
    - Date by which delivery is to be completed
    - Quantity being contracted
    - Price or formula to be used in determining the net price
    - Price adjustment if you are unable to meet the specified grade
    - Signatures of both parties and date of signing.

The following quality requirements have been defined by the processors as a pre-condition for a contractual agreement (Source. Capwel industries 2019)

Specifications

- Variety: N26 (Nylon)
- Moisture content- 14 % Max
- Foreign Matter Organic/inorganic- 1% Max
- Other Grains- 2% Max
- Class that Blend (Cotton Variety) - 10% Max
- Damaged/Rotten/Insect Damage - 2% Max
- Purity – 96% Min
- Size Grading - 95% Min
- Immature Grain - 4%

Market information system

All information about the buying and selling of products and services can be classified as market information. Market information encompasses information about prices and quantities and information about both input and output markets. Examples of market information include:

Categories	Examples of market information
Inputs	location and contacts of input suppliers; type and quality of inputs available prices of different inputs
Demand	size of local, regional and national markets; growth or trends in demand; seasonality of demand
Buyers	location and contact; volume requirements; quality specifications; packaging requirements; seasonal demand; prices offered; payment conditions; support services provided (inputs, credit etc.)
Prices	prices in different markets; price differences according to grade or quality; price seasonality; price volatility within seasons; price trends
Competition	main supplying areas; quality of supply from different areas; seasonality of supply from different areas; imports
Marketing costs	transport; market fees; unofficial charges; Other

Learning Activities/Exercises

Learning Exercise 3.5A: Mapping market outlets for greengram

Learning objective

To identify existing greengram market outlets in participants/ areas and to determine potential markets for greengram

Materials

Flip charts, felt pens and note books.

Method

Group brainstorming session

- Divide the participants into two groups.
- Assign the first group to identify and list the existing market outlets
- Assign the second group to identify and list the potential market channels for greengram in the region
- Each group to make plenary presentation for discussion.

Discussion points:

1. Discuss the challenges existing with the current market outlets
2. Discuss how to utilize the existing market potential

Learning Activities/Exercises

Learning Exercise 3.5B: Determination of the cost of production and offer price of produce

Learning objective

- To calculate the cost of production of greengram per hectare
- To determine the reasonable mark-up for their profit
- To calculate the least price to offer their produce
- To understand the contents and implication of a trade contract

Materials

Flip charts, felt pens and note books.

Method

This should be a facilitated and a highly interactive session among the participants. Depending on their needs, the group discussion may be held in the plenary or in groups. A sample aggregation and group marketing contract document can be used.

Discussion points

- What market arrangements are you currently using to market your greengram? Are there any challenges and how do you deal with them? How do you seek new markets?
- What is the benefit of aggregation and collective marketing?
- What are the benefits of aggregation and group marketing?
- What are the key features of trade contracts?
- What is a warehouse receipt system (WRS)?

Review Questions

1. What is the difference between market and marketing?
2. Why is marketing important in the greengram value chain?
3. What different ways are there to access market in your region?
4. How do you get market information? How do you use this information to improve your markets for greengram? Who controls the greengram market in the area?
5. What are the existing markets for greengram in your area?

6 SOCIO-ECONOMIC ASPECTS OF GREENGRAM PRODUCTION

To prepare for the training, as a trainer, you should take time to read and understand the training content. Maintain interactive engagement with trainees throughout the session.

Learning Exercise 3.3D: Practical demonstration on hand hoe basins construction	
	**Learning objective** By the end of this session the participants should be able to: • Identify the socio-economic factors affecting smallholder farmers in adopting Climate smart technologies for greengram production • Keep farm records, calculate and differentiate profitability between conventional farming and CSA • Explain the gender issues in CSA • Describe the opportunities for youths and women in greengram production cycle and value addition e.g. production of sprouts
	**Materials** Flip charts, marker pens, note books
	**Method** • Facilitation (group discussion, brainstorming, plenary presentation) • Questions and answers • Practical exercises
	**Duration** 5 hours

Discussions points

Include the information below as you discuss with the farmers/trainees, ask as much as you can to open up for discussion.

Introduction

Extension service providers should support smallholder farmers (men, women and youth) in the adaptation and adoption of CSA techniques in greengram production through the improvement of farm management, value addition and marketing techniques. By doing so, farmers can be better prepared to detect opportunities for traditional products in rural economies by adopting a business approach which includes formal agronomic, commercial and economic evaluations for potential market options. Farmers are continually exposed to new information that affects how they organize their farming; what commodities they produce, how they are produced, what inputs they use, how much of each input they use, how to finance the business, and how and when to market their produce. Smallholder farmers have traditionally lacked a business and marketing orientation because farming effort was concentrated on subsistence production.

This session covers the economics of the greengram subsector under CSA, farming as a business, cost benefit analysis, gender issues in greengram value chain and the barriers to CSA adoption

Activity 6.1

Ask the participants;

- *To describe how they have been saving cost of production in their farms both economically and environmentally*
- *Whether they keep records and what types of records they keep and the purpose of each*
- *How they track the performance of their green gram enterprise*

Economics of greengram under CSA

Significant economic and social benefits that accrue from the adoption of CSA practices at farm level include labour saving of up to 60%, Less drudgery and time saving, stable yields and increased incomes and food security, reduced production costs, increased soil fertility and moisture retention, reduced soil erosion, reduced water consumption for agricultural production, reduced greenhouse gas emissions and less wear and tear on farm machinery.

Farming as a business and record keeping

The farmer must run his/her farm as an economic production unit. The aim must be to produce **output** of which, the total value of outputs exceeds the total value of the **inputs**. Doing so, leads to making a **profit**. If the total value of the inputs is higher than the total value of outputs, there will be a **loss.** The total value of the outputs is called **gross output** and the total value of all inputs is called **total costs**.

Activity 6.2

Ask the participants to discuss how they track the performance of their farm on whether they are making profit or loss. Do they cost the family labour? If yes, how do they do it?

The major records for greengram farmers to keep in the farm include Production records; Operation records (e.g. labour, farm inputs, tools and equipment costs); Cash transactions; Sales Records (quantity of sale, value, and name of buyer).

Farm management involves primarily the making of decisions, or choices between alternatives. The decisions each farmer must make as manager include choosing between the varieties and other crops that might be planted in rotation or mixed cropping with greengram. The decision needs to take into account the climate aspects and how to distribute the five capital resources among different tasks, especially at times of the year when several tasks need to be carried out at the same time.

Cost-benefit analysis of greengram production

Gross margin is a simple, useful and practical tool to assess the performance of a farm business by comparing the return or profit from its different farm enterprises. The gross margin for an enterprise is the output (income) from the enterprise minus its variable costs. Calculating gross margins requires the farmer's best estimates of yields or output for each enterprise and expected prices. The calculation of total variable costs requires identifying each variable input needed, the amount required, and its purchase price.

Partial budget

Partial budget is a useful instrument that can be used to assess the effect of marginal changes on overall profitability as well as in choosing between technology and enterprise. The objective of partial budget is to make an overview of the costs and income of different production systems (e.g. conventional vs. Conservation Agriculture). Below is a format of a partial budget.

The partial budget format

Problem			
Additional Costs	KShs	Additional Revenue	KShs
Reduced Revenue	KShs	Reduced Costs	KShs
A. Total Additional Costs and Reduced Revenues		B. Total Additional Revenue and Reduced Costs	
		Net Change in Profit (B minus A)	

Cash flow analysis

The cash flow guides decision making to assess whether the farm is able to generate a cash surplus or incur a cash deficit and to find the time of the year where additional financial resources may be required. The concept of cash flow is simply the flow of money into the farm from sales and the flow of money out of the farm in the form of purchases. The difference between the inflows and the outflows is known as net cash flow.

Cash Inflows include sales of crop products, other farm income sources, sales of capital assets and borrowed money and non-farm income. ***Cash Outflows*** include production costs, capital expenditures, loan payments, and family living expenditures.

Gender issues in CSA greengram value chain

Women constitute approximately 75% of the rural agricultural labour force in Kenya. Gender targeting on better access productive resources and market opportunities requires affirmative targeting and capacity building, by reducing the burden of reproductive role on women in the household.

Studies show that CSA activities have had a direct positive impact on gender equality in the form of enhanced food resources and incomes. With increased productivity more jobs are created for the youth and women in the farm, aggregation centres and the warehouses. The women and youth are able to start small businesses especially through value addition on the greengram, to take advantage of the time and labour saved by applying CSA practices.

Learning Exercises

Learning Exercise 3.6A: Visioning and action planning for introduction of CA

Learning objective

Carry out vision setting and action planning for introduction and adoption of Climate Smart Agriculture in your region

Materials

Masking tape, flipchart stands, coloured markers, projector, leaflet, booklet and handouts/posters.

Method

Brain storm, identify and list the greengram CSA technology options that are feasible in local area giving due reasons

Discussion points

1. Which of these options are farmers will implement?
2. With whom (partners, collaborators) and when will these activities be implemented?
3. What resources (inputs) will be required to implement these activities and when will they be sourced and by who?
4. What further technical back-up would be required to achieve these activities?
5. Summarize the above issues as suggested in the table below.
6. Draw up an action plan for CA implementation - indicate (at least) the following.

List the CSA greengram technologies and socioeconomic options.

No.	Feasible Options	Justification
1		
2		
3		

County/Area Action plan for CSA implementation

Objective	Activities	Responsibility	With whom (partners/ players)	When? (time schedule)	With What? (resources required)	Technical back-up	Remarks

Learning Exercise 6.2: Estimating the variable costs of farm operations

Learning objective

To test the understanding on how to calculate the gross margins of farm enterprises.

Materials

Masking tape, flipchart stands and coloured markers.

Method

1. Review of worked examples on how to establish the gross margins.
2. Fill in the missing information to complete the table, consider relevant formulas.

Variable	Minimum tillage	Conventional ploughing
Grain yield (kg)	1780	368
Gross revenue (KShs/ha) @ KShs 100/kg	A	B
Total labour days	148.27	68.61
Total labour costs @ KShs 300/PD	C	D
Herbicide cost (1lit @ KShs 1000/lit)	E	
Other costs (KShs)	4000	3200
Total Variable Costs	F	G
Gross Margin (KShs/ha)	H	I
Costs per kg	J	K
Returns to labour (KShs/PD)	L	M

Learning Exercise 3.6B: Determination of cost-benefit and cash flow analysis

Learning objective

To test the understanding on how to calculate the cost-benefit and cash flow analysis of a farm enterprise.

Materials

Masking tape, flipchart stands and coloured markers.

Method

Brain storm, solve an example and divide participants into small groups of about 4 people to make calculations based on their experiences.

Example of an Agricultural Cash Flow Statement

Name (s) ……		For Year ……			
Part I Cash Inflows					
Crop		**Livestock**		**Other Revenue**	
Maize		Cattle & calves		Non-farm income #1	
Greengram		Sheep & goats		Non-farm income #2	
Wheat		Dairy products		Ag program payments	
Hay		Poultry		Custom work	
Pearl millet		Breeding livestock		Sales of capital assets	
Other crops		Other livestock		Other sales	
Sub totals (KES) (a)		KES (b)		KES (c)	
Total Cash Inflows (Crop + Livestock + Other Revenue)				KES (a+b+c)	
Part II Cash Outflows					
Production Expenses					
Car and truck expenses		Rents and leases			
Chemicals		(a) Machinery & equipment			
Conservation		(b) Other (land, animals, etc.)			
Custom hire		Repair and maintenance			
Feed expenses		Seed and planting			
Fertiliser and lime		Storage and warehousing			
Freight and trucking		Supplies purchased			
Gasoline, fuel and oil		Taxes (real estate)			
Insurance		Utilities			
Interest		Vet and Medicines			
Labour		Other expenses			
Total Production Expenses				KES (d)	
Part II Other Cash Outflows					
Annual family living expenses[1]		KES (e)			
Purchase of Capital Items		KES (f)			
Principal Payments on term debt					
(a) Intermediate debt		KES (g)			
(b) Long-term debt		KES (h)			
Total Cash Outflows		KES (d+e+f+g+h)			
Cash Position		KES (a+b+c)-(d+e+f+g+h)			

1 Family living expenses should include: health and life insurance/college tuition/income taxes, etc.

Practical application of Cash Flow for farm planning and management

- The actual cash flow from one year can be used to project the cash flow for the next year. In this way, farmers will know that they have cash reserves available and will not be surprised by cash shortfalls.
- Applied to provide solutions to cash shortfalls: The cash flow has an important function of identifying cash shortfalls. This triggers devising ways of addressing the problem, such as borrowing funds, mobilizing savings or selling assets.

Review Questions

1. What is farm management?
2. Describe how you have been saving cost of production in your farms
3. Do you keep records and what types of records do you keep and the purpose of each?
4. How do you track the performance of your greengram enterprise; making profit or loss?
5. What do you understand by these terms: The Partial Budget, Gross Income, Costs of Production, Variable costs, Fixed Costs, Gross Margin, Cash flow?
6. Why is Climate Smart Agriculture more beneficial as compared to conventional farming?
7. What are the benefits of climate smart agriculture?
8. What do you think are the factors that affect adoption of CSA in your area?
9. How can farmers manage risks and uncertainties?
10. How can farmer organisation be established and strengthened?

Variable	Minimum tillage	Conventional ploughing
Grain yield (kg)	1780	368
Gross revenue (KShs/ha) @ KShs 100/kg	A	B
Total labour days	148.27	68.61
Total labour costs @ KShs 300/PD	C	D
Herbicide cost (1lit @ KShs 1000/lit)	E	
Other costs (KShs)	4000	3200
Total Variable Costs	F	G
Gross Margin (KShs/ha)	H	I
Costs per kg	J	K
Returns to labour (KShs/PD)	L	M

Gross Margin

Gross margin is a simple, useful and practical tool to assess the performance of a farm business by comparing the return or profit from its different farm enterprises. The gross margin for an enterprise is the output (income) from the enterprise minus its variable costs.

Example: Gross margin of greengram under conservation and conventional farming practices

	Conservation Agriculture	Conventional farming
Yield levels (t/ha)	1.75	1.25
Selling Price (KShs/t)	80,000	80,000
Gross Income (KShs/ha)	140,000	100,000
Total Variable Costs (TVC)	38,500	47,500
Gross Margin (GM)	101,500	52,500

Cash Flow Analysis

The cash flow guides decision making to assess whether the farm is able to generate a cash surplus or incur a cash deficit and to find the time of the year where additional financial resources may be required. The concept of cash flow is simply the flow of money into the farm from sales and the flow of money out of the farm in the form of purchases.

Net Cash Flow = Cash Inflows - Cash Outflows

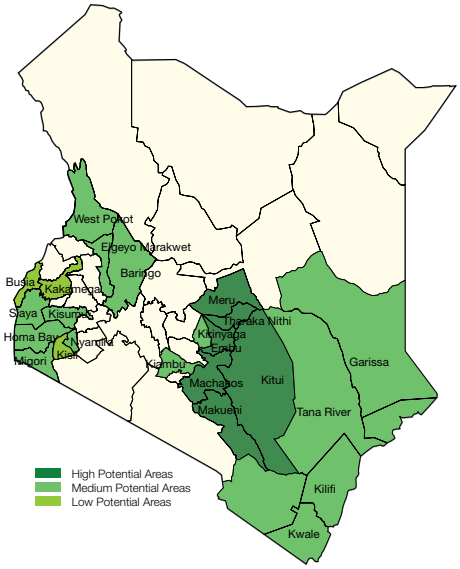
7 ANNEXES

Annex 1.1 Poster on Importance of Greengram

- Title: Importance of greengram
- Content: Photos: greengram plants; greengram seeds
- Importance:
  - Forms part of the healthy food, highly nutritious; consumed in different forms
  - Improve soil quality by fixing nitrogen in the soil (add up to 30-40 kg N/ha after harvest)
  - Can also be grown for hay, green manure or as a cover crop.

Annex 1.2 National Production of Greengram

- Title: National production of greengram
- Content: Map of Kenya showing greengram producing regions in Kenya with their potential indicated. Notable: over 95% of the country's greengram with the major production counties in order of importance being found in Kitui, Makueni, Tharaka Nithi, Machakos and Embu.
- Photos: Greengram plants; seeds and value-added products
- Importance:
  - Trigger discussions why greengram does well in some counties, why and where.
  - Highlight business opportunities in greengram production



From L to R: Greengram whole grain, split green and split dry grain, flour and packed grains,

Annex 2.1 Flyer Greengram Kenya: Climate Change Risks and Opportunities

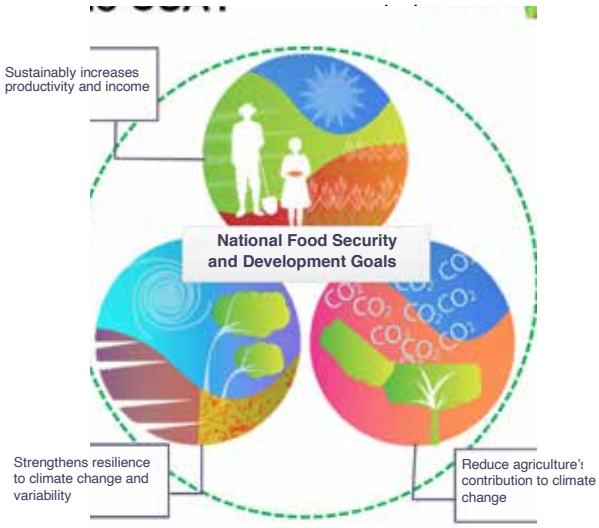
- Title: Greengram, Kenya: Climate change risks and opportunities
- Content: climate change, its projections and impacts on agriculture
- Climate change and its impact on agriculture:
  - Climate change projections - for Kenya: shows increasing temperatures and more frequent climate shocks (droughts and floods).
- CRAFT Climate analysis in GG growing regions:
  - Climate change projection scenarios: Increase in temperature in both short & long seasons, in 2030 & 2050; Rainfall is expected to increase in during the short rainy season (OND), the long rainy season (MAM) is expected to suffer from a long dry spell and a decrease in seasonal rainfall particularly in the north western parts of the country.
- Climate information and decisions
  - Key Decision Points and Key Climate Variable that informs the Decision

Annex 2.2 Poster: What is CSA and What are the Pillars?

- Title: What is CSA and what are the pillars?

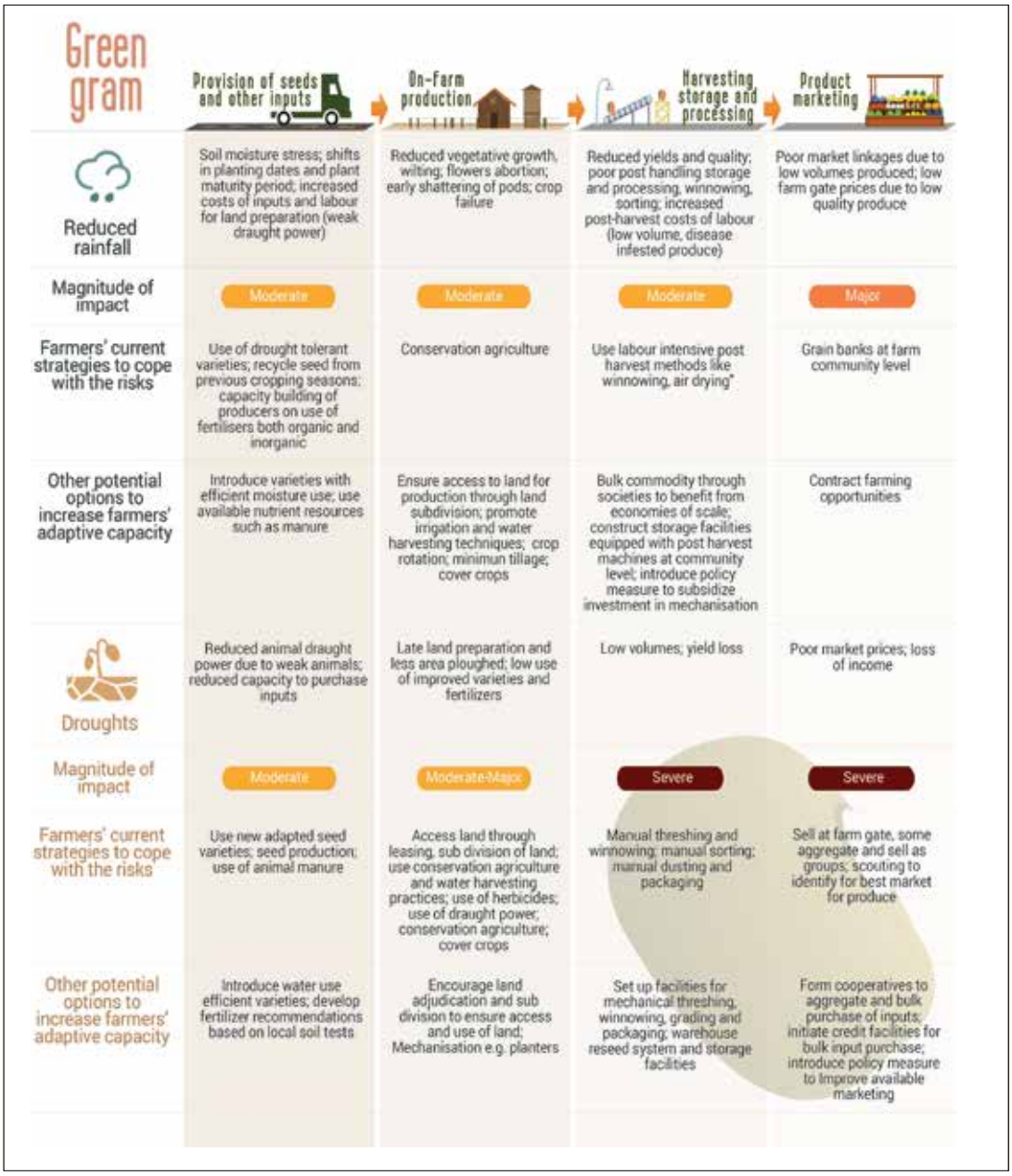
Content: Schematic diagram illustrating the CSA pillars

- What is CSA: An approach for transforming and reorienting agricultural development under the new realities of climate change
- Why CSA: Agricultural activities account for 10 -12 percent of global greenhouse gas (GHG) emissions besides being the key driver of deforestation and land degradation, which account for an additional 12 -14 percent of GHG
- Component/Pillars of CSA:
  - **Productivity:** sustainably increase agricultural productivity and incomes from crops, livestock and fish, without having a negative impact on the environment.
  - **Adaptation:** reduce the exposure of farmers to short-term risks, while also strengthening their resilience by building their capacity to adapt and prosper in the face of shocks and longer-term stresses.
  - **Mitigation:** Wherever and whenever possible, CSA should help to reduce and/or remove greenhouse gas (GHG) emissions.



Annex 3.1 Poster: Strategies Across Greengram Value Chain in Makueni County

Title: Some of the strategies across greengram value chain of adapting its production to changes and variabilities in climate in Makueni County



Source: MoALF. 2016

Annex 4.1 Poster: Methods of Harvesting

- **Title: Methods of harvesting**
- **Content**
  - Methods of harvesting *(illustrated with photos or infographics)*
  - Mature crop ready for harvesting
  - Hand harvesting
  - Machine harvesting (greengram combine harvester)
- **Emphasis and illustrations**
  - Illustrate/indicate that some of the residue is left on the ground during harvesting; e.g. only mature pods are picked and the remaining plant is left in the field. The option is cutting of the stems are at 10cm height and the stump is left intact as opposed to uprooting. Refer to page 41 of the manual.
  - Where home threshing is made, the residues could be returned back to the farm and spread as soil cover.
  - That modern combine harvesters are fitted with a shredder and also a mechanism for spreading it on the ground as soil cover.

Annex 4.2 Post-harvest Management

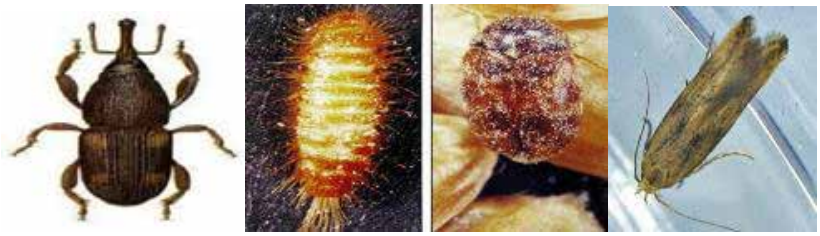
- **Title: Post-harvest management**
- **Content:** Illustrate with photos/graphics the processes of
  - Drying greengram after harvest
  - Threshing
  - Winnowing
  - Grading
- **Emphasis and illustration on winnowing**
  - Illustrate that after threshing the residue is returned to the farm for soil cover

Annex 4.3 Flyer: Greengram Storage and Store Management

- **Title:** Grain storage and store management
- **Content:** The greengram should be dried well before storage to prevent them from weevil attack, rotting or fungal (aflatoxin) infestation. To achieve high prices from greengram production, harvest and storage should focus on preventing:
  - Soil contamination
  - Insect, disease or weather damaged grain
  - Cracked or split grain
  - Uneven crop maturity e.g. immature beans being harvested in the sample
  - Contamination from animals e.g. birds and rodents
  - Weed seed contamination.

Annex 4.4 Flyer: Storage Pest Control for Greengram

- **Title:** Storage pest control for greengram



Common storage pests from L to R - weevil (Sitophilus spp), Anjoumis moth (Sitotroga cerealella), Khapra beetle (Trogodema granarium- larva and adult)

- **Content:** Common storage pests of greengram include *Sitophilus spp (weevil)*, *Sitotroga cerealella (Anjoumis moth), Trogodema granarium (Khapra beetle - larva and adult), Termites, Rodents (rats, mice) and Birds (feral pigeons, house sparrows and starlings). Moulds* are also destructive to grains and occur when the humidity of the grain is favourable

.

REPUBLIC OF KENYA

Ministry of Agriculture, Livestock, Fisheries and Cooperatives

Principal Secretary
Ministry of Agriculture, Livestock, Fisheries and Cooperatives
Cathedral Road
P. O. Box 34188-00100, Nairobi, Kenya
Tel: +254-20-2718870
E-mail: psagriculture@kilimo.go.ke
www.kilimo.go.ke

CRAFT
Climate resilient value chains for improved livelihoods

SNV Netherlands Development Organisation
Ngong Lane, off Ngong Road
P.O. Box 30776, 00100, Nairobi, Kenya
Tel.: +254 724 463355
Email: kenya@snv.org