

Training Manual: The Basics of Financing Agriculture

Module 4.2 | Crop Analysis: Maize

Acknowledgement

The Agriculture Finance Training Manual is part of AgriFin's Agriculture Finance Training Tools. The Manual was developed by [IPC](#) - Internationale Projekt Consult GmbH as part of AgriFin's technical advisory project for Cameroon Cooperative Credit Union League ([CamCCUL](#)).

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Session Overview

LEARNING OBJECTIVE	<p>This session is based on the principles introduced in 4.1 Analyzing Crop Production. Since Maize is a primary crop produced in a number of agriculture-focused countries, this crop has been used as an example to showcase the process of analyzing crops.</p>
SCOPE	<p>By the end of this session, the trainee will be well versed with the following principles in maize production:</p> <ul style="list-style-type: none">• Maize biology and genetics including concepts to understand what IRAD is doing when they produce maize and its varieties.• Maize growth requirements with water, site, and soil selection• Maize cultivation from land preparation to disease prevention• Harvest and Post-Harvest processes of maize• The process of assessment when sanctioning loans for Maize.
TARGET	Agriculture loan officers, financial analysts, trainers, and other professionals interested in agriculture financing
DURATION	3 hour

Content

1. Maize Biology
2. Maize Environment
3. Maize Ecology
4. Maize Cultivation
5. Crop Cycle
6. Post-Harvest
7. Production Costs
8. Assessment

1. Maize: Biology

General

- Scientific name: Zea mays
- English: maize (GB) or corn (US)

Utilization

- Very diverse

Examples of varieties

- 80P, Kasai, Coca (for high altitudes), Okomasa, Golden Crystal, etc.

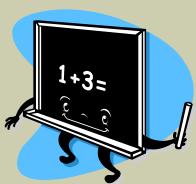
Yields:

- minimum 1.8 t/ha (in the North West Region of Cameroon, for a farmer not using an improved maize variety, just a small quantity of fertilizers and no pesticides required)

Maize is an annual herbaceous cereal, requiring almost no tillage. It presents a large diversity of forms, depending on the varieties. Some varieties are adapted to Bamenda's climate, soil conditions, and pests, while some are not. Farmers will plant seeds they harvested the previous year (but this is not possible with hybrids).



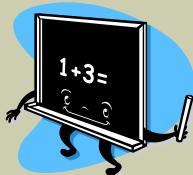
1a. Maize Biology



What are the uses of Maize?

- Human consumption
- Livestock feed
- Biofuels
- Seed production
- Etc.

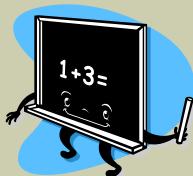
1b. Maize Biology



What is hybrid Maize?

- When maize is self-pollinated, each generation becomes weaker. Self-pollination is the process of taking the pollen from a single plant and applying this to the silks of the same plant. This is called ***inbreeding***. These inbred lines are small in size, have small cobs and reduced yields. However, when two inbred lines are crossed, the vigor is restored in the resulting seed, and the yield of the plants grown from the seed is greatly increased. This is called ***hybrid vigor***. It occurs as a result of the interaction between the sets of genes obtained from the two different inbred lines. The effect of some of the harmful genes expressed in one of the inbred lines will be masked by more beneficial ones found in the other parent plant. This is called ***heterosis***, and has been exploited to develop hybrid cultivars that are now widely grown by farmers. (Refer: <http://www.knowledgebank.irri.org/ckb/quality-seeds-maize/what-is-hybrid-maize.html>)

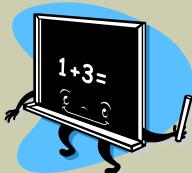
1c. Maize Biology



How do you produce hybrid seeds?

- Hybrid seed production is strictly monitored in order to avoid contamination. Male and female parents are inter-planted in alternate rows. There are normally 3 to 6 female rows and 1 or 2 male rows. The female plants are de-tasseled before they shed any pollen, i.e., the tassels are physically removed. Only the male plants will shed pollen in the field. Inspectors check to see that all emerging female tassels are removed and that neighboring maize plants are at least 360 meters away. This is to ensure that pollen from nearby crops do not fall on to the silks of female plants. Thus, female plants are fertilized by pollen that comes only from male plants. Once male plants have provided the pollen, they are removed from the field to ensure there is no mixing of seed between the male and female plants. Only the seed from the female plants constitutes the hybrid seed.

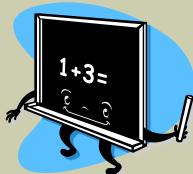
1c. Maize Biology



How do you produce hybrid seeds? (contd.)

- It is important that the male and female plants flower at the same time and that the pollen is shed from the male plants when the female silks are receptive, in order to produce a maximum amount of seed. This is called nicking.

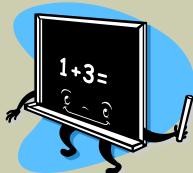
1d. Maize Biology



What are the stages of commercial seed production?

- There are three stages in commercial seed production:
- **Production of the breeder's seed** – this is when the breeder selects and produces the seed for the inbred lines. Only a little seed will be produced as inbred lines are not very vigorous. This seed will then be used for foundation or basic seed production.
- **Foundation or basic seed** is the first multiplication of breeder's seed (inbred lines). This is also the stage in which single-cross hybrid will be produced for three-way or double-cross hybrids. Enough parent seeds will be produced to produce the hybrid seed.
- **Certified seed** is the last stage in seed multiplication. Seed companies contract approved and capable farmers to plant the foundation seed in the ways described above in order to ensure purity and to produce enough seed for the farming sector.

1d. Maize Biology



What are the stages of commercial seed production? (contd.)

- Throughout the production of hybrid seed, the seed company and the seed producer have to **adhere to certification standards**. The seed fields are checked for isolation, off-types and purity, while the harvested seed is verified for lack of defects, adequate germination rate and freedom from pests and diseases. Any crop that fails to meet the standards is rejected and may not be sold as seed. Seed that has been certified by the authorizing agency is labeled accordingly and may be sold.

1e. Maize Biology – Advantages

- **The advantages of growing hybrid maize:**

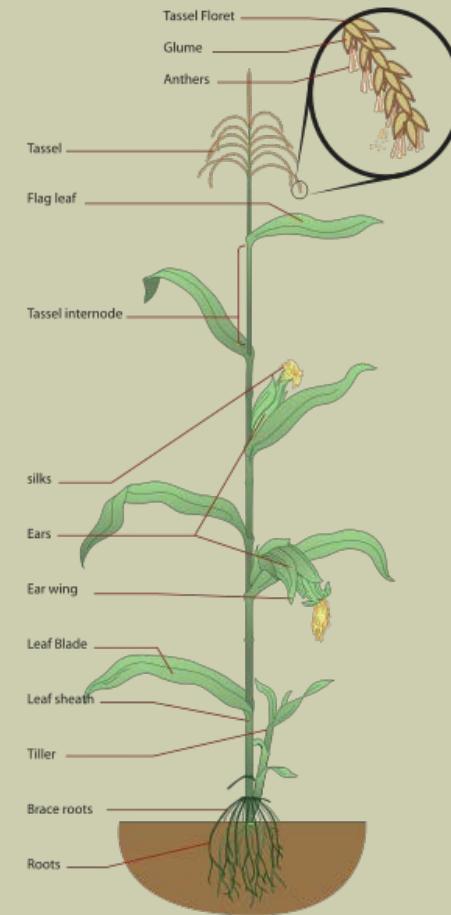
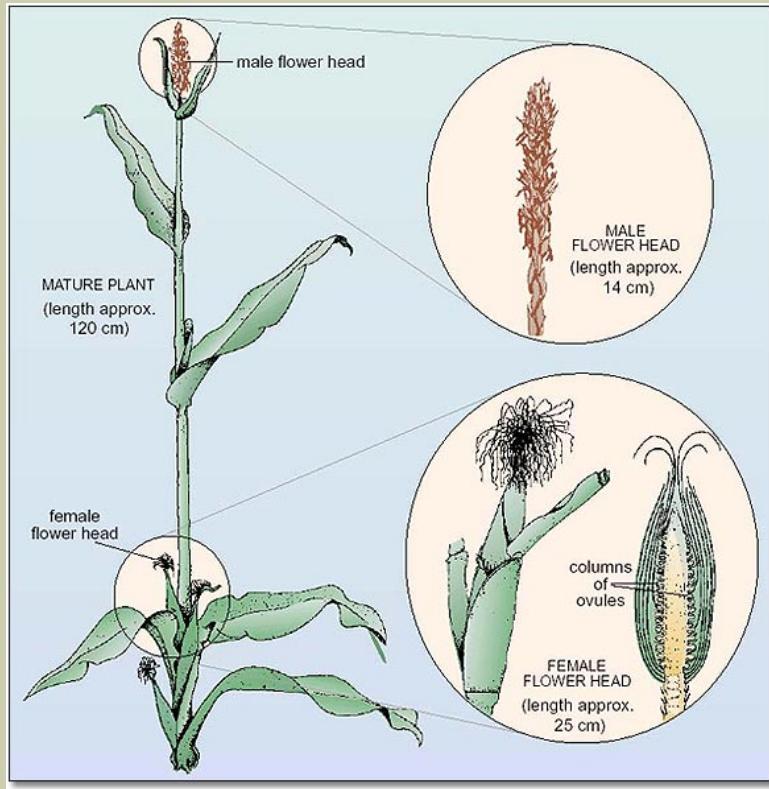
- Hybrids are generally higher yielding than open-pollinated varieties, if grown under suitable conditions.
- Hybrids are uniform in color, maturity, and other plant characteristics, which enables farmer to carry out certain operations, such as harvesting at the same time
- The uniformity of the grain harvested from hybrids can also have marketing advantages when sold to buyers with strict quality standards.

1f. Maize Biology – Disadvantages

- **The disadvantages of growing hybrid maize**

- Hybrid seed is more expensive than open-pollinated maize seed.
- The farmer needs to have a big surface to cultivate in order to justify the cost of the seed. Farmers situated in a low potential environment and who cannot afford extra inputs such as fertilizer will not recover the costs of the hybrid seed.
- Fresh hybrid seed needs to be bought every planting season.
- The grain from a crop grown with hybrid seed should not be used for seed. The farmer cannot replant grain as seed without major reductions in yield, which might be a decrease of 30 % or more.
- The farmer might not always be able to source new seed in time for the planting season.

2. Maize Environment



3. Maize Ecology

Growth requirements

- Temperature ranges 10-38°C [optimum of 25-30°C]
- Rainfall of 500mm – provided most of this falls during the growth period.
- Optimum 750-1500mm rainfall
- Moisture stress during early growth delays flowering. Another moisture stress period is just before tassling

Site selection & soil

- Good rainfall during the growth and dry weather during post maturation
- Fairly flat lands, good drainage, proximity to roads, access to water for irrigation
- Low pest and disease intensity
- Moist soils, well drained, deep, loamy or silty loam. pH of 6-7



3a. Maize Ecology

- The crop is grown in climates ranging from temperate to tropical during periods when mean daily temperatures are above 15°C and frost-free.
- Adaptability to different climates varies widely by variety. Successful cultivation markedly depends on right choice of varieties so that length of growing period of the crop matches the growing season and purpose for which the crop is to be grown.
- Variety selection trials to identify best suitable varieties for areas are often necessary.
- When mean daily temperatures during the growing season are greater than 20°C, early grain varieties take 80 to 110 days and medium varieties 110 to 140 days to mature.
- When grown as a vegetable, these varieties are 15 to 20 days shorter.
- When mean daily temperatures are below 20°C, there is an extension in days to maturity of 10 to 20 days for each 0.5°C decrease depending on variety, and at 1.5°C the maize grain crop takes 200 to 300 days to mature.

3a. Maize Ecology (contd.)

- With mean daily temperature of 10 to 15°C maize is mostly grown as a forage crop because of the problem of seed set and grain maturity under cool conditions. For germination, lowest mean daily temperature is ~10°C, with 18 to 20°C being optimum.
- The crop is very sensitive to frost, particularly as seedling but tolerates hot dry conditions so long as sufficient water is available and temperatures are below 45°C.
- Temperature requirements for medium varieties are 2500 to 3000 degree days, while early varieties require about 1800 and late varieties 3700 or more degree days.

3b. Maize Ecology

- Maize is considered to be either day-neutral or short-day plant.
- Maize growth is very responsive to radiation. However, 5 or 6 leaves near and above cob are source of assimilation for grain filling and light must penetrate to them. For optimum light interception, grain production, the density index (# of plants per ha/row spacing) varies but it averages at ~150 for large late & ~500 for small early varieties.
- Sowing methods and spacing vary, and fertility and water are decisive factors in choosing the optimum density in relation to light interception and highest yields. Plant population varies from 20000 to 30000 plants per ha for the large late varieties to 50000 to 80000 for small early varieties. Spacing between rows varies between 0.6 and 1 m. Sowing depth is 5 to 7 cm with one or more seeds per sowing point. When grown for forage, plant population is 50 percent higher.
- The plant does well on most soils but less so on very heavy dense clay and very sandy soils. The soil should preferably be well-aerated and well-drained as the crop is susceptible to waterlogging. The fertility demands for grain maize are relatively high and amount, for high-producing varieties, up to about 200 kg/ha N, 50 to 80 kg/ha P and 60 to 100 kg/ha K. In general the crop can be grown continuously as long as soil fertility is maintained.
- Maize is moderately sensitive to salinity. Yield decrease is 10% at

3b. Maize Ecology (contd.)

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- Maize is moderately sensitive to salinity. Yield decrease is 10% at 2.5mmhos/cm, 25% at 3.8, 50% at 5.9 and 100% at ECe 10 mmhos/cm.

4. Maize Cultivation

Cultivation

- Land Preparation
 - Organic manure to be incorporated
 - No-till to avoid surface crust which increases run-off and prevents water absorption.
- Planting depths depends on : 1/Climate, soil temperature, pests, soil texture, etc. 2/Deep planting where soil is dry and light 3/Shallow planting where soil is moist and heavy 4/ 2.5 – 5 – 10 cm.
- Seed rate depends on: 1/Method of planting 2/ Variety 3/ Knowledge of soil moisture during the entire growth of the crop.



4a. Maize Cultivation

- **Weeding**
 - Weeding is performed to remove weeds and break up soil.
 - First weeding of maize will coincide with second application of fertilizer to the crop.
 - Weed killer may also be applied:
- **Fertilizer Application**
 - First application could be performed at planting or a week after emergence.
 - Advantages and disadvantages of organic and inorganic fertilizers.
 - To supply 50kg of N apply either 7 t/ha of cattle manure or 4 t/ha of poultry manure
- **Pest & disease control**
 - Maize cultivated in the NW Region are usually resistant against disease (the varieties are adapted)
 - Chemical use against disease usually not justified
 - Chemicals against pests usually not cost effective (except for high yield crops)



4b. Maize Cultivation

VARIETY	DISTANCE BETWEEN ROWS	DISTANCE BETWEEN HILLS	PLANT POPULATION / Ha
Okomasa	90cm	40cm	56000
Golden Crystal	90cm	40cm	56000
Abeelehi	80cm	40cm	62500
Kawanzie	80cm	40cm	62500
Dorke SR	80cm	40cm	62500
Obaatanpa	80cm	40cm	62500
Dodzi	80cm	40cm	62500

4c. Maize Cultivation

PEST	CONTROL	DISEASE	SYMPTOMS
Stem Borers	Actellic	Smut	galls form on aerial portions [mass of black spores]
Earworms	Actellic		yellowish discolouration of leaves
Grain moths	Actellic	Streak	
Weevils	Actellic		
Rats, Squirrels, Birds			

4d. Maize Cultivation - Treatment

- **Treatment** – application of Actellic [powder or liquid]
- **Insecticide treatment.** In the event of an attack by caterpillars, use a cypermethrine based insecticide (such as Cypercal 200 or Cygone 200) at the rate of 90 ml per $\frac{1}{4}$ ha (6 sprayers of 15l). To prevent insect borer attacks especially during the second cycle or after late planting, apply a Carbofuran 100g/kg based insecticide (such as Bastion 10G, or Chrorpyrifos 480g/l such as Dursban).

4e. Maize Cultivation – Fertilizer

Fertilizer recommendations for maize are:

- 60-100kg N/ha; plus
- 50/100kg P²O⁵/ha; plus
- 30-60 kg K²O/ha.
- Maize requires two rounds of fertilizer application, using ideally different fertilizers. The timing of fertilizer application depends on the climatic zone and the variety cultivated (length of maturity cycle). During the seeding or the sprouting period (i.e. two weeks after planting), apply 200-250 kg of NPK fertilizer (14-24-14) plus 5 kg of Sulphur plus 3.5 kg of Magnesium-Oxide (MgO) per hectare. Between 35-40 days after planting, apply 200 kg of Urea (46%N) per hectare. The compound fertilizer (14-24-14) can be replaced with 20-10-10.
- The fertilizer should not be broadcast but placed near the plant at a distance of about 5cm below the surface in humid conditions.
- In Zone III (West and North-West), higher doses of phosphate (>50kg) give better yields.
- Applying organic manure favors the valorization of mineral fertilizers.

4f. Maize Cultivation – Labor Requirements

OPERATIONS	LABOR REQUIRMENT (Working days-ha)												Total days/ha
	January	February	March	April	May	June	July	August	September	October	November	December	
Defrichage	25												25
Piquetage et labour		35											35
Semis			5										5
Fertilizer application				4	2								6
Pesticide application					10								10
1st weeding						10							10
2nd weeding							10						10
Harvest								40					40
Total days/ha	25	35	19	10	12	0	40	0	0	0	0	0	141



4g. Maize Cultivation – Cultural Practices

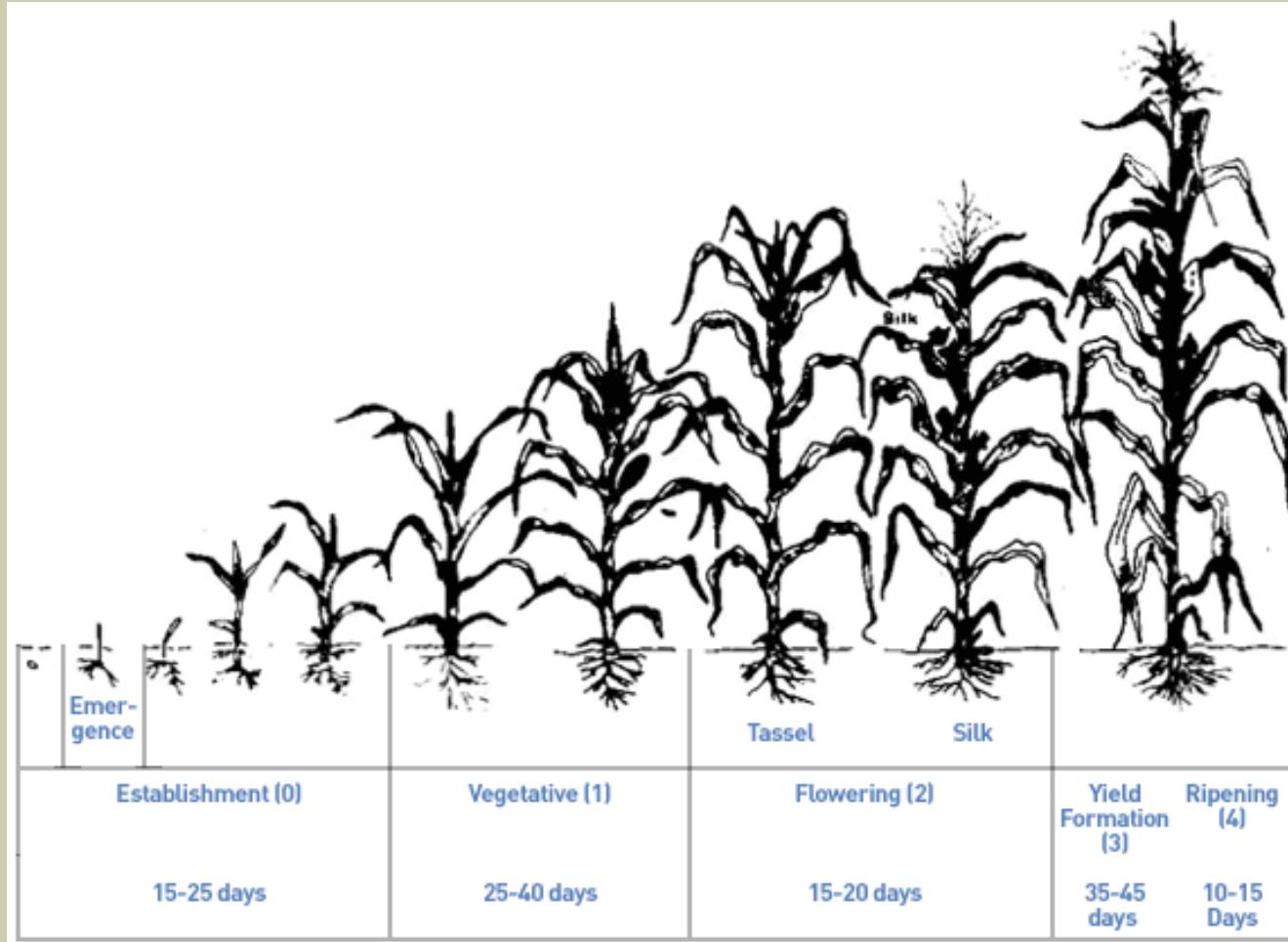
- Labor cost (in 2012)

- Labor duration (and cost) varies a lot depending on the method of cultivation (animal traction, mechanization...)

Labour type	Cost / Ha (XFA)	Remarks
Clear farm	30,000	
Ploughing/ridging	70,000	if mechanised (rent of a tractor)
Planting	15,000	
Apply fertilisers	15,000	
Weeding	30,000	
Apply herbicides	10,000	not everyone applies herbicides
Harvesting	20,000	almost always manual in the NW
Threshing	9,000	depending on the yield. Here: yield = 1.8 t/ha
Treatment of grain	3,600	not everyone does it



4h. Maize Cultivation – Growing Period



5. Crop Cycle – Maize Single Cropping

- Beginning of March: prepare the land (clearing, stumping, ploughing, harrowing)
- End of March or beginning of April (with the first rainfall): planting
- Mid-may: fertilizer spraying (NPK)
- June: Urea spraying
- July: harvest

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Clearing			■									■
Tillage			■									
Sowing				■								
Fertiliser appl.					■							
Weeding						■	■					
Harvesting							■	■■■				

5a. Crop Cycle – Maize Double Cropping

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Clearing												
Tillage												
Sowing												
Fertiliser appl.												
Weeding												
Harvesting												

6. Post-Harvest

- **Drying:**
 - Drying (in cribs or in buildings)
 - A quick dry is a qualitative one (prevents damage from excess moisture...)
 - **Treatment:**
 - Treat with Actellic, neem extract or fumigants- e.g. Phostoxin
 - Untreated maize can stay up to 2-3 months in drying cribs
 - Do not use Ulden, Elocron, DDT, Roxion
 - **Threshing:**
 - Can be done after harvest if maize is already dry
 - **Storage:**
 - After threshing, can be stored in bags, grain elevator/silo or cellar (better)
- NB: Easily storable and transferable both in terms of transportation and convertibility to various end-products for different markets.

7. Production Costs

COSTS for 1 ha (in 2012)	Cost (XFA)
Seeds (25kg @ XFA 800/kg)	20,000
Land preparation (mechanical ploughing)	80,000
Planting	22,500
In crop operation (fertiliser application) (worker/day: XFA 1,500)	30,000
Fertilizer: 20-10-10 (3 bags of 50 kg @ XFA 20,000/bag)	60,000
Urea 46% (2 bags of 50 Kg @ XFA 18,000/bag)	36,000
Harvest (workers: 30 days @ XFA 1,500 and 70 bags for harvest @ XFA 150)	55,500
TOTAL 1	304,000
Pesticides (4,500 litres x 2) + herbicides (4,500 litres x 10) (not systematically used but pesticides can also be used post-harvest)	55,000
Transport	10,000
TOTAL 2	369,000

7a. Production Costs – Fixed Assets

FIXED ASSETS (2012)	Cost (XFA)	Useful life (years)	Cost / year (XFA)
Dabas	2,500	4	625
Hoe	1,500	2	750
Machete	2,075	2	1,038
Pickaxe	2,500	3	833
Handcart (pousse-pousse)	60,000	5	12,000
TOTAL INVESTMENT	68,575	COST PER YEAR	15,246



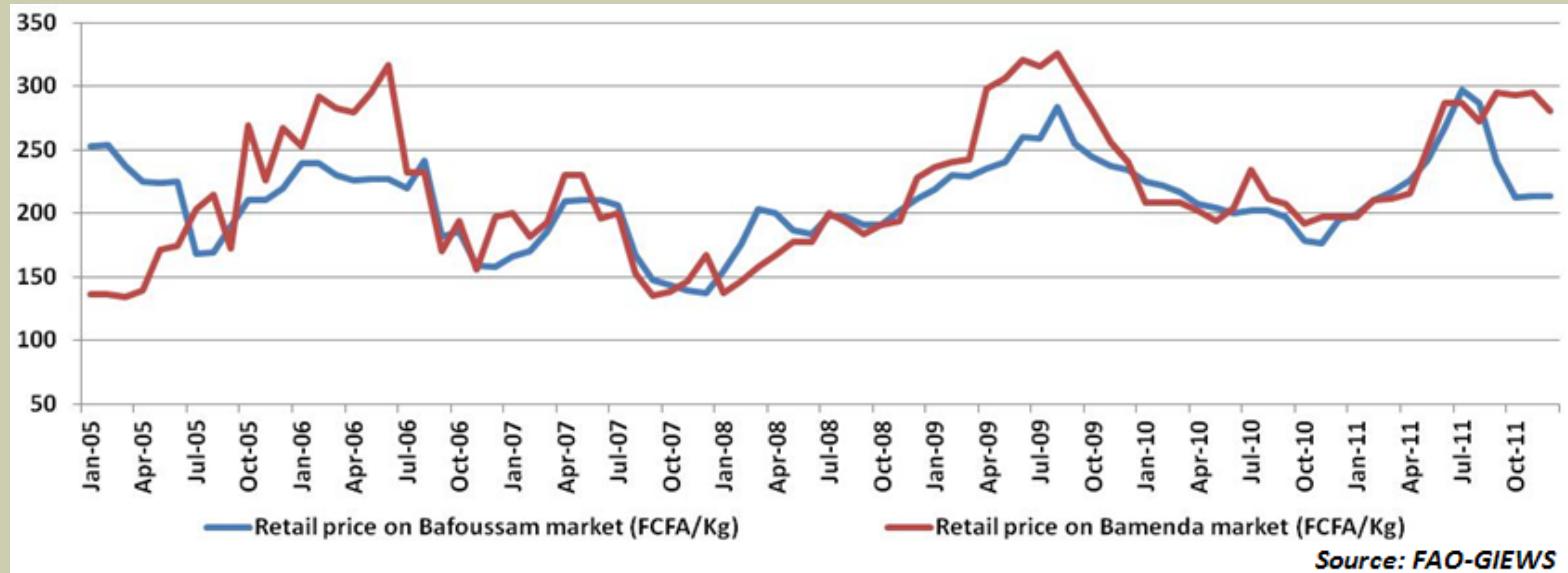
7b. Production Costs – Market Price

Month	Market Prices in 2012 (XAF)					
	Bamunka	Jakiri	Mankon	Nkambe	Wum	Fundong
January	2000	1600	3900	2500	2500	3500
February	2100	1600	3500	2500	3000	3400
March	2250	4000	3520	2800	3000	3500
April	2900		3270	2800	3000	3450
May	2900		3750	3000	3500	3300
June	2900		4000	3500	4000	3400
July	2500		3390	3500	3000	2735
August	2400		4325	3000	2700	2850
September	2200	2300	3950	2500	2700	2365
October	2500		3850	2500	3000	2425
November	2800		3385	2500	3000	2500
December	3000	3000	-	2500	2800	3170

- Local markets
 - Poultry farmers, Export



7c. Production Costs – Evolution of Prices



Maize prices are very different from one year to the next. The prediction of the prices should be done with a very large *margin for error*. Bamenda and Bafoussam mostly follow the same trend, but there can be differences (the largest one: XFA 110/Kg in January 2005). There is a trend where prices in May-June are usually higher than in August from the previous year. But this is not always true (2010). Therefore, prices cannot be predicted easily and so a conservative approach should be taken when calculating repayment plans.



7d. Production Costs – Profit

- Crop costs : between XFA 304,000 and 369,000/ha
- Fixed asset costs: XFA 15,246
- Sales: If the yield is 1.8 t/ha and the market price is XFA 3,500/bucket (1 bucket=15kg) : XFA 420,000/ha
- Profit: between XFA 35,754 and 100,754/ha

8. Assessment



What are the criteria for assessment?

During and after visit, keep in mind:

- Is the member's (hi)story credible?
- Is the potential borrower very open and co-operative?
- General payment behavior?

What matters:

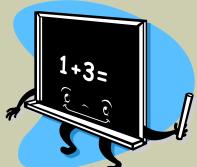
- Willingness to repay?
- Ability to repay?

8a. Assessment - Answers

- Irregular investment (business & private)
- Household expenses
- Family (living conditions, children, planned weddings...?)
- Business implementation (condition of the crops, animals, etc.)
- Collateral
- Legal documents
- Account statement (business & private)
- Liabilities
- Tax payments
- Daily business expenses
- Computer-aided accounting system
- Sales book
- Cash available at the activity
- Receivables
- Assets (business + private = cars, furniture...)
- Inventory turnovers
- Purchase price of stock/sales
- See the stock (count/estimate = margin)
- Loan purpose
- Business environment (competitors)
- Interview with employees, neighbors, clients
- Rent contract
- Client structure
- Structure of suppliers
- Organizational structure of the business
- Business history
- Possible risks and litigation
- Check equipment
- Etc.



8b. Assessment



Which order should you collect the information ?

- Visit the workplaces (check out the fixed assets, collateral, etc.)
- Business history (a member will often like to start talking about how he got there)
- Business management
- Technical data (regarding crops, livestock, all prices... from the past and the future).
- Cross-check with daily business expenses, etc.
- Discuss future projects (loan purpose and other projects)
- Business organization (employees, client structure, supplier structure)
- Risk management
- Business Records, legal documents
- Visit the family households
- Conclude with family details (now that the member knows you better, he will be more comfortable telling you about his family) and cash at hand

8c. Assessment – Historical yield

- Maximum?
- Minimum?
- Average?
- Price @ which the output was sold?
- The marketing channel?
- Whether the yield was up to industry average?
- Level of experience?



8d. Assessment – Variety under cultivation

- Disease resistance?
- Yield per ha?
- Ecological zones coherent?
- Hybrid?





8e. Assessment – Production progress

- Land preparation?
- Planting?
- Fertilizer application?
- Maintenance?
- Harvesting?
- Post-harvest practices (drying, shelling, storage)?
- Marketing?

8f. Assessment – Seasonality and Pricing

- Seasonality?
- Pricing?

8g. Assessment – Equity determination

- The nature of land ownership (lease, inheritance)?
- Age of the plants in the field?
- Amount of fertilizer applied so far?
- Labor costs?





8h. Assessment – Management practices

- Number of years cultivating at this location?
- Sources of inputs?
- Fertilizer application?
- Weeds, pest and disease control?
- Harvest and post-harvest practices?

For more resources please visit AgriFin's website

www.AgriFin.org

We welcome your feedback to help us further refine these training materials. Please contact us at agrifin@worldbank.org.