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# ACRONYMS

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
<td>CA</td>
<td>Conservation Agriculture</td>
</tr>
<tr>
<td>CF</td>
<td>Conservation Farming</td>
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<tr>
<td>CFU</td>
<td>Conservation Farming Unit</td>
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<tr>
<td>FAF</td>
<td>Field Agricultural Facilitators</td>
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<tr>
<td>FFD</td>
<td>Farmer Field Day</td>
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<tr>
<td>FFS</td>
<td>Farmer Field School</td>
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<tr>
<td>GART</td>
<td>Golden Valley Agricultural Research Trust</td>
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<td>GRZ</td>
<td>Government of the Republic of Zambia</td>
</tr>
<tr>
<td>IGA</td>
<td>Income Generating Activity</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>LOA</td>
<td>Life of Activity</td>
</tr>
<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
</tr>
<tr>
<td>MAL</td>
<td>Ministry of Agriculture and Livestock</td>
</tr>
<tr>
<td>OFDA</td>
<td>Office for Foreign Disaster Assistance</td>
</tr>
<tr>
<td>PMP</td>
<td>Performance Management Plan</td>
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<tr>
<td>ToT</td>
<td>Training of Trainers</td>
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<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
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<tr>
<td>ZCA</td>
<td>Zambia College of Agriculture</td>
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<tr>
<td>ZFP</td>
<td>Zambia Fodder Pilot</td>
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INTRODUCTION

This *Fodder and Fodder Seed Production Manual*, also known as the Zambia Fodder Manual, documents best practices that were tested, determined effective, and scaled up through the USAID/OFDA-funded Zambia Fodder Pilot. The overall objective of this manual is to provide guidance on how to incorporate fodder and fodder seed production into the farming systems of smallholder farmers. The manual will help disseminate tested approaches with organizations across Zambia and Southern Africa, specifically to organizations that plan to conduct fodder production and marketing interventions or incorporate fodder components into their agricultural interventions.

This manual shares **best practices and lessons gleaned** during two years implementing the Zambia Fodder Pilot (ZFP), which developed, tested, documented and disseminated ecologically sustainable fodder and fodder seed production systems to vulnerable households. ZFP set out on a mission to include fodder and fodder seed production among farming systems in drought- and flood-prone areas of Southern and Western Zambia—to build livelihood coping mechanisms against economic and environmental shocks. The farming systems prevalent in these areas included livestock and food crop production.

A. Target Audience

This Fodder and Fodder Seed Production Manual guides trainers of trainers (ToTs) and trainers of farmers who seek to include fodder and fodder production among their farming systems, to engage in fodder production as a business, or to simply improve the performance of their livestock by providing them with supplementary feeding during the dry season.

Trainers and extension agents can use this manual as a reference to help provide evidence-based fodder production planning, growing, harvesting, storage and utilization. They will also find it useful for estimating production costs, development of cash flow and fodder flow plans, and deciding which types of fodder crops are best suited for different areas and intended uses.
Readers will also find the manual useful for its **evidence-based agronomic case studies**, which will help with furthering their understanding of fodder crop performance in drought and flood-prone areas, crop pest control through intercropping, and opportunities for further research.

**B. About Land O’Lakes International Development**

Since 1981, Land O’Lakes International Development has been working to improve the quality of life for millions of people in 76 countries worldwide through more than 200 projects that have been funded primarily by USAID and the United States Department of Agriculture. These projects have been generating economic growth, improving health, and alleviating poverty through market-driven solutions to agricultural challenges. Land O’Lakes International Development is a division of the $14 billion agribusiness cooperative, Land O’Lakes, Inc. It works to link farmers to markets, input suppliers and business service providers in a manner that meets market demand, boosts productivity and improves quality. It also strengthens the business and technical capacity of stakeholders throughout agricultural value chains.

**C. About the Zambia Fodder Pilot Project**

The Zambia Fodder Pilot (ZFP) project was conceptualized to respond to an identified need among rural farming families to better protect their critical livestock assets, especially in Southern and Western Zambia’s disaster-prone communities. The quality of rangeland grazing areas in these largely agro-pastoral regions has been significantly deteriorating as a result of variable rainfall and a lack of sustainable rangeland management for communal lands. As a consequence of these issues and the spread of animal disease, livestock health and herd numbers have declined. Years of drought (2005-06 and 2007-08) have been followed by years of flooding (2008-09). These conditions, exacerbated by poor land management practices, have reduced ground cover and vegetation quality. Thus, the number of cattle that the land can

---

1 Evidence shows that the concentration of animals from different regions in riverine flood plains in the aftermath of floods has exacerbated the spread of diseases. See Needs Assessment.
sustain has declined. Household livelihoods and food security have suffered due to a lack of draft power, and inadequate milk and meat production.

The USAID/OFDA-funded Zambia Fodder Pilot project was designed to respond to this problem by improving rural lives through the production of fodder and fodder seeds among smallholder farmers. As a broader goal, the project aimed to improve household resiliency to environmental and economic shocks through the development, testing, documentation and dissemination of sustainable fodder and fodder seed production and marketing systems.

A two-year project that commenced in May 2012, ZFP tested fodder and fodder seed production among 830 smallholder farmers as means to generate income and improve the productivity of livestock farming.

D. Manual Components

This manual is comprised of five modules, including four training modules (1-4) and a module highlighting an adapted technical approach (5), as follows.

1. Fodder Production
2. Harvesting and Post-Harvesting Techniques
3. Basic Business Skills for Managing Fodder Income Generating Activities
4. Ruminant Nutrition
5. Adapting the Answer Plot® by WinField Approach in Africa

The training modules are the outputs of the various training activities used to build the capacity of more than 830 households to manage fodder and fodder seed as income generating activities (IGAs) under ZFP. To ensure the effective adoption and sustainability of fodder production, ZFP used varied technical methodologies in consultation with key stakeholders, especially the Ministry of Agriculture and Livestock (MAL), Golden Valley Agricultural Research Trust (GART) and the Conservation Farming Unit (CFU).

In particular, Module 4, Ruminant Nutrition, will help smallholder livestock farmers begin to plan and produce fodder to feed their livestock throughout the dry season. Non livestock owners producing fodder crops will gain exposure to fodder demand trends and prepare to
position themselves to supply the type and quantity of fodder as per livestock farmers’ demands. This manual, along with the others, acts as stimulant to logical resource search and should not be considered a final resource book.

Additionally, Module 5, Adapting the Answer Plot® by WinField Approach in Developing Countries (WinField Solutions is a wholly-owned subsidiary of Land O'Lakes, Inc.), helps meet the needs of farmers in developing countries to address what has proven to be a best practice for delivering key technical messages to farmers in the production of fodder and fodder seed. The manual also includes job aids that can be as used as guides by farmers in various key components surrounding fodder production and marketing.

While this manual contains training aids and modules designed to facilitate trainings in fodder production and marketing, users are encouraged to adapt the manual’s key insights so that they are appropriate for other local contexts.
BRIEF GUIDE TO THE TRAINING MODULES

A. Training Aids and Modules

Training for fodder and fodder seed production is comprised of short, focused and highly practical (hands-on) sessions that can be delivered as needed, depending on various factors, such as weather, season and availability of farmers.

Following is a checklist for training management (including components and supplies needed), guidelines for effective training, a project overview, and an outline of the training modules and guides.
B. Checklist for Training Management: Components Needed

1. *Training Leadership and Management:*
   Project Managers (ZFP Managers in the case of the project)

2. *Resource Personnel (1 each):*
   - Land O’Lakes ZFP Manager
   - Field Agriculture Facilitator
   - External Trainer

3. *Mode of Training:*
   - Participatory and Interactive Training

4. *Language of Training:*
   - Local language should be used whenever possible.
   - Training materials should be translated to local language as well.

5. *Training Venues:*
   - Community Based/AnswerPlot® Based

6. *Training Times:*
   - Generally 4 hours each, preferably scheduled in the afternoon, when women are most likely to participate

7. *Training Materials and Supplies Needed:*
   - Flip charts
   - Markers
   - Notebooks
   - Pens
   - Glue or tape
   - Technical materials – e.g. baling box, locally available feeds
C. Training Guidelines

- Please note that **running time** is generalized as 4 hours for each module
- **Use participatory methods** as much as possible. Participatory methods include:
  - Group work (20-30 minutes)
  - Buzzing (discussions in pairs) (10-15 minutes)
  - Brainstorming (10 minutes)
  - Role playing (30 minutes)
- Conduct training in the **local language** as much as possible.
- **Prepare** for interactive training. Training notes do NOT take away from the need for preparation! Facilitators must be prepared and study beforehand, to avoid ‘lecturing’ and reading notes during the trainings.
- **Update training materials** as the training program progresses and results of lessons become known.
- Accompany training with **practical sessions**.
- **Allow 3 days** of training for each training module. Training sessions should not exceed 4 hours on any given day; this tends to be the limit to ensure focused concentration among participants, and to respect competing demands on farmers’ time.
- Insist on **participation of women**. This MUST be done, as women are usually more economically vulnerable, despite bearing the onus for carrying out major agricultural responsibilities.
- Develop a **summary and action plan** at the end of each training session, which the trainer can use to follow up with farmers. The action plan should outline the five components of action planning — i.e. Why, What, When, How, and Who — and ensuring that it includes all resources required.
D. Brief Project Overview

Facilitator's Note: This section defines the problem the program works to address. It is important for farmers to understand the underlying goal each intervention is aiming to achieve.

Project Goal (ZFP Example):

Develop, test, document and disseminate ecologically sustainable fodder and fodder seed production systems to vulnerable households participating in this USAID-funded project.

Project Objectives (ZFP Examples):

1. Fodder and fodder seed production are integrated with conservation agriculture practices.
2. Livelihoods improved among 830 households through fodder crop and seed production and sales.
3. Fodder and fodder seed production best practices documented and scaled up among and beyond participating communities.
E. Training Module Outlines

Module 1: Fodder Production

Section 1.1: Introduction to Fodder Production
• Training Objectives
• Fodder Production in Zambia
• Working Definitions: Fodder, Silage, Hay, Legumes
• Advantages of Fodder Production – Livestock Nutrition
• Fodder Production as Part of the Farming System

Section 1.2: Fodder Crop Production and Management
• Conservation Agriculture: Practices in Fodder Production
  o What is Conservation Agriculture / Farming?
  o Advantages/Benefits of Conservation Agriculture
  o Conservation Agriculture (CA) Principles and Practices
  o Conservation Agriculture and Fodder Production

Section 1.3: Fodder Crop Establishment
• Types of Fodder Crops
  o Grasses
  o Legumes
• Fodder Establishment
  o Grasses—soil types, land preparation, planting, fertilizer, weeding, and harvesting (for Rhodes grass)
  o Legumes—soil types, land preparation, planting, weeding, pests and diseases, and harvesting (for many types)
Module 2: Harvesting and Post-Harvesting Techniques

Section 2.1: Fodder Harvesting and Storage
• Training Objectives
• Working Definition: Fodder
• Factors Affecting Fodder Quality
• Types of Hay
• How to Make Good Quality Hay
• Attributes of Good Quality Hay
• Fodder Seed Harvesting
• Fodder Harvesting Tools
  o Recommended Fodder Harvesting and Storage Tools
  o Selecting Artisans to be Trained

Module 3: Basic Business Skills for Managing Fodder Income-Generating Activities

Section 3.1: Introduction to Basic Business Skills
• Training Objectives
• Basic Business Terms and Definitions
• Decision-Making Process
• Stages in Decision Making

Section 3.2: Marketing
• Working Definition: Marketing
• 4Ps of Marketing
• The Marketing Chain

Section 3.3: Profit and Loss Analysis
• Costs and Profits
• Gross Margins
• Cash Flow Budgeting
• How to Construct a Cash Flow Budget
Section 3.4: Introduction to Record Keeping
- What is Record Keeping and What are Business Records?
- Why Keep Records?
- Types of Records
- Financial Records
- Principles of Record Keeping

Module 4: Ruminant Nutrition

Section 4.1: Introduction to Ruminant Nutrition
- Training Objectives
- Understanding Nutritional Requirements of Ruminant Animals
- Characteristics of a Ruminant Animal

Section 4.2: Nutrient Requirements and Their Functions
- Proteins
- Carbohydrates
- Fats and Oils
- Minerals
- Vitamins
- Water

Section 4.3: Basic Principles of Ration Formulation
- Formulating Rations
- Feed Quality
- Feed Quantity
- Feed Mixing
Section 4.4: Feeding Livestock
• Basic Concepts to Optimize Resources
• Feeding Stations and Troughs/Racks
• Factors Affecting Ruminant Nutrition

Section 4.5: Fodder Flow Planning

Section 4.6: Feed Performance Assessments
• Checklists
  o Dairy Checklist
  o Heifer Checklist
  o Calf Checklist
  o Goat Checklist
  o Beef Animal Checklist
• Locally Available Animal Feeds and Their Feeding Values

Module 5: Adapting the Answer Plot® by WinField Approach for Africa

Section 5.1: Introduction to the AnswerPlot® Approach
• What is an AnswerPlot®?
• Factors to Consider when Selecting a Venue
• Management of AnswerPlot®-Style Events
• Farmer Involvement in the Adapted AnswerPlot®

Section 5.2: Farmer Field Schools
• About Farmer Field Schools
• How to Conduct Farmer Field Schools
Key to the “Facilitator’s Note” Symbols

Facilitator’s Note: Discussion or Exercise

Facilitator’s Note: Please Note to Plan Ahead
Module 1

Fodder Production
Module 1. Fodder Production

Section 1.1 Introduction to Fodder Production

1.1.1 Training Objectives
At the end of the training, attendees (mainly farmers) should be able:

- To gain capacity in fodder production principles and practices.
- To integrate fodder production into conservation agriculture practices.
- To appreciate the role of fodder in livestock nutrition.

1.1.2 Fodder Production in Zambia

Facilitator’s Note: Discuss Fodder. Ask the farmers: Have you ever thought of growing fodder? Why? Please discuss in pairs. The group should receive feedback from as many pairs as possible.

Feedback: Many smallholder farmers who own livestock and/or small ruminants believe that fodder production in Zambia is unnecessary; they believe fodder is available naturally in communal pastures year-round. Further, the idea of feeding livestock is unusual for most small-scale farmers because livestock are expected to fend for themselves in the natural veld. This practice has led to poor management of feed resources for livestock, which in turn has led to poor livestock production. Feed shortages, especially during the long dry season, lead to animal weight loss, high death rates, low fertility and poor market sales. Animals are also susceptible to diseases due to high stress. Weak or sick animals make vulnerable farming households even more vulnerable due to the eroding of resiliency provided by livestock ownership.
Facilitator’s Note: Plot a Graph. With the farmers, using the graph below as a guide, plot a graph of fodder availability on a flip chart.

Figure 1 Example of a graph of fodder availability by month on flip chart paper

Figure 2 The challenge is to overcome the scarcity of forage in the dry season to maintain the productivity of livestock.
Farmers have several options and opportunities to counter this challenge. Some of these options include:

1. Planting fodder crops for supplementary feeding during the dry season. This is what the ZFP project is promoting, including the crops listed below.
2. Planting improved pastures for grazing – suitable for farmers on non-traditional land.
3. Cutting natural grass or improved pasture for making hay.
4. Intercropping legumes in maize and/or grass to improve the nutritional quality and utilization of the fodder.

1.1.3 Working Definitions: Fodder, Silage, Hay, Legumes

1.1.3.1 Fodder

- Traditionally, fodder is any crop grown or preserved for livestock feeding. It can be fed to livestock either fresh or preserved.
- Fodder or animal feed can be any agricultural foodstuff used specifically to feed domesticated livestock, such as cattle, goats, sheep, horses, chickens and pigs.
- “Fodder” refers particularly to food given to the animals (including plants cut and carried to them), rather than that which they forage for themselves. It includes hay, straw, silage, compressed and pelleted feeds, oils and mixed rations, and sprouted grains and legumes.

Facilitator’s Note: Please make the definition for “fodder” as simple as possible and – even better – in local language.
1.1.3.2 Silage
Silage is fodder preserved by acids through fermentation process. Bacteria (present on the crop and in the air) produce acid, which reduces the pH of the grass to approximately 4.2. This prevents decomposing and deterioration of fresh grass and preserving its quality. To allow the fermentation process, effectively the grass is chopped and pressed (to expel oxygen and to allow the bacteria to grow) and covered with plastic sheets and a layer of soil (GART, Manual on Improved Feeding of Dairy Cattle by Smallholder Farmers, 2011).

1.1.3.3 Hay
Forage dried by sun and wind, which is conserved as standing hay or cut. Moisture content is reduced from 80% to less than 20% by wilting. Good quality hay is obtained from what is cut before flowering in order to preserve the much needed nutrients which can rapidly decline if the crop “goes to seed” or ages.

1.1.3.4 Legumes
Legumes are a group of nitrogen fixing plants and therefore are richer in proteins than grasses and other fodder crop. The plants have relatively more leaves than stems and leaves contain approximately 80% protein (GART Manual, 2011). When they are cultivated, they inject nitrogen into the soil, replenishing this nutrient into the soil.
1.1.4 Advantages of Fodder Production – Livestock Nutrition

Fodder production:

- **Extends the availability of feedstuffs** for livestock through the dry season when natural pasture is unavailable.
- **Maintains the good condition of livestock** thereby making livestock production more profitable.
- **Assists in maintaining soil fertility** and can prevent soil erosion when introduced in crop farming systems.
- **Serves as a source of income** for households without livestock.
- **Is easy.** Fodder crops are easy to grow and use fewer resources (such as fertility treatments and crop protection products, for example) than most field crops.

1.1.5 Fodder Production as Part of the Farming System

Fodder crops, like other crops, can be introduced and maintained in the farming system. As an added advantage, fodder crops provide much-needed livestock feed — especially in the dry season — making livestock production more profitable. The presence of fodder crops in the farming systems can help to reduce or even eliminate food competition between humans and livestock. Land left fallow can be used to grow fodder legume crops, which can improve soil fertility and reduce erosion. Fodder crops can also be used in crop rotation practices and they tend to have a shorter growing season than other field crops, which reduces the competition for household labor between human food and animal fodder crops.
Section 1.2 Fodder Crop Production and Management

1.2.1 Conservation Agriculture: Practices in Fodder Production

1.2.1.1 What is Conservation Agriculture/Farming?
Conservation Agriculture is, “A way of farming that conserves, improves and makes more efficient use of natural resources through integrated management of available resources with external inputs” (GART Year Book, 2009).

Facilitator’s Note: This must defined in local language.

1.2.1.2 Advantages/Benefits of Conservation Agriculture

- Ensures timely implementation of field activities as land preparation is done before the onset of the rain season.
- Ensures precise field operations, as only land that will be used by the crop is disturbed.
- Ensures efficient use of inputs. (Fertilizer, for example, is applied when and where needed by the crop in pot holes or ripping lines.)
- Higher Yields Leading to Improved Food Security
- Improved Household Income ²
- Reduced cost of inputs.
- Reduced soil erosion and land degradation due to minimum soil disturbance and use of mulch and cover crops.
- Crop rotation leads to less pesticide use as it breaks the life cycle of crop specific pests.

² References:
The Impact of Conservation Farming on Maize Yields and Soil pH over Time in a Three Year Rotation (Langmead, 2010).
Comparison of Conservation Farming Demonstration Plots with Conventionally-Farmed Control Plots (Langmead, 2003).
• Conservation Farming (CF) is suitable for women farmers as it reduces the time required for land preparation and ripping lines and pot holes are made once.
• Enables farmers to do 20 – 40% less work but get 50% higher yields.
• More free time to do other enterprises.
• Promotes wholesomeness and dignity.

1.2.1.3 Conservation Agriculture Principles and Practices
Conservation Agriculture principles and practices include:

• Minimum soil disturbance.
• Mulching and minimum burning of crop residues.
• Mixing and rotating crops, especially with legumes.

Figure 3  Minimum soil disturbance illustration: a woman making planting holes
1.2.1.3 Conservation Agriculture and Fodder Production

Conservation Agriculture practices can be integrated in fodder production through crop rotations and/or by using inter-cropping farming techniques, such as having cowpeas or other fodder-based legumes intercropped with maize and/or other human foods.

Figure 4  Maize inter-cropped with cowpeas: A conservation agriculture (CA) practice
**Section 1.3 Fodder Crop Establishment**

1.3.1 Types of Fodder Crops

Fodder crops include a variety of grasses and legumes.

**Grasses:**
- Rhodes grass
- Napier grass
- Foxtail grass
- Forage sorghum

**Legumes:**
- Velvet beans
- Cowpea
- Sunn hemp (Red)
- Dolichos

**Note:** Other legumes, such as groundnuts and soya beans, though readily available are used primarily for home consumption and as cash crops. Groundnut stovers can be used for fodder while groundnut and soya bean cakes are excellent livestock feed but the cost is prohibitive for small scale farmers.

**1.3.2 Fodder Establishment**

1.3.2.1 **GRASSES**

*Facilitator’s Note: Notes are limited to Rhodes grass only at this stage. (Rhodes grass was the only cultivated grass that promoted by the ZFP project. In the absence of Rhodes grass farmers were encouraged to conserve natural grass for fodder.*)*
Rhodes Grass

- **Soil Types:** Grass is tolerant to a wide range of soils from light sandy to clays (GART Manual, 2011). This makes Rhodes grass suitable for agricultural regions in Zambia. Water-logged soils, however, are not suitable for Rhodes grass. Rhodes grass provides excellent first season grazing and hay, but because yields decline over time, replanting is necessary after 3 – 5 years.

- **Land Preparation:** Land for planting Rhodes grass should be ploughed and the seedbed should be lightly rolled. The seeds are planted by drilling or swept over with branches. The seed is broadcast planted.

- **Planting:** Rhodes grass is established from seed. It should be sown in rows of about 0.5 to 1.0 m apart or broadcasted at the rate of 3 – 7 kg per hectare. Rhodes grass seed is very small and therefore it should not be planted at more than 1 cm deep. Covering of the seeds should be done in such a way that the seed is not pushed too deep in the soil. **Sowing should not be done until the rains are well established.**

- **Fertilizer:** Though inorganic fertilizer can be used to boost the growth of Rhodes grass, it is not often used due to its high costs and its potential deleterious impact on the environment, if not used correctly. Organic fertilizer is recommended, such as cattle or goat manure. The manure should be applied before planting in the dry season.

- **Weeding:** Manual weeding will probably need to be done in the months of December through January.

- **Harvesting:** New strands of Rhodes grass should be allowed to set to seed before cutting. This is particularly important if the stand was poorly established. Peak grass production is usually obtained in the first two seasons. Then allow the stand to flower, and shed seed before harvesting. Plough and replant after 3 – 5 years.
**1.3.2.1 LEGUMES**

**Velvet Beans**

Velvet beans are desirable as a fodder crop because it produces large quantities of vegetative material. It is also recommended as a good cover crop for farmers practicing conservation farming.

- **Soil Types:** Velvet beans are tolerant to a wide range of soils, but are susceptible to water logging. This crop is fairly drought resistant and requires a long warm growing season.
- **Land Preparation:** Using CA practices such as ripping and pot holing.
- **Planting:** Planting should be done at the rate of 40-50kg seed per ha in rows of 0.5 to 1m apart when the crop is planted for its leafy material as fodder. The depth of the seeds should not exceed 2 to 3 cm. When intercropped with maize or sorghum as a mixture to make silage, the seed rate should be 15-20kg per ha.
- **Weeding:** Velvet beans require regular weeding in the first weeks because its initial growth is slow. Later, it effectively overcomes all weed competition.
- **Diseases:** Suffers from root rot in high rainfall areas.
- **Harvesting:** Velvet beans are an excellent silage crop when intercropped with cereal crops like maize and sorghum. When feeding fresh to livestock (cattle and goats), they should be combined with hay or a cereal fodder in a ratio of 1 part velvet beans to 3 parts cereal.

**Cowpeas**

Cowpeas are a triple-purpose crop. The 3 purposes are: it can be used as a fodder crop, it can be used as human food and it can increase the fertility of the soil. As a fodder crop, it is used to provide green fodder, hay, silage or grain as a concentrate.

- **Soil Types:** Cowpeas should be planted in well-drained soils that are weed free.
- **Land Preparation:** Using CA practices such as ripping and pot holing.
- **Planting:** Cowpeas should be planted at a seed rate of 15-20kg/ha
- **Weeding:** Cowpeas should be kept weed free in the first four weeks after which it outgrows the weeds.
• **Pests and Diseases:** Cowpeas are susceptible to fungi attacks. Though fungicides can be sprayed, the best control is crop rotation. It is also attacked by blister beetles, which eat the flowers. These beetles can be killed manually or with a suitable insecticide.

• **Harvesting:** The complete crop can be incorporated in silage or be dried as hay. The seeds can be dried and ground and fed as a meal. As a fresh feed for livestock, the green leaves can be plucked regularly or the whole crop can be harvested when the pods are green. Cowpeas are an excellent fodder crop for smallholder dairy farmers.

**Red Sunn Hemp**

Sunn hemp is predominantly used for green manure due to its rapid growth. It is however used for silage, and hay. It’s a tall, upright annual legume.

• **Soil Types:** Grows practically in any soil and improves soils that are highly infertile.

• **Land Preparation:** It is recommended to prepare a smooth seedbed for sunn hemp though this not recommended in CA.

• **Planting:** Seed should be drilled in a smooth seedbed at the rate of 10 – 15kg per ha in rows of 0.5 – 1m apart. Planting should be done soon after the rains have started.

• **Weeding:** Sunn hemp is not very sensitive to weeds meaning it competes well with weeds and therefore does not priority attention for weeding

• **Pests and Diseases:** It is generally free from most diseases and pests.

• **Harvesting:** When used for silage or hay, it is best cut when the crop starts to flower. In good rainfall seasons, 2 cuttings can be taken in a year.
### 1.3.2.1 Summary Chart of Fodder Crop Management

Table 1 Summary of fodder crop management

<table>
<thead>
<tr>
<th>Crop</th>
<th>Planting depth</th>
<th>Soil type</th>
<th>Time of planting</th>
<th>Weeding</th>
<th>Pest Management</th>
<th>Harvesting</th>
<th>Seed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhodes grass</td>
<td>0.5-1cm</td>
<td>Sandy/loamy Well drained</td>
<td>Nov/Dec</td>
<td>Manual-Dec/Jan</td>
<td>-Crop rotation -Burying of crop debris</td>
<td>At flowering stage for fodder</td>
<td>3 - 7kg/ha</td>
</tr>
<tr>
<td>Velvet beans</td>
<td>2-3cm</td>
<td>Fertile sandy loamy soils</td>
<td>Nov/Dec</td>
<td>Manual-Dec/Jan</td>
<td>-Crop rotation -Burying of crop debris</td>
<td>At flowering stage for fodder</td>
<td>40 - 50kg/ha</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>1-2cm</td>
<td>Fertile moist soils</td>
<td>End of Dec to January</td>
<td>Manual-February</td>
<td>Spray with ash mixed with chillie and Jatropha leaves</td>
<td>At flowering stage for fodder</td>
<td>15 - 20kg/ha</td>
</tr>
<tr>
<td>Pigeon peas</td>
<td>1-2cm</td>
<td>Fertile and well drained soils</td>
<td>Nov/Dec</td>
<td>Manual-Dec/Jan</td>
<td>-Crop rotation</td>
<td>At flowering stage for fodder</td>
<td>35kg/ha</td>
</tr>
<tr>
<td>Sunn hemp</td>
<td>1cm</td>
<td>Well drained and fertile soils</td>
<td>Dec/Jan</td>
<td>Manual-Jan/Feb</td>
<td>Crop rotation</td>
<td>At flowering stage for fodder</td>
<td>10-15kg/ha</td>
</tr>
<tr>
<td>Forage Sorghum</td>
<td>1cm</td>
<td>Sandy/loamy soils and well drained</td>
<td>Nov/Dec</td>
<td>Manual-Dec/Jan</td>
<td>Crop rotation -Burying of crop debris</td>
<td>At tasseling/milk stage for fodder</td>
<td>10kg/ha</td>
</tr>
</tbody>
</table>
Module 2

Harvesting and Post-Harvesting Techniques
Module 2. Harvesting and Post-Harvesting Techniques

Section 2.1 Fodder Harvesting and Storage

2.1.1 Training Objectives

- To train farmers in fodder and fodder seed harvesting techniques, and
- To introduce improved fodder harvesting tools and demonstrate how to use them.
- To train farmers in post-harvesting handling techniques.

2.1.2 Working Definition: Fodder

As a reminder, fodder is any crop, animal feed, or agricultural foodstuff given to livestock and domesticated animals.

Facilitator’s note: It’s important to remind the farmers of the key definitions to maintain the flow from the first training.

2.1.3 Factors Affecting Fodder Quality

The major challenge in fodder production is preserving the feed quality especially during the dry season. Factors that affect the feed quality of fodder include:

- **The stage of harvesting.** As the fodder matures in the field, it becomes fibrous and loses almost all its feeding value.
- **The method of harvesting.** Poor harvesting methods can lead to loss of biomass that has the highest nutritive value.
- **Handling and storage.** Poor handling and storage can lead to spoilage of fodder, especially when it is exposed to adverse weather conditions such as rain and/or too much sunshine.
2.1.4 Types of Hay

Following are types of hay.

**Legume Hay:** Legume hay has high feeding value and is especially rich in digestible crude protein, vitamins and minerals. It is highly palatable. Examples are cowpeas, soya beans, velvet beans, and sunn hemp hay.

**Non-Legume Hay (All Grass Hay):** This is hay from all other fodders (predominantly grasses) and it is generally less palatable than legume hay. The quality largely depends on the stage of harvesting. Protein content, minerals and vitamins are usually lower than in legumes and examples are Rhodes grass, buffel grass, natural grass, and maize stover.

**Mixed Hay:** This is hay made from mixture of grass and legumes. The nutritive value depends on the type of mixture and the ratio of legumes and non-legumes used in the mix.

Examples of mixtures are:

- Cowpeas and Rhodes grass or maize;
- Velvet beans with sorghum and/or maize and/or Rhodes grass.

*Figure 5  Animals eating fodder*
2.1.5 How to Make Good Quality Hay

2.1.5.1 When to Harvest Hay
Harvest at the end of the rainy season, in March or April when there is plenty of sunshine and when the grass fodder is still green and tender.

2.1.5.2 How to Harvest Hay

**Step 1:** Cut the fodder with a sickle or specially made fodder cutter when half the fodder has started to flower. This is the best stage to optimize both quality and quantity of grasses and legume.

**Step 2:** After cutting, dry the fodder as quickly as possible. Spread the fodder in the field to dry for about 4 hours. Once the top is dry, turn the fodder and dry again for approximately 4 – 5 hours. Follow the same process the following day, provided there has not been rain. The hay can be removed from the field for storage the second day. As a guide, **hay is ready to store when no sap (moisture) can be drawn from the stem when pressed with the fingernail.**

![Handling hay](image)
2.1.6 Curing and Storing Hay

Curing and storing hay includes handling, bailing, storing and feeding, as follows.

2.1.6.1 Handling

Hay should be handled gently after drying, as the leaves especially of legumes become crisp and will easily break from the plant. This will lead to loss of the most nutritious part of the plant. To prevent loss of feeding value, the drying period should be as short as possible and after drying hay should be handled as little as possible.

Hay can be gathered loose or can be baled for easier storage and transport. Baling is strongly encouraged as it saves storage space, avoids wastage at feeding and facilitates easy measurement for sale/marketing. To bale hay the following are required:

- A simple rectangular wooden box measuring 100 x 60 x 60cm (Length, width and height) open both sides.
- A string.

Figure 7 Wooden box for bailing hay
2.1.6.2 Baling

Steps for bailing are:

- Fill a wooden box and press the hay tightly in the box by stomping feet on it or using any heavy object, such as a metal bar, to compact the hay.
- Once the box is full, tie the bale with the string.
- Lift the box to release the bale.

Alternatively, hay can be tied in small bundles of 5-8kg each.

Where a wooden box is not available, a pit with the same measurements as the box can be used (as illustrated in the pictures to the right).
2.1.6.3 Storing
The bales and bundles should be stored under a roof and stacked on raised wooden structures. The recommended structure for the ZFP beneficiaries is the specially made hay rack. Selected artisans have been trained in constructing this rack and beneficiaries can contact the trained artisans in their localities. The hay rack provides sufficient ventilation and it helps avoid spoilage caused by rain, sun, or insects like termites.

2.1.7 Attributes of Good Quality Hay
Good quality hay has the following attributes:

- Remains slightly greenish in color
- Leafy
- Clean
- Soft
- Palatable
- Nutritious

2.1.7.1 Feeding
Hay can be given as long materials or chopped in small pieces. If a farmer is able to supply it, adding molasses improves intake and digestibility.

Figure 9  Dried chopped maize stovers, a source of carbohydrate in ruminant feed
2.1.8 Fodder Seed Harvesting

There are two main tips for harvesting all fodder crops, as follows.

2.1.8.1 Tip 1: Harvest when the seed is fully formed.

Grasses
For grass seeds, check the fields often to determine when the crop is ready to harvest. Here are some guidelines that indicate when a grass seed crop is mature enough to harvest:

- A crop is ready to harvest when the seed is at the medium to “hard dough” stage (when moderate to hard pressure with a thumbnail will dent the seed of large-seeded species). Swath when 75 per cent of the seed heads have matured.
- Grass seed heads generally ripen from the top down. Harvest immediately if seed heads shatter when gently struck against the palm.

Legumes
For legume seeds, harvest them when the seeds rattle in the pods.

- The pods turn from green to brown. Do not wait until the pods start shattering.

2.1.8.2 Tip 2: Ensure the seed is completely dry before storage.

Check for these signs to ensure the seed is dry:

Grasses
- Grass seeds will not leave moisture when put in a plastic bag overnight.

Legumes
- Legume seeds will feel hard when pressed between the thumb and fingernails.
2.1.9 Fodder Harvesting Tools

Fodder production is a fairly new concept, so the availability of appropriate fodder tools is still limited. To improve fodder utilization, engage experienced, skilled local artisans and train additional artisans to provide locally manufactured, appropriate technology such as choppers, chopping boxes and chopper grinders. The tools and equipment must be especially helpful for women, to reduce the amount of labor and time involved in harvesting and preparing fodder for use, storage and sale. This strategy supports the holistic nature of the fodder production being promoted.

One added benefit of this strategy is the development of new skills among artisans in the program areas who can continue to repair and sell tools to fodder producers. As fodder production becomes established and viable for increasing numbers of producers in the program areas, demand grows for appropriate tools to use in harvesting and bringing these products to market. The technologies and appropriate tools are manufactured locally by artisans trained in tool manufacturing and repairs. This fosters sustainability and local adoption of labor-saving tools and techniques. In order to ensure that local artisans remain viable and are able to target their businesses — both in terms of tool production and repair — to the needs of local producers they need to be trained in basic business skills.
2.1.9.1 Recommended Fodder Harvesting and Storage Tools

Apart from those mentioned above, the following are the recommended appropriate fodder tools designed by ZFP trained artisans.

**Scythe** – to cut large amounts of fodder in a short period of time. This tool is especially suitable for women as it eliminates bending (as in the case of the traditional sickle).

**Pitch fork** – for lifting hay.

**Metal rake** – for gathering hay. This tool is stronger and more durable than a wooden rake.

**Wooden rake** – for gathering hay. If a farmer can’t afford a metal rake, the farmer can make a wooden rake.
Sled – for transportation of fodder from the field to the place where it is baled.

Hay rack – a fodder storage rack to keep hay dry.

2.1.9.2 Selecting Artisans to be Trained

When local artisans are trained by an organization promoting fodder production and use, the selected artisans should typically already have basic skills in blacksmithing and wood working. However, ZFP also selected women who had interest and were willing to be trained and they performed as well as the previously skilled and experienced men in producing the tools. The training should be done at a well-equipped workshop such as an agricultural college.
Module 3

Basic Business Skills
for Managing Fodder
Income-Generating Activities
Module 3. Basic Business Skills for Managing Fodder Income-Generating Activities

Section 3.1 Introduction to Basic Business Skills

3.1.1 Training Objectives

- To build farmers’ capacity in basic business skills to ensure that fodder and fodder seed production remain viable, sustainable livelihood options.
- To train participants to integrate fodder into their farming system business models.
- To highlight the potential of fodder production and marketing as a viable business.

3.1.2 Basic Business Terms and Definitions

- **What is entrepreneurship?**
  - Innovation – being original or undertaking new things.
  - Identifying opportunities and taking advantage of them.
  - Undertaking business ventures and assuming the risk associated with the business.
  - Capacity and willingness to undertake conception, organization and management of a business activity

- **What is business management?**
  - Business: Income Generating Activity
  - Management: Organization and coordination of activities to achieve a set goal.
  - Business management: Organization and coordination of an income-generating activity to achieve the set goals.

- **What is the importance of entrepreneurship?**
  - It enables us to identify and start business; source and organize resources; and take the associated risks and rewards.
• What is the importance of business management?
  o To use scarce resources (time, money, labor, land) efficiently and effectively.
  o To obtain maximum profit from our business undertakings.
  o To plan activities and manage investments and incomes to ensure that the business will continue over time.

3.1.3 Decision-Making Process

Facilitator’s Note: Role Play Family Decision-Making. Ask for volunteers to role play, “How a family decides what crop to grow.”

Feedback: To make sound or intelligent business decisions, one must have a sound understanding of, and skills in, four broad decision areas:

• Diagnosis
• Planning
• Implementing
• Monitoring and Evaluation

Learning how to make decisions in these four areas will put one in greater command of the resources and processes that influence one’s own or one’s household’s income generation.

These four areas flow in a pattern that supports continuous learning about what works best for the farming family (household) business.

Figure 10  Business Decision-Making Process: Four Broad Decision Areas
3.1.4 Stages in Decision Making

3.1.4.1 Planning

Facilitator’s Note: Clarify “Planning.” Brainstorm with participants to define their understanding of what planning is.

Feedback: “Failing to plan is planning to fail.”

Consider that Planning:
- Involves making decisions about what, how, why and how much to produce, etc.
- Includes the setting of goals and targets.
- Includes decisions about all resources and/or inputs.
- Includes an indication of the expected yields and income.

A business plan needs to be put in writing for easy reference and for monitoring and evaluation later in the season and year. Farmers with difficulties in writing may wish to make use of family members who are literate, for example older, school-going children.
3.1.4.2 Implementing

- Implementing means putting the plan into action.
- During implementation, one may discover that things do not work exactly as planned. The farming household may need to make decisions to adjust the plan to accommodate changes in circumstances, for example.

3.1.4.3 Monitoring & Evaluation

- Monitoring means keeping track of what is happening on the farm and/or in the household farming business.
- The plan is meant to guide or assist with monitoring.
- Monitoring provides the farming entrepreneur with the information, through record keeping, needed to evaluate the business.
- Evaluation means judging how well the business performed by comparing the plan with the actual results (money, yield, change) attained.
- Monitoring and evaluation provides the information the farming entrepreneur needs to analyze and diagnose the relative success of their business and the reasons why a certain level of success was achieved or not realized.

3.1.4.4 Diagnosis

- If deviations from the plan are observed through monitoring and evaluation, the entrepreneur needs to ask why those deviations occurred and what caused them.
- A proper diagnosis of the business result is the basis for making the next seasonal or annual family farming business plan.
Section 3.2 Marketing

3.2.1 Working Definition: Marketing

One definition of marketing is, “Finding out what the customer wants and supplying it at a profit.”

From the point of view of the farmer, marketing is a process whereby a farmer finds out who the customer is, what the customer wants, and where the market is located. The farmer then tries to produce that product at the quality level required to meet that market (consumer) demand. Hopefully, in so doing, the farmer makes a profit.

3.2.2 The 4 Ps of Marketing

Following is a description of each of the “4 Ps” of marketing. Entrepreneurs, in this case, farmers, need to consider each of these critically.

- **Product** – What product will be sold? The decision made about what product to produce and then to sell, depends on what customers want to buy, what product has a good reliable market, and what is more profitable to produce and sell.

- **Price** – When many farmers, especially smallholder farmers, produce and sell in a competitive market that has few buyers, farmers become price takers. Price takers have very little influence on the price. In situations where the market may not yet exist or may be very small, the farmer may be a price maker. This is true for specialized products produced for ‘niche’ markets. Their marketing challenge is getting a higher price by making their products different from other similar products. This could be done by growing a new variety or producing a product of higher quality to be sold in specialized markets (e.g. mushrooms, flowers, etc.).

- **Place** (market) – A market is the place where the buying and selling takes place. The market is made up of sellers, buyers, products and prices. The relationship among these elements influences the amount of money received in exchange for products. Many types of markets exist. Some are close to the farmer; others far away. At some markets, the farmer can sell his or her products with very little packaging, handling and transporting. Other markets may require substantial packaging, handling and
transporting. Each type of market requires different information, skills and decisions. Farmers must carefully consider these requirements when choosing a market.

- **Promotion** (advertising) – Promotion refers to the process of making people aware of your product. Some potential customers may not know that they need your product until you promote it to them and explain its benefits. Most promotion methods may have a cost attached to them, so the entrepreneur should be aware of this and assess whether the added cost will result in increased revenue or not. Below are some of the methods commonly used in promoting a product:
  - T.V. adverts
  - Radio adverts
  - Newspapers
  - Magazines
  - Fliers
  - Posters
  - Banners
  - Hawkers (people moving from place to place)
  - Mega phone
  - Word of mouth

Whether the farm business is small or large, the entrepreneur should put together a marketing strategy and develop a marketing plan that responds to consumers’ needs. An effective marketing strategy can ensure continuing profits.

### 3.2.3 The Marketing Chain

The various steps involved in moving produce from the farm to the consumer are called “the marketing chain.” Each of these steps involves costs. At the simplest level, the steps and cost involved may just be the time taken by the farmer to walk to a nearby market and stay there until all of her fodder is sold. At the most complex level, a product may be stored for long
periods, transported long distances and processed several times before reaching the form in which it is finally sold.

The cost of marketing (including processing, packaging, storage and transport, for example) makes the price of a product in a shop or retail market higher than the price paid to the farmer. Each person or agent who handles the product changes or transforms the product in some way. As this happens, each person charges a fee for his or her services. This fee is added to the cost of the final product sold to the customer.

If the farmer sells directly to the end customer, she or he should receive the full (wholesale) market price. But the farmer will be responsible for all the marketing costs. If she or he sells to someone else (e.g. a trader) who will process the product and then sell it, the farmer will receive only the price paid by the trader. The trader is then responsible for all the other marketing related costs.
Section 3.3 Profit and Loss Analysis

3.3.1 Costs and Profits

Costs associated with a farm can be divided into two kinds of costs: variable costs and fixed costs.

\[
\text{Total Cost of Production} = \text{Variable Costs} + \text{Fixed Costs}
\]

The fixed costs apply to the farm as a whole. Fixed costs are costs that do not vary with changes in production output of a specific type of crop or livestock production. Fixed costs remain the same regardless of the output; even if there is no output, there will still be fixed costs. For example, the cost of land is a fixed cost for the landowner. Fixed costs include, for example, the cost of purchasing a tractor or a piece of equipment used on the whole farm, and the cost of a head of livestock. Most of the costs of keeping a tractor, equipment and draft cattle remain the same if the item is or is not fully used. Fixed costs are also known as overheads. Fixed costs also include permanent labor, management, and depreciation, among others. (Depreciation is the costs of the declining value of things like tractors, machinery and buildings. Depreciation is usually calculated as an annual deduction in the value of the purchased item since when it’s useful life ends and repair costs are too high, one would have to replace that piece of equipment and hence, one should have set aside the funds to do through a depreciation payment.)
### 3.3.1.2 Variable Costs

Variable costs are the costs of actual production. They apply to specific enterprises on the farm. These costs vary as crops change and output changes. For example, labor is required in crop production. If a farmer has to hire labor, then as production is increased the need for hired labor also increases, though lesser, if other options such weed killers are used. If no yield is produced there is no need for hired labor to harvest. Typical variable costs include the cost of seeds, fertilizers, sprayers, fuel for machines, hired labor, livestock feed, and veterinary costs, amongst others. Variable costs can be allocated to specific enterprises. An example of variable costs for Rhodes grass is shown below.

#### Table 2 Variable costs for Rhodes grass

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit price (K)</th>
<th>Amount</th>
<th>Total (K)</th>
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<tbody>
<tr>
<td>Seed</td>
<td>Kg.</td>
<td>5</td>
<td>30</td>
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<tr>
<td>Fertilizer</td>
<td>50 kg</td>
<td>1</td>
<td>250</td>
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<tr>
<td>Manure</td>
<td>Tons</td>
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<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pesticide</td>
<td>Kg</td>
<td>4</td>
<td>30</td>
<td></td>
<td></td>
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<tr>
<td><strong>Labor:</strong></td>
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<td></td>
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<tr>
<td>Land preparation</td>
<td>Person days</td>
<td>20</td>
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<td>Planting</td>
<td>Person days</td>
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<tr>
<td>Weeding</td>
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<td><strong>Total Variable Cost</strong></td>
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</table>
3.3.1.3 Profit

Profit is total income minus fixed and variable costs.

\[
\text{Profit} = \text{Total income} - \text{Fixed costs} - \text{Variable costs}
\]

Figure 15 Profit

3.3.2 Gross Margins

The term gross margin generally refers to the remaining income from an enterprise after the variable and fixed costs are deducted (Gross income less variable and fixed costs). A gross margin budget is a fairly detailed estimate of the output, cost, and profitability of individual enterprises. The gross margin budget includes all costs involved in producing the enterprise. It is not profit because it does not include all costs (it excludes fixed costs which the enterprise shares with other enterprises). But it is an indication of the profitability of an enterprise. If an enterprise does not have a positive gross margin, then that enterprise is not profitable.

How can gross margins be used?

- Make comparisons between individuals running the same business in the same area.
- Make comparisons for your business over time.
- Used as a planning tool in evaluating the potential value of alternative technologies and/or enterprises.
Advantages of gross margins

- The information required is simple
- The information required can be easily collected.
- The analysis is easy to complete.
- The results are easy to understand.

A gross margin is usually calculated on unit basis. It can be calculated on a per hectare basis, or as a return to labor, based on the number of days worked by the farmer and her family. These would be expressed as K/Ha, K/worker, K/person day, respectively.

Every entrepreneur who sells his or her products should know their costs of production and should be able to calculate the gross margin. This will allow them to analyze the current performance of their farming enterprise using current prices and input-output information. Using the gross margin they can project information into the future; this will help them plan and make decisions. This is called budgeting.

### 3.3.2.1 Components of the Gross Margin

The gross margin is made up of two major parts:
- Gross Income
- Variable Costs

The basic calculation for a gross margin is as follows:

\[
\text{Gross Margin} = \text{Gross Income} - \text{Variable Costs}
\]

*Figure 17  Gross margin*
3.3.2.2 Gross Income (Value of Production)

The gross income is obtained by multiplying the physical output by the farm gate price of the product and valuing home consumption.

\[
\text{Gross Income} = \text{Yield} \times \text{Unit price}
\]

Figure 18  Gross income

A more detailed understanding of gross income highlights that the gross income from an enterprise comprises a number of sources of income:
- Produce sold
- Produce consumed by the farmer’s family/workers
- The produce put into storage
- By-products.

3.3.3 Cash Flow Budgeting

To assess the overall effect of the enterprise on the household finances, which is highly useful, the farmer needs to prepare a cash flow budget. The cash flow budget simply notes the flow of money into the farm from sales (or remittances) and the flow of money out of the farm through purchases and other payments.

The farmer can use the cash flow budget to determine the financial performance of his/her household as a whole. It will help him/her to assess whether the family will have enough money to carry out its plans or if they will run short of money in any month. It enables farmers to identify the times of the year when additional financial resources may be required.

There is an important difference between the gross margin and cash flow. The gross margin looks at the overall performance of the farm and its enterprises. When accounting for income, gross margin will include the value of products consumed by the family. In a cash flow budget, only actual cash income is included; even though crops consumed by the family have value, they are not sold, and they do not generate cash. Therefore they are not included in the cash flow budget. Similarly, costs such as family labor, which are often not actually paid, are included in the gross margin, but are not included in the cash flow budget.
This difference is important because although an enterprise may be profitable in terms of gross margin, if the farmer is not selling enough of the crop, then she or he may not generate the cash needed to pay for inputs, hired labor and other cash costs.

### 3.3.3.1 Net Cash Flow

The *net cash flow* is the difference between the cash inflows and cash outflows. Net cash flow is calculated by subtracting the money (cash) spent over the year from the money received. Non-cash item like crops consumed by the family, unpaid family labor, depreciation, etc. are not included in the flow of cash.

\[
\text{Net Cash Flow} = \text{Cash Inflow} - \text{Cash Outflow}
\]

**Figure 19 Net cash flow**

Cash **inflow** is made up of:

- Sales of produce marketed
- Income from wage labor and other employment
- Gifts
- Loans, etc.

Cash **outflow** is made up of:

- Purchases and payments for inputs for the farm (e.g. hired labor, fertilizers, seed, pesticides, animal feeds, salt licks, etc.)
- Land preparation costs, purchase of new machinery and other operational costs
- Household expenses (e.g. medicine, food, school fees, taxes, gifts).

The farm should try to generate a positive cash flow. This comes about by ensuring that more cash flows into the farm than out of the farm. Analysis of a farm cash flow generates a detailed projection of the farmer’s ability or inability to finance an enterprise. In the absence of records, details of household expenditure usually have to be estimated. However, this may not provide
an accurate picture of cash flow because it relies on the memories and accounts of household members, which may conflict. Recorded records are best to keep if at all possible.

3.3.3.2 Use of Cash Flow

A farmer can use a cash flow to analyze his/her farm, plan for the future, and to monitor farm activities. Controlling the flow of cash in and out of his/her farm is an important task of the farmer. Cash flow budgets are important to:

1. Develop the farm plan.
2. Choose between alternative farm enterprises.
3. Compare actual and budgeted results (to enable corrective action to be taken on time).
4. Arrange for loans.

As a planning tool, the cash flow can be used to see the effect of a small change on the farming system or the financial impact of a complete farm plan. It can be used to examine whether the financing is available within the farm household, or alternatively if there is a need to take out a loan. In cases where the farmer has already decided to take a loan, the cash flow will also indicate whether and when the farmer will be able to repay the loan, including the interest and the principal.
3.3.4 How to Construct a Cash Flow Budget

As noted earlier, the main feature of a cash flow budget is that it focuses specifically on cash. The non-cash items included in gross margin analysis are not included in cash flow. Non-cash items include items such as depreciation, the value of family labor and food consumed at home are excluded.

Also as noted earlier, the cash flow for smallholder farmers includes the on-farm and off-farm (household) inflows and outflows. It should cover all cash income and expenditures for the farm household. It should include loans that the farm household receives from money lenders, friends and lending institutions as cash inflows. And it should include repayment of these loans (principal and interest) as cash outflows.

Cash flow can be calculated on a monthly, quarterly or annual basis. Annual cash flows are common for longer-term investments such as livestock and tree crops. Monthly and quarterly cash flow statements are well suited to annual crops.

A farmer can construct a cash flow based on what s/he is currently doing or s/he can construct a cash flow on the basis of what s/he intends to do over the next year. In the following example, construct a cash flow budget to examine the projected cash situation of a plan to introduce a new enterprise in this case fodder. Look at cash flow projections monthly for one year.

Facilitator’s Note: Imagine this Financial Scenario. Let us imagine a farm household that earns some income from selling maize and cassava and rearing dairy cows. The household also has some chickens. The family has three children attending school. The farmer wishes to introduce fodder into her system. She knows that the fodder enterprise could be profitable but she wonders whether she has enough funds to finance the enterprise.
When the farmer plans the farm program for next year, she wants to find answers to the following questions:

- How much money are the farm enterprises likely to generate and how much cash expenditure will be needed to cover costs?
- When will she receive the money (inflow) and when will the money be needed (outflow)?
- If the amount of money she expects to receive over the year does not cover the amount needed, how can she make up the difference? Will savings make it up? Does the farmer have reserves? Does the farmer have access to loans?
3.3.4.1 Steps Involved in Preparing the Cash Flow Budget

Step 1: Identify Inflow and Outflow
List the income and expenditure items and when they occur in the year, as shown in the table below — which is an illustrative time schedule.

### Table 3: Income and expenditures

<table>
<thead>
<tr>
<th>Cash Inflow</th>
<th>Description</th>
<th>Month</th>
<th>Income (KW)</th>
<th>Cash Outflow</th>
<th>Description</th>
<th>Month</th>
<th>Expenditure (KW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale of maize</td>
<td>January</td>
<td>250</td>
<td></td>
<td>Money spent on farm inputs (maize)</td>
<td>March</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of cassava</td>
<td>Apr</td>
<td>340</td>
<td></td>
<td>Money spent on farm inputs (Cassava)</td>
<td>April</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aug</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of milk</td>
<td>March- Sept</td>
<td>480</td>
<td></td>
<td>Money spent on farm inputs (livestock)</td>
<td>January</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Feb to Sept</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>October</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Dec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of chicken</td>
<td>January</td>
<td>130</td>
<td></td>
<td>Brooding cost and feeding (chickens)</td>
<td>Sept</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>60</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Planned sale of beans</td>
<td>July</td>
<td>450</td>
<td></td>
<td>Money spent on inputs (beans)</td>
<td>April</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>July</td>
<td>40</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>October</td>
<td>180</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dec</td>
<td>40</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Money to cover living expenses</td>
<td>Jan to Dec</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Money to cover school expenses</td>
<td>Feb</td>
<td>200</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>May</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Money to cover health expenses</td>
<td>Jan-Dec</td>
<td>240</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3030</td>
<td></td>
<td>Total</td>
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<td>2837</td>
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</table>
Step 2: Prepare a Cash Flow Table
From the inflow outflow table, we can work out the illustrative monthly balance.

Table 4 Cash inflow

<table>
<thead>
<tr>
<th>MONEY COMING IN</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sales of farm products:</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Maize</td>
<td>250</td>
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<td></td>
<td>300</td>
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<td>100</td>
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<tr>
<td>Cassava</td>
<td></td>
<td></td>
<td>340</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td></td>
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<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>130</td>
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<td></td>
<td>60</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Planned sale of fodder</td>
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<td></td>
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<td></td>
<td>450</td>
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</tr>
<tr>
<td>Total Cash Inflow</td>
<td>380</td>
<td>0</td>
<td>360</td>
<td>400</td>
<td>60</td>
<td>60</td>
<td>510</td>
<td>180</td>
<td>420</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
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</table>

Table 5 Cash outflow

<table>
<thead>
<tr>
<th>MONEY GOING OUT</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Payments &amp; Purchase of inputs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Maize inputs</td>
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<tr>
<td>Cassava inputs</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Farm inputs livestock</td>
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<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>30</td>
<td>30</td>
<td>30</td>
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<td>Chicken feeding expenses</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Fodder inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Household expenses:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living expenses</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<td>School fees</td>
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<td>140</td>
</tr>
<tr>
<td>Hospital expenses</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total Cash Outflow</td>
<td>50</td>
<td>270</td>
<td>370</td>
<td>307</td>
<td>260</td>
<td>70</td>
<td>110</td>
<td>70</td>
<td>530</td>
<td>230</td>
<td>50</td>
<td>90</td>
</tr>
</tbody>
</table>
Step 3. Calculate the Monthly Net Cash Flow
Subtract the illustrative expenses from the illustrative income for each month. It will be positive if income is greater than expenses, and negative if income is less than expenses.

Table 6 Calculating monthly net cash flow

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cash Inflow</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>380</td>
<td>0</td>
<td>360</td>
<td>400</td>
<td>60</td>
<td>60</td>
<td>510</td>
<td>180</td>
<td>420</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>Total Cash Outflow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>50</td>
<td>270</td>
<td>370</td>
<td>307</td>
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<td>70</td>
<td>110</td>
<td>70</td>
<td>530</td>
<td>230</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td>Monthly Net Cash Flow</td>
<td>350</td>
<td>-270</td>
<td>-10</td>
<td>83</td>
<td>-200</td>
<td>-10</td>
<td>400</td>
<td>110</td>
<td>-110</td>
<td>-130</td>
<td>50</td>
<td>310</td>
</tr>
</tbody>
</table>

Step 4. Calculate the Cumulative Net Cash Flow
To assess whether the family will have enough cash over the year to cover the introduction of fodder, we have to construct a cumulative cash flow chart. The cumulative net cash flow is calculated by adding the monthly net cash flow with the cumulative net cash flow of the previous month.

For example, in January, the monthly net cash flow was K350. This is also the cumulative net cash flow because it is the first month in the season. In February, the monthly net cash flow is -K270. Adding these two together tells us that by the end of February, the cumulative net cash flow was K80.

Table 7 Cumulative net cash flow chart

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly net Cash Flow</td>
<td>350</td>
<td>-270</td>
<td>-10</td>
<td>83</td>
<td>-200</td>
<td>-10</td>
<td>400</td>
<td>110</td>
<td>-110</td>
<td>-130</td>
<td>50</td>
<td>310</td>
</tr>
<tr>
<td>Cumulative balance</td>
<td>350</td>
<td>80</td>
<td>70</td>
<td>153</td>
<td>-47</td>
<td>-57</td>
<td>343</td>
<td>453</td>
<td>343</td>
<td>213</td>
<td>263</td>
<td>573</td>
</tr>
</tbody>
</table>

Note: All of these calculations (Steps 2, 3 and 4) are meant to appear in a single table. See Table 9 Complete cash flow budget at the end of the steps.
Step 5. Analyze the net Cash Flow
This example shows that the family has a shortfall of cash in May and June. This means that even though Fodder is a profitable enterprise the family does not have the money available to cover the expenditures expected to occur in those months. What can the family do? There are a number of possibilities:

- The farmer could decide not to introduce fodder.
- The farmer could try to save some money in order to cover the financial shortfall.
- The farmer might decide to cut back on some of the inputs used for growing fodder.
- The farmer might decide to reduce some of the area under maize and cassava in order to reduce costs.
- The farmer might sell some of her livestock to cover the financial gap.
- The farmer might decide to take a loan to cover the shortfall.

Using a loan
Let us assume the farmer decides to finance her shortfall with a loan. She would need to determine how much of a loan she needs and whether and when she could make payments to repay the loan.

The shortfall that cannot be covered amounts to K104. A loan of K200 would ensure the cash flow required. If she is to repay the loan over four months and is charged a rate of 18% interest, she will make 4 payments of K59 each. The total repayment would be K236.
The table below sets out an example of how a loan and repayment schedule could be planned to make this proposal feasible.

**Table 8 Example of a loan repayment schedule**

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Monthly Balance</strong></td>
<td>350</td>
<td>-270</td>
<td>-10</td>
<td>83</td>
<td>-200</td>
<td>-10</td>
<td>400</td>
<td>110</td>
<td>-110</td>
<td>-130</td>
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</tr>
<tr>
<td><strong>Proposed Loan</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Proposed Repayments</strong></td>
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<td>-59</td>
<td>-59</td>
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<tr>
<td><strong>Cumulative Balance</strong></td>
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<td>70</td>
<td>353</td>
<td>153</td>
<td>143</td>
<td>484</td>
<td>535</td>
<td>366</td>
<td>177</td>
<td>227</td>
<td>537</td>
</tr>
</tbody>
</table>

**Assumptions:**
- Loan of K200 paid back over 4 months
- Grace period of two months
- Interest rate at 18%
- Payable at four equal installments

In this example, if the farmer took out a loan of K200, she would cover the financial shortfall and would have the funds available to repay the loan. The cumulative balance would then be positive for the entire twelve-month period showing that there is no more need for finances.

Where loan options are viable it is necessary to understand that taking out a loan is treated as an inflow, but the cost of repayment (principal and interest) also needs to be taken into account and is treated as an outflow.

In conclusion, the farmer should be confident that introducing fodder into the farming system is profitable and taking a loan would also be financially feasible. The final decision rests with the farmer.
### 3.3.4.2 Complete Cash Flow Budget

**Table 9 Complete cash flow budget**

<table>
<thead>
<tr>
<th>MONEY COMING IN</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
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<th>Sep</th>
<th>Oct</th>
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</tr>
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<tbody>
<tr>
<td><strong>Sales of farm products:</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Maize</td>
<td>250</td>
<td>300</td>
<td></td>
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<tr>
<td>Cassava</td>
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<td></td>
<td>340</td>
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<tr>
<td><strong>Total Cash Inflow</strong></td>
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<td>0</td>
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<td>400</td>
<td>60</td>
<td>60</td>
<td>510</td>
<td>180</td>
<td>420</td>
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<table>
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<th>Mar</th>
<th>Apr</th>
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<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<td></td>
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<td></td>
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</tr>
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<td></td>
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<td></td>
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<td></td>
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<td>Cassava inputs</td>
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<td></td>
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<td>50</td>
<td>50</td>
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<td>60</td>
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<tr>
<td>Fodder inputs</td>
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<td>50</td>
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<td></td>
<td></td>
<td>180</td>
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<td><strong>Total Cash Outflow</strong></td>
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<td>370</td>
<td>307</td>
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<td>70</td>
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<table>
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<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tbody>
<tr>
<td>Living expenses</td>
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<td>10</td>
<td>10</td>
<td>10</td>
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<tr>
<td>School fees</td>
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<td></td>
<td></td>
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<tr>
<td>Hospital Expenses</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<td>10</td>
</tr>
<tr>
<td><strong>Total Cash Outflow</strong></td>
<td>50</td>
<td>270</td>
<td>370</td>
<td>307</td>
<td>260</td>
<td>70</td>
<td>110</td>
<td>70</td>
<td>530</td>
<td>230</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td><strong>Total Cash Inflow</strong></td>
<td>380</td>
<td>0</td>
<td>360</td>
<td>400</td>
<td>60</td>
<td>60</td>
<td>510</td>
<td>180</td>
<td>420</td>
<td>100</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td><strong>Total Cash Outflow</strong></td>
<td>50</td>
<td>270</td>
<td>370</td>
<td>307</td>
<td>260</td>
<td>70</td>
<td>110</td>
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<td>530</td>
<td>230</td>
<td>50</td>
<td>90</td>
</tr>
<tr>
<td><strong>Monthly Net Cash Flow</strong></td>
<td>350</td>
<td>-270</td>
<td>-10</td>
<td>83</td>
<td>-200</td>
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<td>400</td>
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<td>-110</td>
<td>-130</td>
<td>50</td>
<td>310</td>
</tr>
<tr>
<td><strong>Cumulative Balance</strong></td>
<td>350</td>
<td>80</td>
<td>70</td>
<td>153</td>
<td>-47</td>
<td>-57</td>
<td>343</td>
<td>453</td>
<td>343</td>
<td>213</td>
<td>263</td>
<td>573</td>
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</table>
Section 3.4 Introduction to Record Keeping

3.4.1 What is Record Keeping and What are Business Records?

Facilitator’s Note: Discuss Record Keeping. Pair farmers and ask each pair to discuss, “What does ‘record keeping’ mean to you?”

Record keeping is a process by which data is systematically collected, organized and stored. The stored data can be retrieved, put together in different ways and then analyzed – turning the data into information, which can then be used to make decisions. Farm business records would include data or information about things like wholesale or farm-gate output market prices, agricultural input prices, and the costs of farm labor.

3.4.2 Why Keep Records?

The recorded data and/or information can be used to:

- Measure the production performance of the farm business;
- Measure the financial performance of the farm business;
- Examine the performance of the farm business as a whole against your plan;
- Plan the way forward for the farm business.

More importantly, without good records, a farmer must rely on her or his own memory for gathering the data or information needed to make well-informed decisions. Having a workable system for recording and retrieving data and/or information will make it much easier for a farmer to improve the profitability of her or his farm. She or he will need to record, keep and be able to retrieve data about the costs of production, marketing, processing and household consumption and expenses. Keeping records also allows for continuity of business ventures in the absence of the entrepreneur.
3.4.3 Types of Records

Record keeping can be kept simple and need not take up much of one’s time. There are many simple methods that have been devised to keep records. It does require self-discipline and commitment to fill in records regularly. So the entrepreneurial farmer has to be motivated by a desire to improve his or her level of income.

Some of the most commonly used records are listed below:

3.4.3.1 Physical Records

Physical records show the quantities of the inputs used and outputs obtained. In addition, physical records indicate timing and methods of operations.

3.4.3.2 Production Records

These provide farmers with valuable information on yields, inputs and cropping practices used in the production process on specific parcels or plots. A crop record should include details about the crops grown on each plot, the dates of planting and harvesting, the amounts and costs of seed used, and the yields, and the amount and price of any complementary agricultural inputs used, such as soil testing services, fertility treatments, crop protection products, etc. Production records should also include data on the amount of labor used at field preparation, sowing, weeding and other farming operations up until and including harvesting and post-harvest handling. Cost estimates should be made if only household labor is used, whereas if hired labor is used in farming operations, these costs should also be included. Yields may be measured in the traditional way as so many bags or baskets or in kilograms (kg) or tons. The actual weight sold can also be recorded particularly at point of sale. The yield per hectare of a crop is calculated by dividing the total yield of the plot by the number of hectares to that crop.

3.4.3.3 Labor Records

These keep track of labor inputs. The labor inputs are expressed in hours or days of operation for each of the farm enterprises and the corresponding payment in cash or kind. It may also be useful if these records indicate the source of this labor, e.g. family, hired from community, migrant, etc.
3.4.3.4 Machinery and Equipment Records
These keep track of the expenses involved in operating machinery. This includes regular running costs, the nature, and the type and cost of repairs. This kind of record is most commonly usually kept by larger, more commercial farmers. However, it can be applied even to animal draft and hand equipment, where the records will help the farmer know the cost of farming with this kind of technology.

3.4.3.5 Livestock/Poultry Records
Just as a farmer keeps records for crops, she or he should also keep records on the livestock. Many farmers keep a few pigs, hens, goats, and sheep or cattle. Records should be kept for each animal and/or class of stock. It is important to keep a record of the number of animals on the farm. This not only gives a check on theft, deaths and losses, but knowing the numbers of animals helps the farmer calculate yield per animal or per bird. These include information on breeding, health, production and feed composition, etc.

3.4.3.6 Marketing Records
These records refer to information on market transactions and procurement of purchased inputs.

3.4.4 Financial Records
Financial records are used to evaluate the financial performance of an individual enterprise or of the whole farm. They are also used for cash flow analysis. Financial records help the farmer to know how well individual enterprises perform and contribute to overall farm profit at the end of the season or production cycle. Financial records include the main cash transactions on the farm: sales, purchases and money borrowed as expressed in the cash flow and gross margin calculations.

Financial records are kept in the form of accounts of what the farmer spends and receives. Purchases and expenses can be recorded on one page. Sales and receipts can be recorded another. An example of a simple account book is shown below:
Figure 20 Example of a simple account book

An alternative structure is to have what is called an analyzed cashbook. In this case, receipts and expenditures are noted down under separate headings for each enterprise or type of commodity. The analyzed cashbook also includes a running total of money received or paid. Using the analyzed cashbook opens up the possibility of monitoring budgets more closely.

### 3.4.4.1 Home Consumption, Income and Expenses

Records can also be kept of home consumption, of other non-farm sources of income, and of expenditure. If the farmer uses a large part of her production to feed her family it should also be recorded. This part of production does not appear as sales in the account book, but it has value. The value of the farmer’s crop includes not only what is sold, but also what the farmer’s family consumes. Keeping a record of farm products consumed acknowledges the value of that production. It also ensures the farmer has an accurate record of production from his/her farm. This will help him/her determine the true profitability of his/her farm.

This information could be recorded as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>Details</th>
<th>K</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 1st</td>
<td>6 eggs</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td>January 15th</td>
<td>2 kg of spinach</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Figure 21 Home consumption

At the end of the year the farmer adds up the total value of home consumption. The value is added to the farmer’s total receipts to give the value of total production of the farm. The value
of sales plus the value of home consumption, less total expenses provides an assessment of farm profit.

Another record could cover household non-farm income sources and expenditures. This will help the farmer when s/he wants to understand the role of the household cash flow on the farm. An example of this kind of record is shown below.

<table>
<thead>
<tr>
<th>Income Sources</th>
<th>Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Item of income</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

*Figure 22 Non-farm income sources and expenditures*
3.4.5 Principles of Record Keeping

Some general principles apply to all record keeping. Records should be:

- Accurate, complete and filled in as soon as possible after the operation.
- Neat and written clearly.
- Complete by not leaving out any information.
- Be simple in design, easy to keep and retrieve.
- Easy to analyze.
- Appropriate.

Care should be taken to ensure that only the really vital information required by the entrepreneur is collected through record keeping. The whole purpose of record keeping is to improve the standard of the business. There is no value in spending time on records and calculations of profit and production in individual enterprises, if no use is made of them. All of the results should be compared with some standards as discussed above.
Module 4

Ruminant Nutrition
Module 4. Ruminant Nutrition

Section 4.1 Introduction to Ruminant Nutrition

4.1.1 Training Objectives

At the end of the training, attendants (mainly farmers) should be able:

- To identify ruminant nutritional requirements,
- To name types of feeds required by ruminants and their functions,
- To use basic principles of ruminant ration formulation from fodder crops.
- To feed ruminants and monitor feed performance.
- To name factors affecting ruminant nutrition.
- To plan for fodder flow.

4.1.2 Understanding Nutritional Requirements of Ruminant Animals

Fodder producers also owning livestock need to know the nutritional requirements of ruminant animals in order to include in their farm plans crops that will enable them feed to their livestock a balanced ration. A ruminant balanced ration requires that a farmer grow fodder crops that once combined provide the animal with enough proteins (body building foods), carbohydrates (energy foods), vitamins and minerals (protective foods).

Fodder producers without livestock will need to understand the needs of their potential market (Livestock owners) and thus strategies to produce fodder types that will meet the needs of livestock owners (fodder with high demand). This will enable them easily sale their farm produce and make money.

Both fodder producers with and without livestock will appreciate more why the choice of fodder crops if they understand why ruminant animals’ nutritional requirements are unique.
Facilitator’s Note: As an exercise, ask participants to mention different types of animals. Ask them to group the animals according to the type and form of food they eat. Let them make suggestions on why the different animal types eat different type and form of foods.

Feedback: Commonly reared animals will include: chickens, guinea fowls, goats, sheep, cattle, doves, pigs, etc. On one hand, chickens, doves, pigs and guinea fowls eat foods that are easily digestible. On the other hand, goats, sheep and cattle eat feeds that are not easily digestible, because of differences in the structure and form of their digestive systems. Animals with simple stomachs will eat easily digestible feeds whereas animals with complex stomachs will eat feeds that require fermentation as part of the digestion process.

4.1.3 Characteristics of a Ruminant Animal

Ruminants are animals that depend on plants for sustenance. To effectively draw nutrients from plants, their digestive system is uniquely made to process plants for their nutrition. The mouth lining, tongue and teeth are specially made for grazing and chewing plants.

The gullet allows a two-way flow of grazed plants into, out, and finally into the complex four-chambered stomach. The chewed feed eventually enters the small intestine and then large intestine before exiting through the rectum as dung.
Ruminants are thus called animals with four-chambered stomach. The four-chambered stomach allows ruminant animals to draw nutrients for growth and development and production from fodder unlike single or simple stomach animals.

![The four-chambered stomach](image)

**Figure 24** The four-chambered stomach

**4.1.3.1 Feed Utilization – Simple Stomach vs. Complex Stomach.**

![Simple vs. complex stomach](image)

**Figure 25** Simple vs. complex stomach
Animals with a simple stomach eat feed and break it down into substances ready for absorption—carbohydrates are broken down into sugars, proteins into amino acids, and fats into fatty acids. Ruminants, however, will first ferment the feed and only subsist on some products of fermentation. Microbes found in the rumen play a major role in ensuring smooth fermentation process. Satisfying conditions favorable for optimal microbial activity become an important aspect in ruminant feeding. Feed given to ruminants should thus satisfy microbial demands first. Critical factors to enhance microbial function include feeding rations rich in readily digestible proteins, minerals, vitamins, carbohydrates, and water, plus feeding in correct quantities and at regular intervals.

Some products of fermentation are immediately absorbed by the animals, while others require more time to break down. Products immediately absorbed include volatile fatty acids and ammonia. Those needing further digestion include dead microbes to release amino acids and remnant carbohydrates to release sugars. Methane, another product of fermentation, is belched out in large quantities.
Section 4.2 Nutrient Requirements and Their Functions

4.2.1 Proteins

Proteins are feeds rich in nitrogen needed by animals for development, body maintenance and repair, production, and reproduction. Proteins are found in soft and green parts of plants and are highly concentrated in tender legume leaves. Some examples of crops rich in proteins are: velvet beans, sunn hemp, cowpeas, groundnuts stovers, pigeon peas, etc.

Figure 26  Sunn hemp at flowering stage – high protein level available.
Once legumes grow old, they store the protein in seeds and roots.

Figure 27 Overgrown sunn hemp crop – low protein level available.

Not all the protein found in plants is available to an animal. Available proteins are said to be digestible and proteins not available are non-digestible. Error! Reference source not found. (at the end of this module) shows different types of fodder crops’ digestible crude proteins.
4.2.2 Carbohydrates

Carbohydrates are feeds rich in starch and sugars needed by animals for energy. Such feeds include grains (such as maize), molasses, tender grass family crops, and tubers (like cassava and potatoes).

Figure 28  Chopped cereals
As plants grow older, they become more fibrous.
The fiber is a source of carbohydrates but ruminants do not easily access carbohydrates from older plants. Ruminants need fiber for effective digestion. Carbohydrates are needed for energy for growth, production, reproduction, and maintenance. Rumen micro-organisms required for enhanced feed utilization by ruminants need carbohydrates for growth and multiplication.

4.2.3 Fats and Oils

Fats and oils are high-energy feeds found in cakes such as sunflower cake, soya cake, and cotton seed cake. Animals need them as sources of fat-soluble vitamins and essential fatty acids. Unfortunately, fodder hay has low levels of fats and oils.
4.2.4 Minerals
Minerals are the inorganic matter in the feeds vital for development and maintenance of animal tissue structures, proper digestion and absorption of other feed nutrients, production of enzymes and hormones that maintain growth and fertility. Fodders generally contain only small amounts of minerals. Minerals are found highly concentrated in lick blocks, feed premixes, and bone meals. Some anthills are rich in minerals and so animals will seek them out.

4.2.5 Vitamins
Vitamins are feed components needed for good health status. They are also called protective foods. Ruminants fed on green fodder will synthesize enough vitamins to meet their daily needs. Other sources include cereals, cakes, bone meal, fish meal, and feed premixes.

4.2.6 Water
Water is life! Water is a solvent for most feed nutrients, thereby playing a pivotal role in digestion and absorption, and excretion of waste. The figure below summarizes feed requirements and their purpose.

![Feed Requirements Diagram]

*Figure 31 Feed Requirements. Source: GART Dairy Manual*
Facilitator’s Note: Tabulate Feed Resources. Ask farmers to tabulate locally available feed resources and help them classify these according to major nutrients contained. Among the answers: natural grass, crop residues, local legumes, e.g. Musekese, etc.

Section 4.3 Basic Principles of Ration Formulation

4.3.1 Formulating Rations

The non-availability of good quality forage/fodder throughout the year and the need to optimize the efficient utilization of locally available feed resources requires the application of basic nutritional principles when considering ration formulation. Feeding standards, as practiced in developed countries, should not be used in a copy-and-paste manner when home-grown feed resources are used in formulating rations for ruminant livestock. The trainer needs to refer to feed values as derived from locally grown fodder.

When formulating rations for ruminant livestock consider:

• The efficiency of the rumen ecosystem. Ensure the feed can support optimum rumen function.

• The quantity of feed the animals eats in relation to how available its nutrients are to the animal. Feeds with nutrients readily available should be fed in lesser quantities than feeds whose nutrients are less available to the animals.

• Feed intake is often influenced by supplementation. When concentrates are fed, the quantity of fodder (hay) required would be lower than in a situation where animals rely solely on hay.

• Protein values based on digestible protein (refer to section on proteins) and not crude protein. This is important to ensure protein levels are not understated in a ration. Crude protein values include protein that is not digestible.

• The energy value of a diet and how the animal can use it. Ensure you include high fiber feeds to high-energy feeds to help the animal use the feed efficiently.
Fodder farmers should therefore take advantage of locally available feed resources as they attempt to maximize animal production.

### 4.3.2 Feed Quality

The quality of locally available feeds depend on many factors among them type of soil in which grown, stage of growth, season, and age of target ruminant animal. They are categorized as:

- **High fiber-low protein feeds**, which include fibrous residues arising from crops grown for human consumption, such as straws and stovers from rice, millet, sorghum and maize, and sugarcane bagasse.

![Figure 32 Maize stovers on the rack being mixed with chopped pigeon peas hay.](image)

- **High fiber-high protein feeds**, which are by-products derived from crop production (tops and haulms from groundnuts, the sweet potato vine, cassava leaves, bean straw) and industrial processing (bran from cereal milling such as for rice, wheat and maize, and brewer’s grain), fall into this category of feeds.
• **Low fiber-low protein feeds** include feed resources derived from crops such as sugarcane by-products (molasses) and root crops (cassava waste).

• **Low fiber-high protein feeds** are feeds traditionally called “concentrates” and include oilseed meals and cakes (soybean meal, cotton seed cake, groundnut meal/cake) and animal by-products (fishmeal, blood meal, feather meal).

**Note that** natural pastures for fodder fall in category one or two above depending on the time of harvesting, type of fodder, climatic conditions during growth, season, and whether pure stand or mixed.

*Facilitator's Note: Categorize Local Feeds. Assign farmers to bring locally available feeds and group them according to categories above.*
4.3.3 Feed Quantity

To determine quantities of feed resources required by ruminants owned by smallholder farmers, it is important to bear in mind the state in which these feed resources are provided. They are either cut fresh (as-fed-basis) and fed to the animal or cut and air-dried (air-dry basis) before being fed to animals. The state of the feed will help determine how nutritious it is and what kind of nutrition it provides for the animal. For our purposes, we will use air-dry basis, since most farmers will be using hay that was air-dried. Dry matter is estimated at 90%.

Facilitator’s Note: Formulate Daily Rations. Select two participants and ask them to characterize their herds. Use this information to work out feed requirements for them. Use the basic rule of one-quarter legume to three-quarters grass hay combination. Consider grown cattle to consume 3% of body weight while goats consume from 1.5% to 2% of their body weight. Use feed nutrient indices in Table 2 Variable costs for Rhodes grass below.

4.3.4 Feed Mixing

After portions are determined as above, always mix the smaller portions first. The mixture of smaller portions is then added to the next larger portion and so on till the largest portion gets in last.

Facilitator’s Note: Prepare Feed. Conduct a practical exercise on feed preparation for mixing, mix, and package & store in readiness for feeding.
Section 4.4 Feeding Livestock

4.4.1 Basic Concepts to Optimize Resources
When considering ways to optimize use of feed resources for ruminants, it is necessary to apply three basic concepts:

- Ensure the animal eats enough. Avoid over feeding. Too much feed eaten at one time will make the animal sick and it will fail to digest the feed.
- Supply nutrients to improve animal’s well being.
- Any further increases in production should be given through supplements of protein, starch and lipids.

4.4.2 Feeding Stations and Troughs/Racks
Feed forms the major component of production costs. Ensuring each animal eats enough without wasting feed, farmers should be encouraged to establish feeding stations equipped with feeding structures. This will allow their animals to make the best use of the feed and give better performance (More milk, more meat, more animals being born, and more animals growing faster, fewer animals dying due feed contamination or worm burden). Feed stations should have the following attributes:

- Located on well-drained, firm ground, to avoid the area being muddy and becoming a fly breeding ground.
- Shade places to ensure unlimited access and to keep water cool for optimal intake by animals. Animals will keep away from feeding stations located in open places, especially when the weather becomes very hot.
- Easily accessible all the time by the target animals.
Facilitator's Note: Identify and mark two areas (one open, one under shade) for a given animal category and take feed specific to the animal category to those areas and observe times in which each station will be accessible all the time.

Note: Control other animal categories from accessing the feed.

Feeding from feed structures (troughs/racks) minimizes feed losses, prevents internal parasite infesting animals, and reduces incidences of diarrhea among animals. Depending on type and quantity of feed, the farmer should make hay racks for hay and feed troughs for silage or concentrates.

Facilitator’s Note: Carry farmers through construction of hay racks/troughs. Artisans will be useful for this exercise. For water, use half plastic drums cut longitudinally; or construct water troughs out of wood or concrete.

4.4.3 Factors Affecting Ruminant Nutrition

Age of animal: Older ruminants use feed poorly, while younger ruminants use feed better.

Health status: Sick ruminants use feed poorly, while healthy ones use it better. Consider deworming, vaccinations, and dipping your animals for optimal feed utilization.

Weather conditions: Ruminants poorly utilize feeds in hot and dry weather than in cool and wet weather.

Season: Ruminants poorly utilize feed in the hot dry season compared with the cool and wet season.

Availability of water: low water supply will reduce feed intake and utilization. Ensure water is available all the time.

Stage of lactation: Lactating cows use more feed than dry cows.

Pregnancy status: Pregnant ruminants need more feed than empty ones. The unborn also requires a share of the feed.

Animal use: Oxen will need more and better quality feed, especially if they are used for animal traction or transport or other logistical work on or around the farm.
Section 4.5 Fodder Flow Planning

The dominant variable cost on any livestock farm is feed. Frequently, because of poor planning aggravated by inefficient production practices and adverse weather conditions, basic feed supplies are erratic and inadequate. Basically, farmers need to ensure the proper nutrition of their animals, but supplements are too expensive to use all of the time to make sure that animals get the supplies of fodder they need throughout the year. Fodder is a better for meeting these nutritional needs because it costs less. Dairy and livestock farmers are more likely to buy fodder and feed it to their animals when they need an additional feed resource than purchase expensive supplements. In the long run, fodder is more practical for farmers to ensure the nutrition and productivity of their animals. A constant supply of good quality fodder is the solid foundation upon which profitable livestock farming is built.

The objective of fodder production planning is to match the production capabilities of the farm with the animals' feed requirements in order to obtain the greatest margin over feed costs; and be within safe limits of natural resource utilization. The maximum amount of fodder that can be produced from the land on farm, not the owner's target income, must determine the size of the herd: specifically, the quantity of suitable fodder can be produced annually on farm should be used to determine the livestock herd-size. If the farmer plans to buy extra fodder to cover the herd size over and above what the farm can produce, the farmer needs to consider contracting farmers to produce and supply the extra fodder.

When developing a fodder flow plan, it is important to note:

- That fodder planning maps out a program of fodder development in years. It takes time to achieve results.
- The farmer should know from start that the Fodder Flow Plan is like any other plan. Results may not be fully attained as planned due to implementation constraints beyond the farmer’s control.
- That the plan should be over ambitious. It should take into consideration prevailing economic as well as weather conditions.
• The farmer is very much a part of the farm. The plan must take account of his technical knowledge and managerial strengths and weaknesses, his interests and dislikes, and especially his financial position.
• Clarify the objectives of planning before starting the exercise.
• Round off the results of calculations in such a way that estimates of fodder requirements are increased rather than decreased; that is the least expensive error to make and will lead to the more profitable decision.
• Although the farmer is concerned primarily with the average year in his forward outlook, he should not forget that non-average, but not impossible, conditions once every few years could ruin everything. The best insurance against such disaster is a bulging fodder bank balance.

The soundness of any fodder flow plan, existing or proposed, may be evaluated against the following four criteria in very strict order of precedence:
• Safe use of resources (land, grassland, water, labor, management, and capital);
• Meeting the animals' requirements at all times (adequate feed produced, stored, accessible to feed all animals);
• Positive Gross Margin over all feed costs (never push up number of animals if feed is the limiting factor);
• The system's realism and manageability.

Facilitator's Note: Design a fodder flow plan and work out details of implementation (action plan) for a farmer with:
• One dairy Holstein cow weighing 500Kg live body weight.
• One goat weighing 30Kg live body weight.
• One beef cow weighing 400Kg.
Section 4.6 Feed Performance Assessments

This section contains checklists for assessing dairy cows, heifer, calf, goat and beef cattle. A table of locally available animal feeds and their feeding values follows.

### 4.6.1 Checklists

#### DAIRY COW CHECKLIST

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SITUATION ANALYSIS</th>
<th>FINDING</th>
<th>DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk production</td>
<td>Is the milk production according to what you would expect?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td>Are the animals in a poor, fair or good condition score?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>Is the animal’s heat cycle normal?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calving intervals</td>
<td>Is the animal calving once a year?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair coat</td>
<td>Is the hair coat smooth and shiny?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>Is the animal social?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the animal eating and ruminating?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water availability</td>
<td>Is there free access to water all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Is the farm providing enough feeding space?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type, quality, and quantity of</td>
<td>Has the animal got access to roughage?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>roughage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals</td>
<td>Do cows have continuous access to mineral licks?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>Are concentrates fed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>Are records kept?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can the records show farm activities?</td>
<td></td>
<td></td>
</tr>
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</table>

*Figure 34 Dairy cow checklist*
## HEIFER CHECKLIST

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SITUATION ANALYSIS</th>
<th>FINDING</th>
<th>DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>Is the heifer growing according to what you would expect?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td>Are the animals in a poor, fair or good condition score?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>Are the heifers coming on heat as expected?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at first Calving</td>
<td>Is the animal calving at expected age?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair coat</td>
<td>Is the hair coat smooth and shiny?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>Is the animal social?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the animal eating and ruminating?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water availability</td>
<td>Is there free access to water all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Is the farm providing enough feeding space?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type, quality, and quantity of roughage</td>
<td>Has the animal got access to roughage?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals</td>
<td>Do heifers have continuous access to mineral licks?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>Are concentrates fed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>Are records kept?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can the records show farm activities?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 35  Heifer checklist*
## CALF CHECKLIST

<table>
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<tr>
<th>INDICATOR</th>
<th>SITUATION ANALYSIS</th>
<th>FINDING</th>
<th>DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf survival rate</td>
<td>Are calves born alive?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How many survive up to weaning age?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth rate</td>
<td>Is the calf growing according to what you would expect?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the age at weaning as expected?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td>Are the animals in a poor, fair or good condition score?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the animal's heat cycle normal?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair coat</td>
<td>Is the hair coat smooth and shiny?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>Is the animal social?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the animal eating and ruminating?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water availability</td>
<td>Is there free access to water all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Is the farm providing enough feeding space?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type, quality, and quantity of roughage</td>
<td>Has the animal got access to roughage?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals</td>
<td>Do calves have continuous access to mineral licks?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>Are concentrates fed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>Are records kept?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can the records show farm activities?</td>
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<td></td>
</tr>
</tbody>
</table>

[Figure 36  Calf checklist]
### GOAT CHECKLIST

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SITUATION ANALYSIS</th>
<th>FINDING</th>
<th>DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>Is the growth according to what you would expect?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td>Are the animals in a poor, fair or good condition score?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>Is the animal’s heat cycle normal? Are the bucks active and mounting?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calving intervals</td>
<td>Is the animal calving normally?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair coat</td>
<td>Is the hair coat smooth and shiny?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>Is the animal social?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the animal eating and ruminating?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water availability</td>
<td>Is there free access to water all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Is the farm providing enough feeding space and feeds?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type, quality, and quantity of</td>
<td>Has the animal got access to roughage?</td>
<td></td>
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</tr>
<tr>
<td>roughage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals</td>
<td>Do goats have continuous access to mineral licks?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>Are concentrates/supplements fed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>Are records kept?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can the records show farm activities?</td>
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<td></td>
</tr>
</tbody>
</table>

*Figure 37* Goat checklist
## BEEF CATTLE CHECKLIST

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SITUATION ANALYSIS</th>
<th>FINDING</th>
<th>DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>Is the growth according to what you would expect?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body condition</td>
<td>Are the animals in a poor, fair or good condition score?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>Is the animal’s heat cycle normal? Are bulls mounting?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calving intervals</td>
<td>Is the animal calving once a year?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hair coat</td>
<td>Is the hair coat smooth and shiny?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>Is the animal social?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is the animal eating and ruminating?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water availability</td>
<td>Is there free access to water all the time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding</td>
<td>Is the farm providing enough feeding space?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type, quality, and quantity of roughage</td>
<td>Has the animal got access to roughage?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals</td>
<td>Do cows have continuous access to mineral licks?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>Are concentrates fed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>Are records kept?</td>
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</tr>
<tr>
<td></td>
<td>Can the records show farm activities?</td>
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</tr>
</tbody>
</table>

*Figure 38  Beef cattle checklist*
### 4.6.2 Locally Available Animal Feeds and Their Feeding Values.

**Table 10 Locally available animal feeds and their feeding values**

<table>
<thead>
<tr>
<th>Feed</th>
<th>Dry Matter (DM) %</th>
<th>Total Digestible Nutrients</th>
<th>Digestible Crude protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green cut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural grasses (young)</td>
<td>20</td>
<td>116</td>
<td>11</td>
</tr>
<tr>
<td>Natural grasses (old)</td>
<td>25</td>
<td>135</td>
<td>8</td>
</tr>
<tr>
<td>Rhodes grass</td>
<td>28</td>
<td>134</td>
<td>15</td>
</tr>
<tr>
<td>Fodder sorghum</td>
<td>23</td>
<td>115</td>
<td>13</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>20</td>
<td>99</td>
<td>20</td>
</tr>
<tr>
<td>Sunn hemp</td>
<td>26</td>
<td>116</td>
<td>23</td>
</tr>
<tr>
<td>Velvet beans</td>
<td>24</td>
<td>140</td>
<td>25</td>
</tr>
<tr>
<td>Hay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural grasses (young)</td>
<td>93</td>
<td>455</td>
<td>4</td>
</tr>
<tr>
<td>Rhodes grass</td>
<td>87</td>
<td>425</td>
<td>15</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>91</td>
<td>500</td>
<td>83</td>
</tr>
<tr>
<td>Ground nut</td>
<td>92</td>
<td>470</td>
<td>51</td>
</tr>
<tr>
<td>Velvet beans</td>
<td>90</td>
<td>480</td>
<td>77</td>
</tr>
<tr>
<td>Crop residues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize stover</td>
<td>90</td>
<td>450</td>
<td>1</td>
</tr>
<tr>
<td>Sorghum stover</td>
<td>90</td>
<td>500</td>
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</tr>
<tr>
<td>Cowpea straw</td>
<td>91</td>
<td>380</td>
<td>20</td>
</tr>
<tr>
<td>Concentrates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize bran</td>
<td>90</td>
<td>648</td>
<td>40</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>90</td>
<td>586</td>
<td>99</td>
</tr>
<tr>
<td>Cotton seed cake</td>
<td>93</td>
<td>690</td>
<td>279</td>
</tr>
<tr>
<td>Sunflower seed cake</td>
<td>94</td>
<td>660</td>
<td>282</td>
</tr>
<tr>
<td>Velvet beans</td>
<td>90</td>
<td>810</td>
<td>171</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>86</td>
<td>765</td>
<td>168</td>
</tr>
<tr>
<td>Molasses</td>
<td>75</td>
<td>540</td>
<td>7</td>
</tr>
<tr>
<td>Maize No. 3 meal</td>
<td>90</td>
<td>702</td>
<td>57</td>
</tr>
<tr>
<td>Bone meal</td>
<td>96</td>
<td>625</td>
<td>453</td>
</tr>
</tbody>
</table>
Module 5

Adapting the

*Answer Plot® by WinField*

Approach for Africa
Module 5. Adapting the AnswerPlot® by WinField Approach for Africa

Section 5.1 Introduction to the AnswerPlot® Approach

5.1.1 What is an AnswerPlot®?

An AnswerPlot® is a Land O’Lakes, Inc., WinField Solutions term and concept for an agricultural platform where the private sector and other agricultural firms and institutions introduce new technology and improved sound agronomic practices to farming communities. It is used throughout the USA, and Land O’Lakes has launched AnswerPlot® sites in Canada and Mexico also. The International Development division of Land O’Lakes adapted the AnswerPlot® and introduced it to Africa in 2010. AnswerPlot® platforms in Africa were modeled after the corporate version, but adapted and introduced into Kenya, Malawi and Zambia, using the “AnswerPlot® for Africa” toolkit.

Figure 39  A community coming together to prepare the land
Unlike typical demonstration plots which only demonstrate new technology and sound agronomic practices, an AnswerPlot® demonstrates new technology and sound agronomic practices in comparison with the community-based traditional practices, and farmers are fully involved from inception to sitting, establishment, management and monitoring and evaluation.

When adapting the AnswerPlot® by WinField approach to suit project target areas, ZFP referred to the “AnswerPlot® for Africa” toolkit for technical support and lessons learned. The purpose of the “AnswerPlot® for Africa” toolkit is to guide projects to work with input supply companies and other partners, including post-harvest handling and storage firms and complementary service firms, to teach community-based smallholder farmers better farming or agronomic practices and to introduce new products and/or technology through the modified AnswerPlot® approach, to increase their productivity and incomes.

Zambia Fodder Pilot Project (ZFP) customized the “AnswerPlot® for Africa” toolkit to suit the Zambian Agricultural policy framework, Zambian land tenure system, target community cultural norms, gender framework, socio-economic trends, weather and seasonality of activities, livestock type and rearing system, target community demographics, corporate world investment trends, and research institution focus.

Key innovations to the “AnswerPlot® for Africa” toolkit included the following:

- Trainees participated actively in AnswerPlot®-style events. Farmers learn better through hands-on training that allows them to gain “a feel for” what is said during training sessions. Hands-on training also allows farmers to make mistakes and have an opportunity to be corrected.
- Land hosting for the AnswerPlot®-modeled event was donated. Hosts were encouraged to show support for other community members by not charging a fee. This proved to be a sustainable way of doing business.
- Target communities managed the adapted AnswerPlot® approach communally, with backstopping support from ZFP agronomist.
Inputs for the adapted AnswerPlot® platform were donated through a Memorandum of Understanding (MOU) between Land O’Lakes ZFP project and the input supply companies.

Sessions on theory and practice were done concurrently, and farmers were free to visit the farmer field school on their own time and to discuss and/or teach one another the innovations that had been demonstrated during the AnswerPlot®-style event.

Weather monitoring points were included.

Adapted AnswerPlot® platform produce for practical sessions and products of the practical shared among all.

5.1.2 Factors to Consider when Selecting a Venue

The following factors are considered when selecting a venue for the adapted AnswerPlot®-style event:

- Select the community where the AnswerPlot®-style event will be located. This should be done in close consultation with identified stakeholders and should go to the selected community and look for sites.

- Work collaboratively with the village(s) wherein an adapted AnswerPlot® will be located. The team making the selection should keep in mind by selecting a site situated in densely populated villages within a 5 to 10 kilometer radius of a potential site, so that it is relatively easy for many farmers to get to the site by foot, by bicycle, by donkey-cart or by other means of transport.

- Once a cluster of villages or a village or community has been selected to host a modified AnswerPlot® site, community based baseline surveys must be conducted among a representative sample of smallholder farmers in order to determine what crops are grown, what farm management and agronomic practices are used to grow those crops, and among the important characteristics to consider in the survey is the average size of a smallholder farm in a community, in terms of acres or hectares. This information is critical because the average size of the community based farms will drive the size of the community-based
AnswerPlot®-style event as this is important for farmers to believe and feel that this farm is no different from their farm.

- Identify a local progressive farmer within the community who might be willing to host the AnswerPlot®-style event on her or his farm. A progressive farmer is ideal because he/she will support the educational efforts within the community and not try to undermine what is done on his or her farm. There is need to balance the need to have a progressive farmer, with the need to have the farm site on a well-travelled road or near a place where many people tend to pass by on a daily basis—such as near a crossroads or not far from a community market or church, any place where people tend to pass to and from their homes, going to markets or churches, so that farmers will see the farm and its signage on a regular basis.

- Other factors to consider include the crop performance history of the land, erosion free site, not waterlogged during rainy season and on a flat land.

For detailed discussion on other factors, refer to the “AnswerPlot® for Africa” toolkit.

Figure 40  Preparing the land
5.1.3 Management of AnswerPlot®-Style Events

An AnswerPlot®-style event should be managed by farmers themselves. This implies that any new technology and improved agronomic practice introduced by the private sector and other agricultural firms should be introduced in presence of farmers, and farmers should be left to demonstrate their traditional practices in comparison to the new technology and improved agronomic practices. Through this, farmers gain “hands-on experience,” enhancing technology transfer.

Treatments should be designed to demonstrate and compare traditional farming practices from the local community with the modern farm management practices for fertility, crop protection methods and products, seed planting depth, seed or planting spacing, and row spacing, intercropping cereals with legumes, and environmentally sustainable farming practices, including no till and minimum till, should also be demonstrated and in the second season or year of farming at the AnswerPlot®-style site, crop rotation can also be introduced and demonstrated. Additionally, an adapted AnswerPlot® platform should be data-driven in terms of management.

5.1.4 Farmer Involvement in the Adapted AnswerPlot®

Farmers should be involved with all farm activities taking place at the AnswerPlot®-style event; this should be done from inception- sitting, establishment and management. It is advisable to agree a day every week for farmers to meet and discuss the new technology and sound improved agronomic practices in relation to their traditional practices, and during peak periods of farm activities such as on field management practices (weeding, disease and pest control), farmers can adjust to meet twice or thrice in a week so as to maintain a good crop stand.
Section 5.2 Farmer Field Schools

5.2.1 About Farmer Field Schools
A farmer field school is a living classroom for smallholder farmers. It is a venue (an AnswerPlot®-style site) where farmers meet to practice the new technology and sound improved agronomic practices and to compare them with their traditional practices. The private sector and other agricultural firms also introduce and demonstrate their innovations during the farmer field schools. Thus it is a platform where theory and practice are done concurrently, and farmers are free to visit the farmer field school at their own time and discuss and/or teach one another the innovations that have been demonstrated through the modified AnswerPlot® approach.
5.2.2 How to Conduct Farmer Field Schools

Farmer Field Schools should be conducted and run by farmers themselves; farmers should agree on a day every week they should be meeting, and these days and dates are communicated to the private sector and other agricultural firms willing to showcase their innovations at the adapted AnswerPlot® event. Thus a farmer field school would be conducted either in presence of the private sector or agricultural firms/institutions or without them (discuss with one another on the innovations in relation to their traditional practices).
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