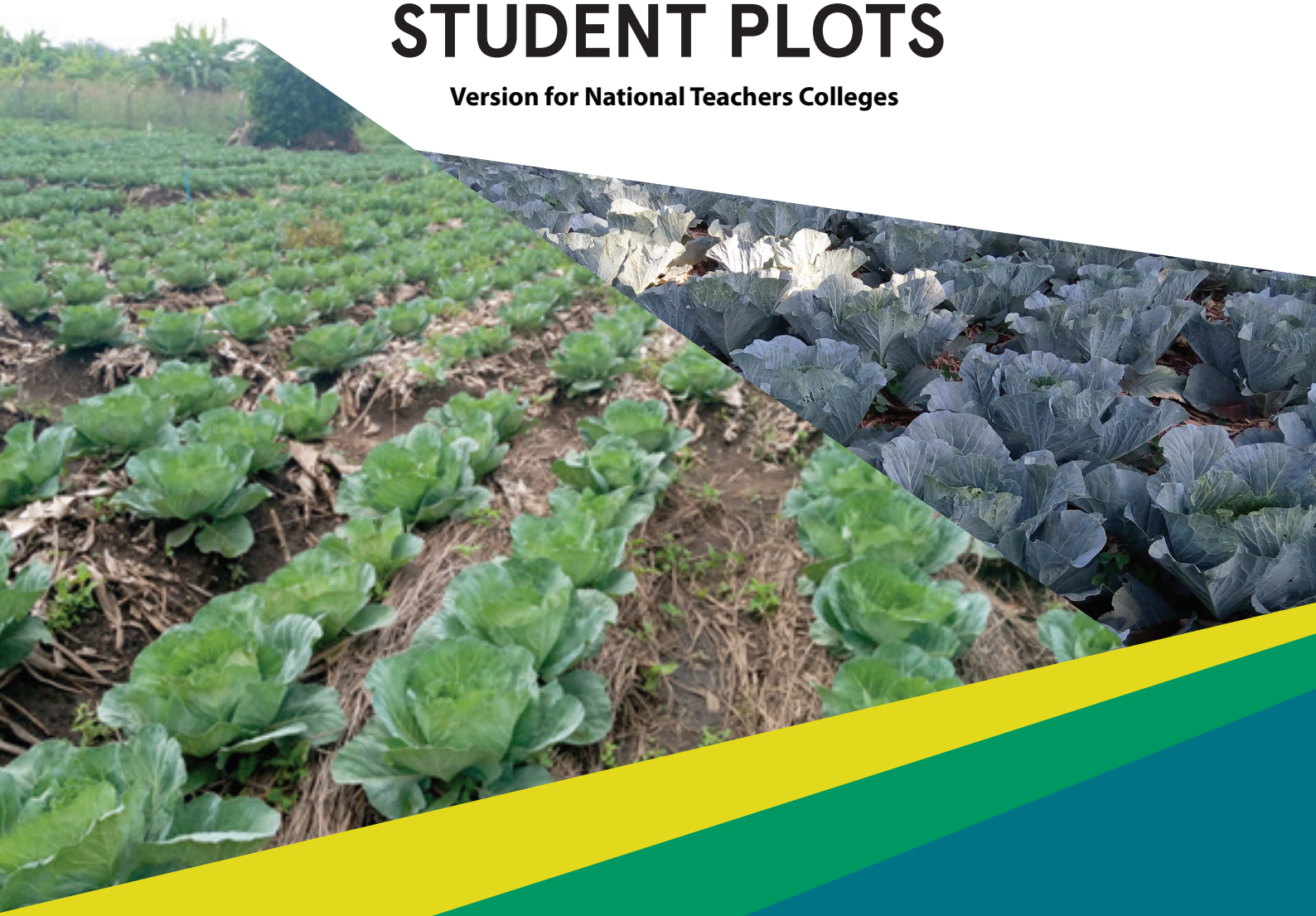
TEACHING AGRICULTURE PRACTICALLY WITH STUDENT PLOTS

Version for National Teachers Colleges



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TEACHING AGRICULTURE PRACTICALLY WITH STUDENT PLOTS

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The Teaching Agriculture Practically (TAP) programme started in 2019 and is funded by the Belgium government. It focuses on the professional development of teachers and instructors in agricultural education and agri-entrepreneurship education. Partners are the Ministry of Education and Sports, National Teacher Colleges (NTCs) Mubende & Unyama, National Instructors College Abilonino (NICA) and VVOB - education for development. More information at *https://www.vvob.org/en/programmes/uganda-teaching-agriculture-practically.*

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List of Abbreviations

BMC:	Business Model Canvas
CBET	Competence Based Education and Training
DEP	Diploma in Education Primary
DES	Diploma in Education Secondary
DITTE	Diploma in Instructor and Technical Teacher Education
MoES	Ministry of Education and Sports
NIC(A)	National Instructors' College (Abilonino)
NTC	National Teacher's College
STPL	Student plot
TAP	Teaching Agriculture Practically
(B)TVET	(Business), Technical and Vocational Education and Training
VVOB	VVOB education for development

Overview/General introduction

This guide handles student plots that are part of the teaching/learning aids at the Teacher Training Colleges. These enable and encourage practical learning, which is an essential part of the learning programme of the curriculum of future agricultural teachers. The teaching of agriculture practically is at the centre of the training acquired by those future agricultural teachers. They are trained in such a way that they acquire practical skills which they later apply.

One of the approaches used is to ensure that the students set up their own plots so that they can practise the skills which they are being trained to acquire. The guide highlights the importance of practical learning at the Teacher Training College by adopting the Teaching Agriculture Practically (TAP) programme and how it can help the students as they practice on their plots. The colleges put aside a portion of land specifically for setting up these plots, a testimony that the student plots are a vital component of the teaching and learning process.

The concept of student plots is well explained so that it can be easily understood. This includes a thorough description of what student plots are and the goal for establishing them. The other features the guide looks at are: organisation and demonstration sites for the student plots; dimensions, entrepreneurship; timing; use of irrigated student plots by non-students and the role of lecturers and farm managers in student plots.

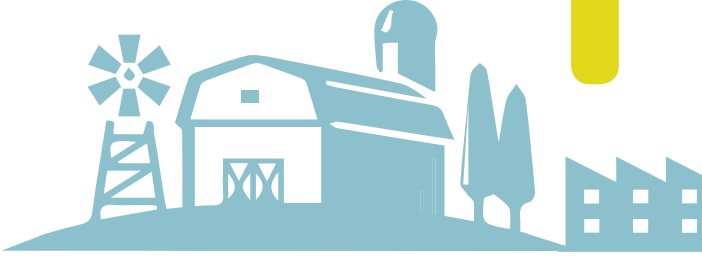
The guide also attempts to link the student plots to the NTC curriculum, particularly Paper V by emphasising the role of student plots in the assessment and evaluation of Paper V. In addition, the relationship between course units and student plots is highlighted in addition to the use of portfolio and the competences acquired from the student plots.

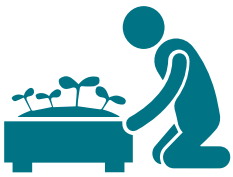
Equally important, the guide includes the preparation for practical work at the student plot. This as well includes a simplified business plan; an introduction to the student plot principle to the students; safety and tools; record keeping and environmental sustainability.

This guide belongs to lecturers, as it provides a complete overview on how teaching in agriculture could become more practical with student plots. It is an enormous resource of ideas, examples, and knowledge about student plots and it uses a hands-on approach. Lecturers can use this guide in the preparation of the activities within their course units and related learning activities, leading to a more practical teaching approach, linked to the curriculum objectives.

This guide is also relevant to students, as it helps them to better understand what the college and lecturers aim for with student plots and how the curriculum relates those objectives. But also: how active teaching and learning can be made real, based on the numerous examples, formats, schemes and other tools that are part of the guide. These examples and experiences are useful for when students become teachers as well.

Lastly, the guide is useful for the other stakeholders within the college, more in particular to the farm manager and farm attendants. It provides insight in the objectives and organisation of the learning and work at the students plots, as well as hands-on approaches with explanation of their role in the learning and work processes.





Chapter One:

The importance of practical learning at the Teacher Training College

1.1 Introduction

Practical teaching and learning refer to teaching and learning processes characterised by a strong focus on transfer of knowledge, building of skills and development of attitudes through practical exercises. Even though a theoretical basis remains an important precursor to practical teaching and learning, in practical teaching and learning both teachers and learners invest an important part of their time on the practical application of theoretical knowledge and concepts.

The need for practical teaching and learning in agriculture is underlined by the education sector, as well as some of the main policies that are related to the sector. From several policies and studies, it is made clear that there is a skill mismatch (between skills on demand by the labour market and skills that graduates possess), which needs to be focused on (National Human Resource Development Planning Framework for Uganda, 2018). From the Uganda Vision 2040, it becomes clear that the education system needs to be changed to emphasize, among others, practical skills. The National TVET policy (2019) states that all TVET institutions must emphasise practical and hands-on training which is integrated with flexible and work-oriented delivery methods.

1.2 Teaching Agriculture Practically (TAP)

The TAP programme stands for Teaching Agriculture Practically. This joint effort of VVOB, MoES, NTCs Unyama and Mubende and NICA started in 2019 and has the objective of strengthening the professional development of teacher educators at the level of O-level secondary teachers to teach agriculture practically. The programme enables the graduates develop the competences, skills, and attitudes for practical teaching / learning of agriculture. Important to acknowledge is that teaching agriculture practically is a process of instruction that facilitates acquisition of basic knowledge and practical skills by student teachers in the field of agriculture. TAP is made possible by engaging learners in practical lessons with hands-on instruction, mainly outside the classroom on land or the farm, at times also using video and other trajectories as demonstration methods of practical agricultural skills or participating in

a value addition activity within a production space. The TAP programme focuses on several principles that ensure its effective implementation and learning outcomes. These are explained in the next section.

1.3 Principles of TAP

The principles of teaching agriculture practically are outlined as follows:

1. **Participation;** TAP is directed towards supporting student teachers / instructors, and lecturers work out their own problems rather than being given ready-made solutions.
2. **Learning by doing / hands-on learning;** trainees learn better through their own experience rather than passive listening to lecturers and watching demonstrations.
3. **All stakeholder involvement;** this includes lecturers, instructors, farm managers, student instructors/teachers, college administration, governing council, and the community.
4. **Evaluation;** the effectiveness of TAP will be measured in terms of the changes brought about in the skills acquired and adoption of practical work.
5. **Stimulating** creativity, innovation and experimentation.
6. **Using locally available materials** and learning through collaboration and sharing.
7. **Use of technology** in a meaningful way and focus on technical skills.
8. **Making use of student plots** / demonstration / projects sites.
9. **Relating to the world of work** in the agricultural sector when training.
10. **Exposure of students** to a variety of agricultural activities.
11. **Focus on entrepreneurship** and learning as one earns.

1.4 TAP and student plots

The teaching within the new O-level curriculum takes a competence-based approach, just like it is already with the certificate level Technical Vocational Education and Training (TVET) programmes. The TVET programme took on a purely competence-based education and training (CBET) approach with the launch of the Business Technical Vocational Education and Training (BTVET) strategic plan, the new syllabi for TVET institutions and latterly the launch of the new TVET Policy. CBET requires the learners to advance in knowledge, skills and attitudes that they can apply in their day-to-day life situations. As a teacher of agriculture, you need to bring all academic concepts to life with visual or practical learning experiences in order to enable the learners relate what they are studying to their day-to-day life experiences.

Student plots offer an excellent opportunity for experiential learning, which is a form of practical learning. In student plots, learners gain valuable experience and develop technical agronomy skills, entrepreneurial competences and life skills as well as teaching skills. They learn practically how to grow (horticulture) crops, how to deal with adversity (such as coping with pests and diseases, soil infertility, adverse weather, etc.) and how to market their produce. The role of the lecturers is to provide the theoretical basis on agronomy and entrepreneurship (through lectures and demonstrations), as well as provide active coaching to learners before and during the production cycle of the crops. Farm managers and farm assistants take the role of mentors and advise the learners in technical aspects of the daily management of their plots.

Chapter Two:

What are student plots?

2.1 Introduction

Student plots are plots of college farmland of variable dimension allocated to individual student teachers for the purpose of practical work.

2.2 Description and goal of student plots

YEAR 01
students grow horticulture crops (on the irrigated site).
1

2
YEAR 02
students tend to other crops (cereals, perennial crops, bi-annual crops) grown outside the irrigated site.

Since the cycle of some of these crops outlast the duration of an academic year, the Year 2 students are accompanied by farm attendants, who continue the work beyond the end of the academic year.

NOTE **This guide will majorly focus on student plots for Year 1 students, although many principles are also valid for the case of Year 2 students.**

The goal of student plots is to allow students to practically apply what they have learned in the classroom or witnessed at the demonstration site by growing crops on a small scale. The student plots can also be used for microteaching practices. This stimulates the development of technical agronomy skills, as well as entrepreneurship competences, life skills and teaching skills. Annex 1 contains several crop sheets with key information on how to grow some of the common horticulture crops.

The development of entrepreneurship competences implies the application of the "learn as you earn" principle, whereby students market their own produce and keep the biggest portion of the profit[1].

NOTE

1 The exact distribution key of the profit varies from one college to another. As the college provides the seeds and sometimes other inputs, part of the profit should flow back to the college.

Picture 1. Nursery beds at NTC Unyama

2.3 Student plots and demonstration site

A portion of the college farmland reserved to students to grow crops will serve as a **demonstration site.** At the demonstration site, lecturers and/or the farm manager demonstrate specific agricultural practices during practical lessons. Students then replicate the techniques and practices in their own plots. Each college decides on the dimension of the demonstration site reserved for this purpose.

The principle of demonstration and creative replication

Prior to setting up student plots, a demonstration plot is set up by the lecturers. During practical lessons students first witness and learn how each activity is carried out in the demonstration plot. Then students replicate the activity in their own plots under the guidance of lecturers, farm manager, farm attendant and even peer student teachers. Of course, there is room for creativity within the replication process. Students are actively encouraged to experiment with alternative techniques, e.g., alternative spacing distances, alternative mulching techniques, use of self-made biopesticides, etc. to make the learning process more interesting and effective.

Picture 2. Student mulching his plot.

2.4 Organisation of student plots

2.4.1 Dimensions

The dimension of a student plot typically varies from 5m x 5m (=25 m^2) over 5m x 10m (=50 m^2) to 10m x 10m (100 m^2). The exact dimension depends on the availability of suitable land at the college, the topography of the land and the number of agriculture students. Education authorities provide no official guidelines to this regard.

2.4.2 Entrepreneurship

As already stated, development of entrepreneurial competences at student level is a specific objective of the student plots, in addition to development of technical (agronomy) skills, life skills and teaching skills.

Year 1 students are instructed by their lecturers to set up an individual horticulture project based on a business idea that is set out in a **simple business plan**. The business plan focuses on a business idea, referred to as the "value proposition". This is explained in detail in Chapter 5 of this guide.

NOTE

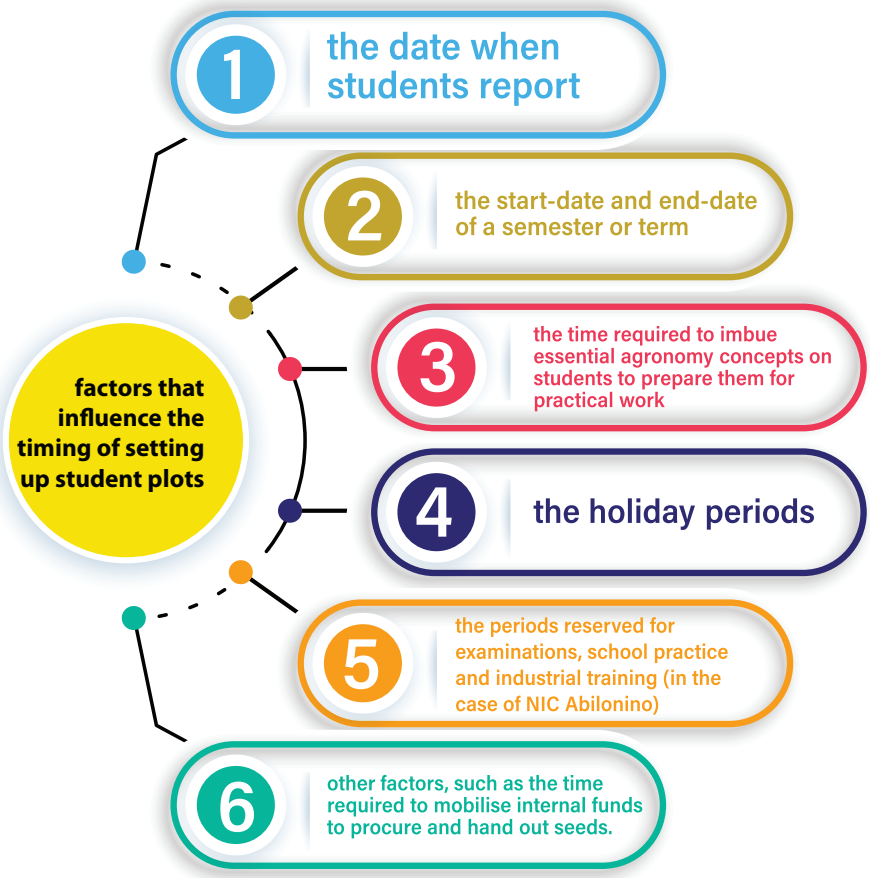
The college provides seeds to the agriculture students. Students do not have an unlimited choice of crops and need to select from the range of crops and crop varieties offered by the college. The college commits to offer a good range of seeds of different crops and crop varieties to the students.

2.4.3 Timing

Student plots for Year 1 students, who grow horticulture crops, are typically organised from September to December. Alternatively, the student plots for Year 1 students can also be organised from February to May. Eventually the decision on when to set up the student plots is taken by the college Agriculture

Department, after internal discussion between the agriculture lecturers and the farm manager, with consultation of the students.

There are factors that influence the timing of setting up student plots:



When student plots cannot be maintained by the Year 1 students for whatsoever reason, DEP students (in case of NTCs) and/ or farm attendants come in to take over the management of the plots.

Given the longer cycle of cereal crops, bi-annual crops (such as cassava) and perennial crops, the timing of the Year 2 student plots is different. It is up to the lecturers of the Agriculture Department to organise and plan the student plots for Year 2 students. It is obvious that in some cases (banana, cassava) the crop cycle is longer than the academic year, which may require the active involvement of farm attendants to grow the crop.

2.4.4 Use of irrigated student plots site by non-students

Since the duration of the cycle of most horticulture crops is limited to 3 – 4 months, several cycles can be set up within the same year, especially since water is available through irrigation. Therefore, the college is free to decide how the area of the student plots is used in periods when Year 1 students are not present in the college.

The college could, for example, decide to mobilize the farm attendants to grow horticulture crops for the benefit of the college, or allocate the plots for a certain period to students from other courses / departments or to individual lecturers or other college staff, or even to members of the community living in the immediate vicinity of the college. It is important that the conditions under which the plots are allocated are **transparent** and applied correctly.

2.5 Role of lecturers and farm manager in student plots

The role of lecturers, farm manager and farm attendants is to **supervise and guide** the students when they are working in the student plots.

The guidance can be **formally** organised, for example during a **practical lesson** taught by a lecturer in the student plots. During the lesson, the lecturer demonstrates certain principles or practices in the demonstration site (see Section 2.3), so that the students can replicate them in their individual plots. In order to better manage a large group of students, the lecturer can request the support of the farm manager (or a farm attendant) to assist in the demonstration.

Furthermore, since there is no specific provision for supervision of the students on the timetable, and since students require additional accompaniment beyond the duration of the practical lessons, the supervision and guidance of students should also be organised more **informally** (in addition to the formal method mentioned above). Both lecturers and the farm manager engage in informal guidance of students according to agreements made at the departmental level. A typical example of this informal method of guidance is the farm manager visiting the student plots each morning to encourage students tending to their crops (coaching) and – if necessary – provide specific technical guidance (mentoring).

The supervision and guidance of students by lecturers and the farm manager is a combination of coaching and mentoring:

01 Coaching

This is about helping the student achieve his/her goals and reach his/her full potential. The key element is that a coach helps the student in finding his/her own solutions rather than just telling the student what to do.

- The lecturer / farm manager helps the student to identify obstacles and potential solutions to problems encountered in the student plots.
- The lecturer / farm manager helps the student to weigh the various alternatives and select the best solution.
- The lecturer / farm manager helps the student become self-motivated.

02 Mentoring

This is about passing on skills, knowledge and experience from a senior or more experienced individual (the mentor) to a junior or trainee (the student).

- The lecturer / farm manager is a practitioner of horticulture him/herself and directly transfers specific knowledge and / or skills to the student.

Although both lecturer and farm manager can fulfil both roles of coach and mentor, traditionally the role of the lecturer during supervision and guidance of students in their plots is focusing more on coaching aspects, whereas the farm manager focuses more on mentoring aspects. The average time allocation for coaching and mentoring is 10 hours in a week. Saturday is for self-supervision.

Picture 3. Lecturer coaching a student.

2.6 Examples of how student plots are organised

Student plots at NTC Mubende

Student plots are areas earmarked for students to carry out practical work. These are organised because agriculture is a vocational subject and students need to get practical experience. Student plots are organised by the MASTA club (Mubende Agriculture Student Association) and supervised by all lecturers. Students are grouped, although each student works on an individual plot. This is on the one hand because the proportion of female students in the agriculture course is low and on the other hand because two categories of students are admitted; i) those from farm schools with a lot of practical experience, and ii) those from general secondary schools whose experience with practical agriculture is limited or non-existent. The irrigation site also serves as a demonstration area to acquire practical skills.

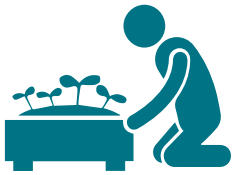
Students develop both soft and hard skills that are involved, starting from the raising of plants in the nursery bed up to the marketing of the harvested crop. In case surplus land remains after a plot has been allocated to each agriculture student, then the surplus plots are allocated to students from other courses.

Student plots at NTC Unyama

The student plots sit on 2 acres of land dedicated to horticultural crops. The land is fenced and equipped with a sprinkler irrigation system. It is supervised by the Head of Agriculture Department with the help of the lecturer in charge of crop production, farm manager and farm attendants. The students carry out production of selected vegetables on a plot measuring 9m by 9m. The college procures farm inputs such as seeds, fertilisers and pesticides.

The students take 70% of the proceeds from the sales and 30% goes to the college account to help in buying farm inputs, and to contribute to maintenance and repair of the irrigation system. Currently the student plot is used as a learning centre for the community in and outside the college.

Picture 4. Students at work in the student plots at NIC Abilonino.



Chapter Three:

Student plots and the NTC curriculum

3.1 Introduction

In the NTC Agriculture curriculum there are two ways to link the curriculum with the work on the student plots. Those are the **Paper V** practical project and the **course units** that are described in the curriculum of the Kyambogo University syllabus for NTCs. As already mentioned, student plots are a means to implement practical work for agriculture students. The Kyambogo University syllabus for NTCs gives the following additional information on practical work with three types of practicals:

01 Practicals done before, during or after a lecture aimed at fortifying the concept being learnt. These practicals are typically organised at the demonstration site, where the lecturer demonstrates a certain practice, which the students replicate in their own plots. The demonstration site is an area within the student plots designated for demonstration purposes by the lecturer and / or farm manager.

02 Timetabled routine laboratory or field practicals.

03 Practical projects designed and executed by the students for purposes of assessment.

Paper V is the most substantial practical project organised at NTCs.

According to the NTC syllabus, students should participate actively in all practical work and farm activities. Students are required to keep proper records of these practical projects. The records are eventually assessed alongside the project(s). Furthermore, students use the plots to practise simple scientific experimentation and written reports are emphasised.

In section 3.2, Paper V is explained further, including how this relates to the practical work of students on their plots, after which the use of student plots within the structure of the course units is explained in Section 3.3.

3.2 Student plots and Paper V

3.2.1 What is Paper V?

Paper V is a practical paper (a project) which is examinable by Kyambogo University as a requirement for the award of a Diploma in Secondary Education (DES). Students are given plots where they grow selected vegetable crops and write a report.

3.2.2 Introducing Paper V

The lecturers orient student teachers about the objectives of Paper V and its requirements, for instance in terms of tools, equipment, and materials required. Furthermore, the time frame of the project is explained. Special attention goes to the requirement for students to develop a business idea (see Annex 2 and 3 and Section 4.2).

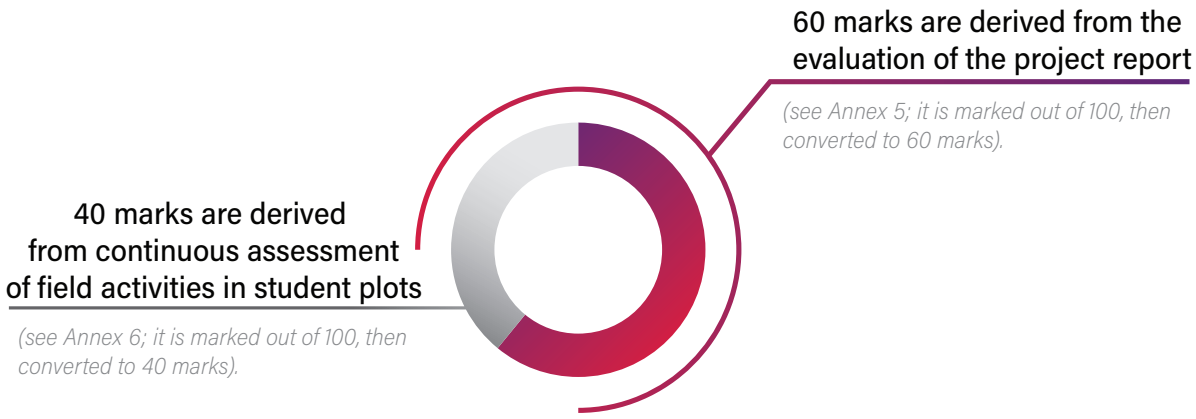
Students are grouped (although each student still works on an individual plot), share responsibilities and are provided with inputs (seeds, fertilisers, hoes, strings, etc.) based on their respective business ideas. Allocation of plots to student teachers is done under the guidance of lecturers, the farm manager, farm attendants and peer student teachers.

Prior to setting up student plots, the lecturer carries out normal theoretical aspects on the agronomic practices to be applied later by the student teachers in their plots.

3.2.3 The role of student plots in the assessment and evaluation of Paper V

At the end of the Paper V practical project, the learners write a report on all the activities done during the project (note that students are strongly encouraged to keep notes throughout their field activities to facilitate the writing of the final report). Annex 4 contains more specific information on report writing.

The Paper V practical project is marked out of 100 marks:



The continuous assessment is done by lecturers (especially the lecturer in charge of the supervision of the student plots), supported by the farm manager and peer student teachers, to whom parts of the assessment can be delegated if necessary or desirable.

The evaluation (marking of the report) is done by one specific lecturer (the Head of Agriculture Department consults with his fellow lecturers to decide on which lecturer marks the report). The marking of the report is moderated by the external examinator from Kyambogo University.

3.3 Student plots and course units

Student plots offer a rich learning environment that is not only used for the students' work on the Paper V practical project. It is also used in several course units. In this section, further explanation is given on the course units and the role played by student plots in the course units.

3.3.1 Course units with a substantial link to student plots

The following course units make substantial use of the student plots as part of the learning activities:

Course Code and Name	Year and term	Course units	Typical activities in STPL	Assessment method
AG 018 Farm Machinery and Equipment	Year I term I	1 1/2	Use of irrigation equipment, use of tillage tools and equipment, crop protection equipment	Students demonstrate their competence in handling the hand hoe, irrigation equipment, crop protection equipment. The lecturer uses a rubric to assess the competence level.
AG 0111 Horticulture	Year I term II	1	Projects on vegetable growing practices and management, identification of pests and diseases of the crops	Students demonstrate management practices for the crops grown in the student plot. Technical agronomic practices, e.g. Nursery bed preparation, seedbed preparation, planting, fertiliser application, pest and disease control, harvesting, etc.
AG 0112 Weed Science	Year I	1/2	Identification of weeds, selection and application of suitable weed control methods depending on the type of weeds	Students collect various types of weeds in a weed album.
AG 0114 Production Economics	Year I	1	Preparation of BMC Experiment the law of diminishing returns	Develop a business model for the student plot. Design and execute and experiment in the student plot to establish the law of diminishing returns (report is assessed).
AG 0116 Introduction to Soil Science	Year I	1/2	Physical examination of soil for structure and texture, presence of organic matter, soil profile	Students categorise soil texture using manual analysis (holding grains between the finger and thumb, coarseness of the grain, using teeth, etc.).
AG 0117 Soil Physics	Year I	1/2	Soil testing (texture and structure)	Water holding and retention capacity
AG 0118 Soil Chemistry	Year I	1/2	Soil testing (pH, organic matter content)	Testing the pH, confirmatory tests for plant nutrients available or lacking.
AG 0119 Soil and Water Engineering	Year I	2	Construction of ridges, construction of diversion channels	Soil and water conservation measures, for example mulching, absorbent bank etc.
AG 0120 Crop Production Practicals	Year I	2	Assessment of all activities	Technical agronomic practices, e.g. Nursery bed preparation, seedbed preparation, planting, fertiliser application, pest and disease control, harvesting etc.
AG 025 Farm Structure and Farm Planning	Year II	1	Participating in planning meetings, operation of the sprinkler irrigation	Identification of the components of the fence, farmhouses.

AG 027 Crop Pests	Year II	1	Scouting for pests, selection of suitable pesticides, measurement and mixing of pesticides, and application of pesticides	Pest identification and damages caused to the crops, mode of feeding and suggestion of the control measures
AG 028 Crop Diseases	Year II	1	Scouting for diseases, selection of suitable chemicals, measurement and mixing of chemicals	Identification of signs and symptoms of the diseases and suggestion of the control measures
AG 0213 Farm Management	Year II term II	1 1/2	Record keeping (production records)	Drawing the farm lay out, keeping records of the activities.
AG 0217 Soil Fertility and Plant Nutrition	Year II	1 1/2	Mulching, preparation of manure, e.g., compost, farmyard manure, fertiliser application	Soil testing for pH, nutrient content

NOTE

Practical activities of course units organised in Year 2 are already practically illustrated to Year 1 students on the demonstration site, so that they can replicate them in their student plots; whereas the theoretical learning is done in Year 2. The above table (especially in the column "Typical activities") clearly illustrates that there are several course units for Year 2 students that have links to the student plots. These activities for Year 2 students are assessed in the student plots.

NOTE

Year 2 students set up student plots outside the irrigated site, focusing on cereal crops, bi-annual crops and perennial crops, whereas Year 1 students focus on vegetables.

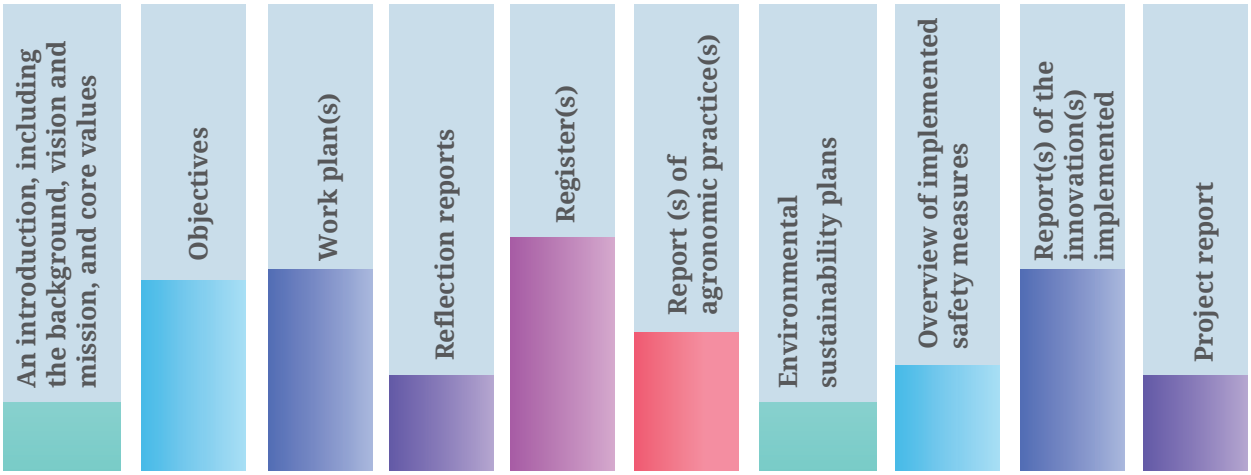
3.3.2 The role of student plots in the assessment and evaluation of course units

In awarding the marks for course work, student plots should play an essential role, as they are a major instrument for the promotion of teaching agriculture practically. Continuous assessment tools (such as assessment rubrics) are to be developed and used to mark course work in the student plots. These assessment rubrics can be very similar (or even the same) as the assessment rubrics developed for assessment of the practical work of the Paper V practical project. It is up to the lecturer teaching the course unit in question to identify and select (or develop, in case the rubric does not exist yet) the relevant assessment rubric in line with the content of the course unit. An example of a rubric has been added in Annex 7.

3.4 Use of a portfolio

Students work in their student plots, where they have to plan, make records, reports, etc. The documentation of the work is well suited to be organised in a portfolio and could demonstrate learning and growth over an extended period of time. The portfolio is a transcendent tool not limited to a specific course unit. It stimulates student teachers taking more ownership and responsibility over the learning process.

The contribution of the portfolio assessment for each relevant course unit needs to be defined by the lecturers of each course unit that has activities within the student plot. The components could include:



An example of how such a portfolio could look like, can be found in Annex 8.

3.5. Competences acquired from the student plots

The aim is to enable the student acquire:

Technical skills

in the various aspects of crop production. Some of the skills are displayed as follows (Note: the list is suggestive, not exhaustive).

Nursery practices:
choosing a suitable nursery site; preparing a nursery bed; planting seeds; care of nursery seedlings; transplanting and care of seedlings in the field, etc

Soil analysis and conservation:
soil sampling; examining the soil profile; crop nutrient deficiency symptoms; making compost and farmyard manure; other methods of protecting soil from erosion.

Land preparation:
laying out contours; marking out fields; making bench terrace; fertiliser identification and application, etc.

Crop protection:
identification of pest and disease damage; deciding on the appropriate control of pests and diseases; handling agricultural chemicals; mixing and applying chemicals to crops; calculating chemical application rates; identification of weeds; control of weeds; herbicides and their use, etc.

Harvesting, storage and packaging and record keeping;
identifying crop maturity, applying harvesting techniques, applying correct storage techniques, applying proper packaging of the product.

Picture 5. Protecting seedlings after transplanting.

Entrepreneurial competences

Having analytical capacity and capability to identify market opportunities:
Recognising and detecting market needs, comparing crops and their market potential.

Being creative:
Developing an innovative business idea that responds to an existing market need.

Daring to take informed risk:
Ability to cope with uncertainty and risk, showing audacity, having the willingness and readiness to act.

Having a sense of initiative:
Taking action, anticipating potential challenges.

Being financially literate and numerate and managing your farm:
keeping records, estimating expected production costs and expected incomes, predicting profit, comparing expected profit with real profit and interpreting.

Being able to plan:
Prioritising, preparing and budgeting activities for implementation.

Personal skills:
learning from mistakes, determination, discipline, dedication, self-awareness, confidence (to counter low self-esteem), punctuality.

Life Skills

Problem-solving:	identifying and analysing the problem, exploring problem-solving options, selecting best strategies, planning, implementing and evaluating.
Critical thinking:	being sceptical, asking for proof, doing fact-checks, evaluating cause and effect, formulating and evaluating hypotheses.
Collaboration	participating and interacting with group members, showing flexibility and empathy, listening and responding to others, sharing insights, recognising others, allocating work, planning.

Teaching skills

Preparing a practical lesson: collection of relevant didactic materials, dividing learners in groups, identifying tasks for different groups, preparing the terrain, etc.

Implementing a practical lesson: short recapitulation of theory, demonstration of practices to be taught, supervising learners during practical work, etc.

Assessing a practical lesson: assessing individually or in a group, setting assessment criteria, etc.

Chapter Four:
Preparations for the practical work at the student plot

4.1 Introduction

Prior to establishing student plots, the students prepare a simplified business plan for a crop enterprise of their choice. The enterprises are selected by the students, but they may be guided by the lecturers and farm manager, partly because the college may not have seeds for any crop, thereby limiting the choice of the student.

4.2 A simplified business plan

In business planning, a brief template inspired by the business model canvas is used and it comprises the following components (see Annex 2):

THE VALUE PROPOSITION:

This is a description of the product (or products) and services to be produced by the student, including a description of:

- ☑ the market need that is being addressed,
- ☑ the selected crop(s) and variety(ies),
- ☑ the competition (other producers),
- ☑ the uniqueness of the proposed product and / or services.

THE PRODUCTION:

- ☑ Key activities: list of activities to be carried out to grow and market the crop(s).
- ☑ Key resources: list of resources (intellectual, material and financial) required to grow the crop(s).
- ☑ Key partners: list and short description of essential stakeholders with whom the student will interact with to acquire resources required to grow and market the crop(s).

THE SALES:

- ☑ Customer categories and profile: who are your customers and why?
- ☑ Marketing strategy: how will you attract customers?
- ☑ Sales mechanism: how will you organise sales? Direct sales at the farm? Through an intermediary? Other solution?
- ☑ Will you accept credit or only cash?

COSTS:

- ☑ Fixed costs: these are costs that do not depend on the volume of production. List and quantify the fixed costs of production (salaries, utilities, depreciation, rent, publicity, etc.).
- ☑ Variable costs: these are costs that depend on the volume of production. List and quantify the variable costs (cost of agricultural inputs such as seeds, fertilisers, pesticides, hired labour, consumables such as fuel, etc.).

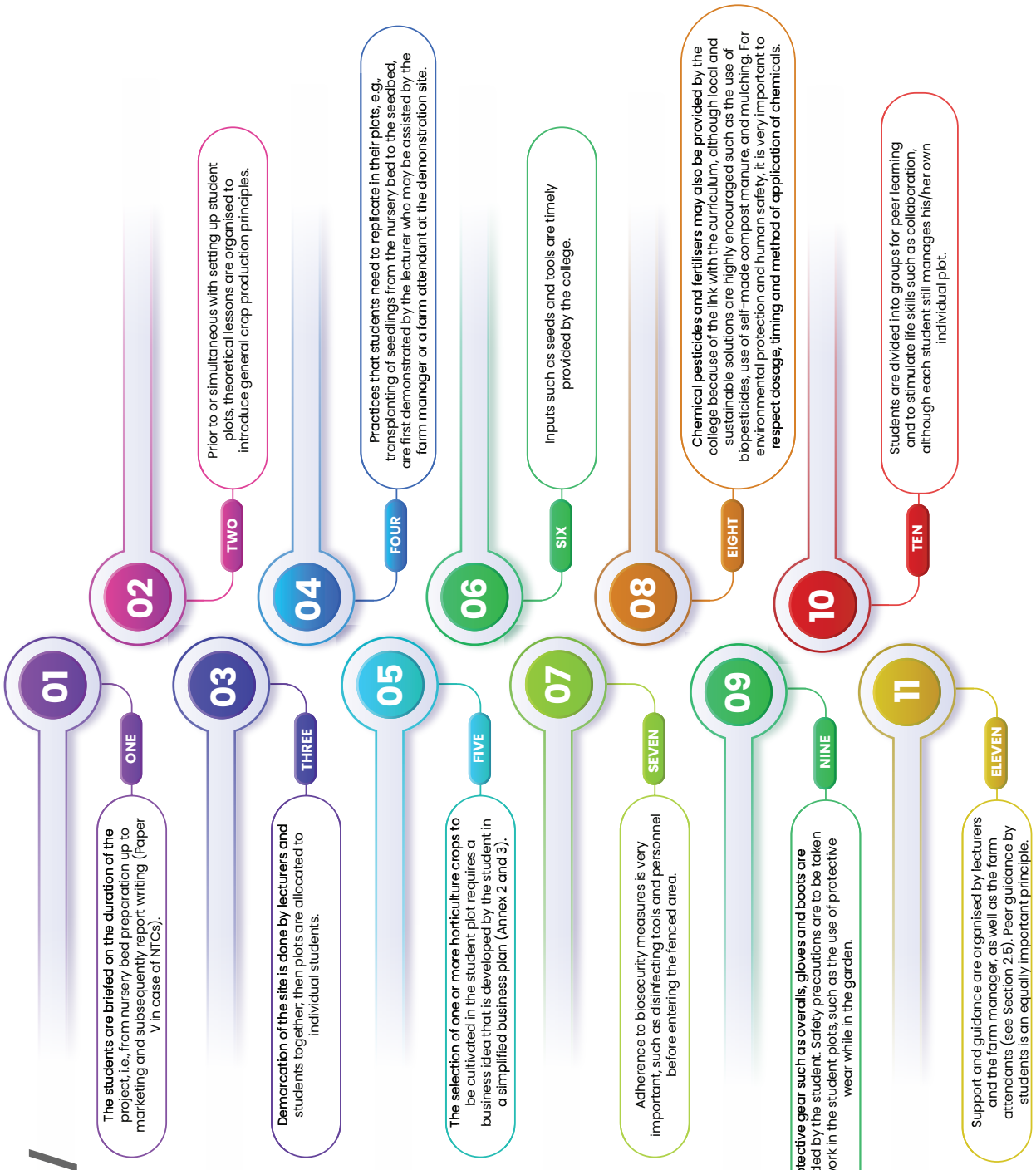
REVENUES:

- ☑ Expected sales volume: quantify the expected sales volume. This depends on the total acreage of the crop, as well as the spacing distance. Take into account losses due to pests and diseases, theft, post-harvest losses, etc.
- ☑ Selling price and break-even point: calculate the selling price of your product based on the cost of production, adding a profit margin. Also calculate the break-even point.
- ☑ Expected revenue and profit: calculate the total expected revenues and compare it with the total expected costs. Calculate the expected profit.

The template of a business plan is in Annex 2 and a hypothetical example is in Annex 3.

4.3 Introduction of the student plot principle to students

Before students set up their student plots, they receive the following information and guidelines:



4.4 Safety and tools

The following table summarises the tools and gear to use for field work in the student plots.

Gear	Safety and production precaution gadgets: waterproof overalls, waterproof hand gloves, eye masks, plastic nose and mouth masks, gumboots, dust masks.
Tools	Garden tools and equipment such as hoes, pangas, garden forks, knapsack sprayer, rakes, watering cans, strings, dibbers, slashers, tape measures, spade, wheelbarrows and many others.
What to buy and where?	The necessary inputs such as planting material, fertilisers, pesticides, fungicides, bactericides, gear and tools can be purchased from agro-input shops after following the proper procurement procedures.
What to wear?	All students are expected to observe health and safety precaution measures by putting on the personal protective equipment which are the safety precaution gadgets and production precaution gadgets.

4.5 Record keeping

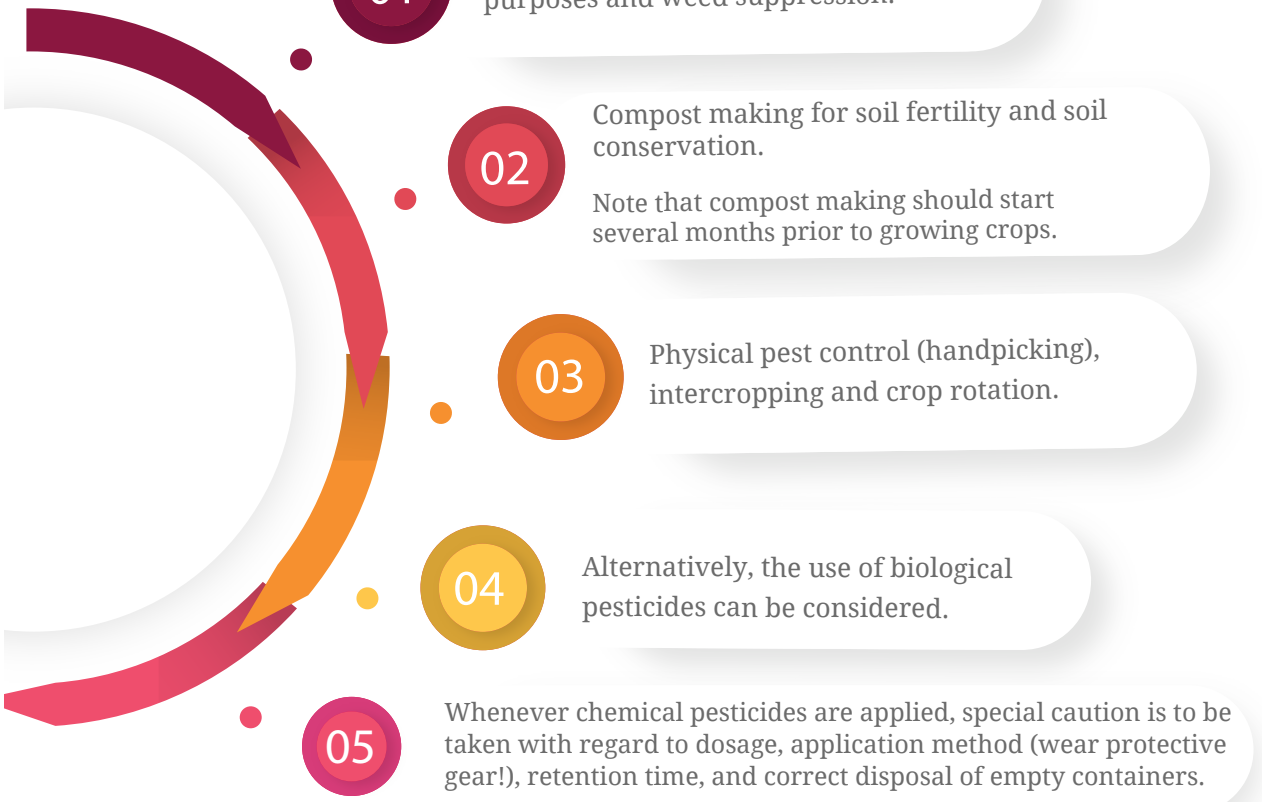
Students are taught how to keep crop production records. A template is shown in Annex 9, with a hypothetical example in Annex 10.

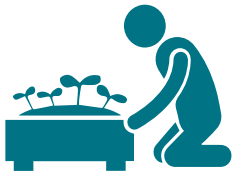
During and after the production cycle, students compare the business plan provisions to the actual outcome records. Deviations are identified and explained.

Picture 6. Essential production records are kept safe inside a plastic bottle.

4.6 Environmental sustainability

Lecturers, farm managers and farm attendants are highly encouraged to promote environmentally sustainable production methods. Therefore, the following practices are highly encouraged (Note: the list is suggestive, not exhaustive):





Annexes

Annex 1: An example of a crop sheet

Crop				
CABBAGE *(Brassica oleracea)*	ONION *(Allium cepa)*	GREEN PEPPER *(Capsicum annuum)*	EGGPLANT *(Solanum malongena)*	CARROTS *(Daucus carota)*
1. Varieties				
Gloria, Baraca, Fanaka F1, Drum head, etc.	The common Onion varieties grown in Uganda include; Malbec, Red coach, Nofeka F1, Red Creole, Red Queen F1, Red Sanga F1, Red Sart F1. Tropicana F1, Jambar F1, Red passion F1, and Bombay red and Red pinoy F1.	The common varieties on the market include: Ace, Banana supreme, Bell boy, Sweet red cherry, Lilac Bell, and California wonder.	Black beauty, Long purple, Green gold Select varieties that are high yielding, resistant to insect pests and diseases, non-seasonal, adapted to local climatic conditions and acceptable to the consumers, to gain optimum yield and profit.	• Nantes carrots (orange roots), • Chantenay carrots (dark orange roots), • Miniature carrots, • Imperator carrots, • Danvers carrots
2. Crop season				
Throughout the year (with irrigation). Without irrigation, the season depends on the exact location within Uganda.	• Mid-March to mid-April, and • September to early October (depending on the location). Harvesting should occur during the dry season. Prepare your nursery beds according to the dry season of the planting area; prepare your nursery beds 4 months before planned harvesting date. The crop cycle varies from 80 to 150 days, depending on the variety.	• First season: mid-March to June, and • Second season: starting in August / September	June is the best but can grow all year around depending on the climatic conditions.	• The first season starts in April. • The second season starts in August.

3. Method of propagation (cabbage, onion, green pepper, eggplant, carrots).				
By seeds from which seedlings are raised in the nursery bed and seed box/block.	By seeds; seedlings are raised in the nursery bed and transplanted to the seed bed. How to sow onion seeds in the nursery bed: • Make drills of about 5 cm deep in lines of 25 to 30 cm apart. • Spread the seeds in the drills and cover with fine soil. • Mulch. • Water frequently in the morning and evening. • Remove the mulch after germination and construct the shade at the same time.	By seeds: seeds are first sown in the nursery bed and later transplanted. The seeds germinate within 10 - to 12 days depending on the variety and how the moisture content has been maintained.	By seeds: seedlings are raised first in the nursery bed or box; tray method. Sterilisation of the nursery bed: spread mulch about 3 to 5 cm thick on top of the seedbeds and burn slowly. Do not sow seeds immediately after sterilisation. Seed rate: 200 grams per acre. Spread the seeds evenly in the furrows/ drills made and lightly cover with fine soil.	Carrots are propagated by seeds.
4. Land preparation (cabbage, onion, green pepper, eggplant, carrots).				
• Primary and secondary cultivation to a depth of 30 cm. • Fine tillage.	Preparing the planting site: • Carry out deep cultivation up to 30 cm using a hand hoe, oxen or tractor. • Add manure or compost to the soil during land preparation.	The land should be ploughed to a fine till. Loosen the soil by digging down 30 cm deep. This should be done a week in advance before transplanting. Apply manure into the soil to help provide the necessary nutrients for growth.	Prepare the field as early as possible to give enough time for the weeds and stubbles of previous crops to decompose. Plow 2 to 3 times alternately at one week interval at a depth of about 10 cm.	• Primary and secondary land preparation. • Deep cultivation (30 cm). • Incorporation of manure during secondary land preparation. • Seed beds are raised (ridges) to 10 cm height (width: 1 – 1.2 meter; length: any).
5. Growth requirements (cabbage, onion, green pepper, eggplant, carrots).				
	• Onions grow best in loose, well drained sandy loam and grow well in raised beds of least 10 cm high. • Well drained fertile soil, sandy and clay loam is preferred because of less risk of bulb disease, pH 6.5 - 7.0	• Well drained fertile soil • pH: 5.5 – 6.5	Eggplant thrives best in sandy loam and clay loam soil.	• Light: › Carrots need a location that receives full sunlight. • Soil: › well drained and heavily fertilised soil with compost › pH: 5.5 – 6.5 › They require very fine soil without any large stones or obstacles. The soil should be light/ loose and sandy (or loamy) if possible and not recently manured, so that carrot roots can easily push down through the soil.

6. Transplanting and spacing (cabbage, onion, green pepper, eggplant, carrots).				Direct planting
• Select healthy seedlings at the stage of 3-4 true leaves (about 15 cm high). Usually this is at the age of 3 to 4 weeks. • Transplanting is done in the early morning or late afternoon; provide shade on sunny days. • Most varieties are spaced 60 cm x 60 cm.	How to transplant onion seedlings to the seedbed: • Select the healthy seedlings and remove them carefully from the nursery bed or container. • Transplanting takes place 28 – 50 days after seed sowing, depending on the variety. • Place the onion seedling upright in the hole 2 – 3 cm deep, push back the soil and firm it gently. • Spacing distance: 30 cm x 10 cm (133,000 plants/acre), alternatively 30 cm x 15 cm can be applied (depending on the variety). Varieties such as Malbec and Red Coach have smaller spacing (e.g. 10 cm x 10 cm or 10 cm x 15 cm) in Sebei region and Western region.	The seedlings take 6 weeks in the nursery bed because seedlings have a relatively low growth rate. Hardening off should be done a week before transplanting. The process helps seedlings adjust so that they will experience less stress when you transplant them to the seedbed. Transplanting should be done early in the morning or late in the evening. Mix compost or other organic matter into the soil when planting. Spacing depends on the variety. The ideal spacing is 60cm x 40cm.	One week before transplanting, harden the seedlings by gradually exposing them to sunlight, and withholding water. However, make sure that the seedlings do not wilt severely. Gradually reduce the amount of water and frequency of watering to enhance hardening of seedlings. Hardening is done to prepare the seedlings to field conditions. Eggplant is ready for transplanting 4 to 6 weeks after sowing. Transplant only one seedling per hole/ per hill. Transplant during cloudy days or late in the afternoon to avoid transplanting shock. Apply 75cm x 60 cm spacing (this can vary according to the variety).	• Seed rate: 2.5 kg per acre. • Seeds are directly planted in the garden rather than transplanting. • The seed bed is cleared from weed seeds present to avoid their germination • Hoe or rake out the young weeds before you plant your carrot seeds. • Carrot seeds are very small and difficult to sow, so mix your carrot seed with sand at a ratio of 100 to 1, that is about a quarter teaspoon of carrot seed to a quarter cup of sand. • Sow your carrot seeds in shallow drills about 2cm deep. • Spacing for carrot: 30 cm x 5 cm. Thinning: • The best time to do this is in the evening. • Thinning carrots is carried out when seedlings are an inch tall. • Gently pull up any excess carrot seedlings to leave spacing of 5 cm between plants. • Remove any weed seedlings which may have come up.

7. Weed management (cabbage, onion, green pepper, eggplant, carrots).				
• Mulching. • Use of hand hoe and hand pulling. • Crop rotation.	Onion beds require more weeding than other vegetable beds. Because onions leaves are thin and strappy, they do not block the sun from the soil which, in turn, allows weed germination. Weed using a small hand hoe so that the onions do not have to compete for nutrients or resources.	Regular weeding is necessary to avoid competition and care should be taken not to damage the roots. Weed at an interval of at least 2 weeks to avoid competition with weeds. Mulch the field by spreading the mulch around plants while leaving a gap of 10 cm away from the plants. It is also one way of minimising competition with weed growth.	Cover the entire garden with suitable mulching material preferably using dry grass up to 3 to 5 cm thick.	• Keep carrots weed free for best results. Carrots are bad competitors with weeds so ensure a weed free environment as much as possible. • Pick any weeds by hand between the rows. • The second weeding should take place when the seedlings reach roughly 3 – 4" in height. • The third weeding should be done when the seedlings are 5 – 6" in height. • To minimise labour and maximise results, weeding and cultivating the carrot plant should take place several times at least 3, or preferably 4 times during the growing season. • Mulch carrots entirely to retain moisture, to speed up germination, and to block the sun from hitting the roots directly.
8. Irrigation/ watering (cabbage, onion, green pepper, eggplant, carrots).				
Irrigate in early morning and late afternoon in the dry spell.	Irrigate moderately and timely at the growing stage and at the bulbing stage.	Watering is done immediately after transplanting and during dry spell.	Try not to over-water eggplants because it can cause fungus and disease and frequent watering promotes shallow roots.	If the weather is dry, keep your carrots watered.
9. Fertiliser application (cabbage, onion, green pepper, eggplant, carrots).				
• There is need to do soil analysis first. • Organic fertiliser (mulching) and inorganic fertiliser like DAP (at transplanting). • NPK and urea may be required at the leafy stage if the soil is very poor.	• DAP during transplanting at rate of 80kg /acre • 1st top-dressing: 30 days after transplanting at 40 kg/acre of CAN • 2nd top-dressing: 45 days after transplanting at 80 kg/acre of CAN	Fertiliser application should be done if the soil analysis indicates there is need. However, over-fertilisation – which may result in too large fruits to meet market demand – should be avoided.	NPK during planting and at a time when the crop is flowering so that they can become healthy, strong and develop vigorous leaves. The quantity and kind of fertiliser to be applied depends on the soil fertility and on the previous crops grown in the plot.	Fertilise carrots with low-nitrogen but high-potassium and phosphate fertilisers 5 to 6 weeks after sowing. Note that excess nitrogen in the soil promotes top, or foliage growth – not roots.

10. Pest and disease control (cabbage, onion, green pepper, eggplant, carrots).

- Scout to identify pests (caterpillars, aphids, cabbage webworm, diamond back moth, mole cricket, snails and rodents) and diseases (Downy Mildew, Club root, Alternaria leaf spot, bottom rot, black rot, black leg, bacterial soft rot, bacterial leaf spot)
- Control measures against pests:
  - Do handpicking
  - Use appropriate chemicals
  - Practise crop rotation
  - Practise crop sanitation
- Control measures against diseases:
  - Use appropriate chemicals
  - Use resistant varieties
  - Practise crop sanitation
  - Practise crop rotation

- Common pests:

  Onion thrips

  Control:
- Keep plants well irrigated since water stressed plants are more susceptible to thrips damage
- Maintain weed-free plots
- Rogue heavily infested plants
- Neem extracts can be sprayed on attacked plants
- Spray with insecticide

  Onion fly

  Control:
- Practise crop rotation
- Use well decomposed manure/compost
- Practise field sanitation: remove and destroy infested plants
- Carefully plough in crop residues immediately after harvest

  Nematodes

  Control:
- Rogueing of infected plants
- Crop rotation
- Apply nematicides

  Stem and bulb eelworms

  Control:
- Remove infested plants
- Use repellents, such as specific plants (smell)

Common diseases:

- Onion Downey Mildew
- Purple Blotch
- Rust
- Pink Root
- Neck rot
- Onion smut
- Leaf blight (blast)
- Bacterial soft rot

Common pests:

- Thrips: causes upward curling of leaves
- Mites: larvae and adults feed on leaves and buds and cause downward curling of leaves
- Whiteflies: suck the sap and release honeydew which turns to dark sooty substance preventing photosynthesis from taking place
- General control measures against pests:
  - Field hygiene
  - Use of sticky cards (yellow one to control whitefly and blue to control thrips)
  - Spray the plants with a fungicide and pesticide to keep off pests such as whiteflies, mites, aphids, pepper weevil, leaf miners, nematodes and thrips.
  - Practise crop rotation to control pests such as mites which are serious in hot, dry conditions.

Common diseases: fungal diseases

- Common pests:
  - Eggplants can be attacked by cutworms, aphids, flea beetles, Colorado potato bugs, spider mites, and tomato hornworms.
- Control measures:
  - Keep the garden clean of debris.
  - Crop rotation
  - Spray the infestation with insecticide.
- Common diseases:
  - Eggplant is susceptible to fungal and bacterial diseases.
- Control measures:
  - Planting disease- resistant varieties when possible is recommended.
  - Keep the garden clean of debris.
  - Diseased plants should be removed immediately before the disease spreads to healthy plants.
  - Protect the plants against soil-borne diseases by rotating crops.
  - Do not plant eggplant family members including tomatoes, potatoes, and peppers in the same spot two seasons in a row.

- Common pests:
  - Black canker (Itersonilia)
  - Carrot rust flies
  - Flea beetles
  - Wireworms
  - Root-knot nematodes
- Control measures (against nematodes):
  - Sterilise the soil either by heating it or by applying nematicides (methyl bromite).
  - Practise crop rotation.
  - NB: do not plant carrots in a field previously planted with Irish potatoes or tomatoes.
- Common diseases:
  - Aster Yellow Disease: will cause shortened and discoloured carrot tops and hairy roots.
  - Carrot blight (fungal disease): causes small brown / black spots with yellow edges appearing on the leaf margins and eventually the whole plant turns brown.
- Control measure: spray with fungicide such as peronox or diathene M45

	• General control measures against (fungal) diseases;
	  ➢ Crop rotation
	  ➢ Field hygiene
	  ➢ Use of tolerant varieties e.g. Red Pinoy F1
	  ➢ Use of fungicides to treat fungal diseases; e.g. Mancozeb (Cadilac®, Dithane M45® etc.)			

11. Yield and harvesting (cabbage, onion, green pepper, eggplant, carrots).				
After 7 to 8 weeks after trans-planting when the heads are fully hard. Bend and cut slightly above the outer (wrapped) leaves using a sharp knife. Yield: 4 to 5 tons/acre with good management.	Onions can take 80 to 150 days to reach maturity depending on how they are planted; • Seeds (takes 5 months, depending on variety and management). • Sets (takes 2 months) • Transplanting of seedlings (takes 2 months to reach maturity). Harvest mature onions in dry conditions. Onions harvested when wet do not cure well and may rot in storage. The yield depends on many factors such as management and variety. Onions can yield from 16 to 25 tons per acre. For Malbec and Red Coach varieties the harvest varies from 7 - 10 tons per acre (after 85 days).	Time of maturation: 60 to 90 days from transplanting. Harvest peppers that have just begun to change the colour (green to purple stage) using a knife to cut them from the stem while leaving a portion on the stem still attached. Pulling them off with the hand can damage the plant. Up to 5000-6000 kg per acre can be harvested.	• Time of maturity: 70-80 days from transplanting. • Yield: 16 to 32 tonnes per acre. • Harvest fruits that are still tender and young. • Harvest early in the morning. • Cut eggplants from the stem with a sharp knife. Leave a short stub of stem attached to the fruit. • Harvesting is usually done two times a week.	• Maturity is reached after 100 - 120 days (2.5 – 3 months). • Harvest carrots all at once if you wish. • Harvest whenever desired maturity or size is reached. Carrots should be about as wide as your thumb. • Just grab the tops and pull gently. • A garden fork or trowel can be used to loosen the soil around the carrots if required. • Yield potential: up to 16,000 kg per acre.
12. Storage (cabbage, onion, green pepper, eggplant, carrots).				
	How to store onions: • Let the onions cure on dry ground for a few days and then hang them in a cool, dry, well-ventilated area. • Do not store in a refrigerator as conditions will be too damp.		Protect the fruits from the sun, rain, and mechanical damage. Harvest all fruits from the plants to prolong the fruiting period of the crop.	

Annex 2: Simplified business plan template

Value proposition: unique value of your enterprise	
Market demand	Conduct a market survey and describe the market demand for your product (or service). Estimate the number of customers and the price range they are willing to pay for the product plus the quality, type and quantity of the product required by the customers.
Crop(s) and variety(ies)	Based on the market research, name the crop(s) you will cultivate, as well as the variety(ies).
Competitors	Describe who are your competitors for the product (or service) that you are offering to the market. Identify at least five competitors, by name, location, price, quality, quantity and type of product.
Uniqueness	Using the findings of your market research, explain which unique value your enterprise will deliver. Why will customers prefer your product above that of the competition?
Production	
Key activities	Identify and describe the key activities to carry out in your enterprise. Avoid lengthy answers.
Key resources	Identify and describe the key resources required for your enterprise to deliver the unique value of your enterprise (e.g. financial, technical, material, and human resources, and time).
Key partners	Identify and describe the key partners that you need to interact with to deliver the unique value of your enterprise.
Sales	
Customer categories and profile	List and describe the different categories of your customers and their preferences in terms of payment, quantity, qualities, varieties, frequency, etcetera.
Marketing strategy	Describe how you will attract your customers (e.g. packaging, advertising, promotions/discounts, customer care, etc.).
Sales mechanism	Describe how you will sell your product (e.g. at the gate, through middlemen/ brokers, market, etc.) and how you will be paid (e.g. cash payment, on credit, etc.).

Production costs	
Fixed costs	Identify and quantify the fixed costs related to production (e.g. salaries, rent, reimbursement of loans, advertising, depreciation, cost of utilities such as water and electricity.).
Variable costs	Identify and quantify the variable costs related to production (e.g. inputs – seeds, fertiliser, pesticides, etc.; consumables – fuel, etc.).
Selling price, break-even point and profit	
Expected quantities to be sold	Calculate the expected quantity of each crop to be sold. Take into account estimated percentage production losses (e.g. pests, diseases) and other losses (e.g. storage, transportation).
Selling price and break-even point	Calculate the selling price per unit, considering the production cost and other costs per unit, while adding a margin for profit. Also consider the unit prices of your competitors and the market price. Calculate the break-even point.
Expected revenue and profit	Calculate the total expected revenue and compare it to the total expected costs to predict the expected profit.

Annex 3: Example of a filled-out simplified business plan template

'Cabbage express Ltd'

<table>
<tr><th colspan="2">Value proposition: Unique value of your enterprise</th></tr>
<tr><td>Market demand</td><td>To establish the market demand for cabbage, I used observation and interview methods. The research demonstrated there is a vast demand for cabbages as illustrated by the following findings. There is a bigger demand for white cabbages but there is an unmet demand for red cabbages as well.
<table>
<tr><th>Customers identified</th><th>Quantity</th><th>Current purchase price</th></tr>
<tr><td>Pauline Hotel</td><td>10 cabbages per week</td><td>500 shs per unit for a white cabbage
1000 shs for red cabbage</td></tr>
<tr><td>Lira Hotel</td><td>15 cabbages per week</td><td>500 shs</td></tr>
<tr><td>Lira City Main Market</td><td>Around 30 sellers purchase and resell cabbage, average of 5 per day</td><td>450 shs per head</td></tr>
<tr><td>Lira University</td><td>Student and staff restaurant purchases around 10 cabbages per week</td><td>400 shs</td></tr>
<tr><td>Roadside vendors</td><td>Around 50 sellers purchase and resell cabbage, average of 5 per day</td><td>Between 400-450 shs</td></tr>
<tr><td>Abilolino Trinity S.S.</td><td>Once a week, 3 cabbages</td><td>400 shs</td></tr>
</table></td></tr>
<tr><td>Crop(s) and variety(ies)</td><td>Based on the market research, I have opted to grow predominantly white cabbages (Baraka F1, Gloria); these can grow up to a big size and are rich in flavour. I will also dedicate a portion of the garden to growing red cabbages to supply hotels.</td></tr>
<tr><td>Competitors</td><td>Through snowball sampling I identified three major suppliers of cabbages in Lira City.
1. Mr John grows 3 acres of cabbages and has supply contracts with a number of schools. He grows white cabbages. The sale price ranges from 350-1000 shillings depending on the quantity bought.
2. Madam Josephine grows 10 acres of cabbages and supplies to the market vendors. She grows Baraka F1.
3. Madam Zula grows five different varieties of cabbages on 3 acres; she sells directly in the market; customers have mentioned her cabbages are excellent.</td></tr>
<tr><td>Uniqueness</td><td>Cabbage Express Limited will be unique in two ways. First, our cabbage products are unique. We shall provide white cabbages of varying size, red cabbage, cut cabbage and ready-made coleslaw. Secondly, we deliver on-demand (express service); when someone needs cabbage urgently, we shall deliver it within 60 minutes. To ensure our cabbages are 'ever-ready' I will plant the cabbages at different intervals.</td></tr>
</table>

<table>
<tr><th colspan="2">Production</th></tr>
<tr><td>Key activities</td><td>• Land preparation: soil testing, tillage, harrowing, levelling.
• Crop growing and management: organic pest control, weeding, irrigation.
• Marketing: logo design, record radio jingle, visits, church and community meetings to spread the word.
• Record keeping: expense tracking, crop development tracking, pest and disease tracking.
• Relationships: broker relationship with cyclists to act as express delivery agents.
• Harvesting.
• Post-harvest handling: cleaning, storing, coleslaw fabrication.</td></tr>
<tr><td>Key resources</td><td>Human resource
• Daily management practices in the garden.
• Express delivery agents.
• Marketing support.
Financial resources
• Cash to purchase seeds.
• Cash to purchase ingredients for organic pest control (chili, garlic).
Material resources
• Waste material to create organic fertiliser (compost).
• Farm tools (panga, hoe).
Time
• 3 months till first harvest.</td></tr>
<tr><td>Key partners</td><td>Mama Jonah, seed dealer.
Lira District Extension worker.
Juliet, cousin to provide a loan for seeds.
Procurement and administrative staff of hotels, schools and universities.
Boda-boda and bicycle riders for express delivery.
Market Vendor Association.</td></tr>
<tr><td colspan="2">Sales</td></tr>
<tr><td>Customer categories and profile</td><td>
<table>
<tr><th>Customers identified</th><th>Preferences</th></tr>
<tr><td>Pauline Hotel</td><td>The hotel has been buying white cabbage but is also looking for red cabbage. The hotel cares about consistency in quality and size.</td></tr>
<tr><td>Lira Hotel</td><td>White and green cabbage; the cabbage should be big in size and rich in flavour.</td></tr>
<tr><td>Lira City Main Market</td><td>Variety of size to cater for different customers.</td></tr>
<tr><td>Lira University</td><td>Simple white cabbage; the administration cares mostly about the cost and promptness in delivery.</td></tr>
<tr><td>Roadside vendors</td><td>White cabbage; variety of size to cater for different customers. The vendors look for lower prices and attractive looking cabbages.</td></tr>
<tr><td>Abilolino Trinity S.S.</td><td>Simple white cabbage, low cost and flexibility in ordering one week but not the other depending on the school budget.?</td></tr>
</table>
</td></tr>
</table>

Marketing strategy	The express delivery will be advertised through word of mouth, starting from church and community gatherings. There will be a promotion – if we delay on the express delivery, you will receive a 50% discount on your next order. I will work with boda-boda and bicycle riders who will receive transport bonus for any express delivery they make so that they are motivated to search for customers. The packaging will be clean and unique, I will ensure each cabbage is clean and the 'mega cabbages' of a big size will be delivered with a ribbon around them.
Sales mechanism	The customers can call for an express delivery; this will be delivered within 60 minutes by a boda-boda or bicycle rider. Contracts will be formulated for long-term customers such as hotels; the cabbages will be delivered to the hotels. Payment will be in cash or by mobile money.

Production costs

Fixed costs

No	Item	Unit	Unit cost [UGX]	Quantity	Amount [UGX]
1	Advertisement (local radio)	Radio spot	50,000	3	150,000
2	Depreciation (tools & equipment)	Value of tools	100,000	50% (i.e. life expectancy of 2 years)	50,000
3	Depreciation (irrigation system)	Value of irrigation system	50,000,000	5% (i.e. life expectancy of 20 years)	2,500,000
4	Own salary	Month	200,000	4	800,000
TOTAL fixed costs					3,400,000

Variable costs

No	Item	Unit	Unit cost [UGX]	Quantity	Amount [UGX]
1	Seeds	Tin	80,000	2	160,000
2	Pesticides	Litres	50,000	9	450,000
3	Fertilizers	Kg	5,500	100	550,000
4	Hired labour	Hour	12,000	50	600,000
5	Transport	Km	50,000	4	200,000
TOTAL variable costs					1,960,000

TOTAL cost of production = Total fixed costs + total variable costs = 3,400,000 + 1,960,000 = 5,360,000 UGX

Selling price, break-even point and profit

Expected quantities to be sold	The total plants for sale = total plants produced in an acre – 10% of total plants lost to pests, thieves, diseases, etc. = 14,815 – (10/100 * 14,815) = 13,334 heads of cabbage to be sold.

Selling price and break-even point	Selling price = cost of production per unit + profit margin Step 1: determine the cost of production per unit. • Total production cost = 5,360,000 UGX • Total units produced that are marketable = 13,334 UGX • Cost of production per unit = 5,360,000 / 13,334 = 402 UGX. In other words, it costs 402 UGX to produce a head of cabbage. Step 2: determine the profit margin. • The selling price should not only cover the cost of production, but also add a profit margin. • This margin covers the risk of the entrepreneur and the need for profit. • Generally, the margin is set between 10% and 25% of the production cost; this depends on how severe competition with other producers is. • Let's set the margin at 20% in this example. • Margin = 402 x 0.20 = 80.4 UGX = rounded off to 80 UGX Step 3: add the production cost and the margin to set the selling price • Selling price for one head of cabbage = 402 + 80 = 482 UGX • However, this is not a very practical price. Therefore, it is rounded off to 500 UGX per head of cabbage. The break-even point: Formula: BE (Q) = fixed costs / contribution margin Step 1: determine the fixed costs • Total fixed costs = 3,400,000 UGX Step 2: determine the contribution margin • Contribution margin = selling price per unit – variable cost per unit • Contribution margin = 500 UGX – (1,960,000 / 13,334) = 500 – 147 = 353 UGX Step 3: calculate the break-even point (in terms of quantity) • BE (Q) = fixed costs / contribution margin • BE (Q) = 3,400,000 / 353 = 9,632 heads of cabbage • This means that when 9,632 heads of cabbage are sold at a price of 500 UGX a piece there will be neither loss nor profit. If more cabbages are sold, there will be profit made.
Expected revenue and profit	Expected revenue = total sales = 13,334 x 500 = 6,667,000 UGX Expected profit = expected revenue – total costs = 6,667,000 – 5,360,000 = 1,307,000 UGX

Annex 4: Format of a project report for Year-1 students (Paper V) for NTCs

1. **The preliminary pages**

   The preliminary pages include the cover page, the declaration, the supervisor's approval, dedication, and acknowledgement, table of content, list of plates and list of tables. The cover page should not be numbered but all other preliminary pages should be numbered in Roman numerals, for example i, ii, iii, iv, v, etc.

2. **Cover page**

   The cover page should be written in the APA format. The cover page should state the name of your institution, the topic (name of the crop) of the project, the name of the student, the registration number and a statement that indicates the award that will be given and the awarding institution.

3. **Declaration**

   This is a swearing in statement by the author. Example: I …… declare that this project report is my original work and it has not been submitted to any institution for any award. At the end there should be a provision for the student to sign and the date he signed.

4. **Supervisor's approval**

   This contains words that show that you worked on the project under the guidance of your supervisor(s) and he/she as accepted that the work contains the required quality expected by the awarding institution. At the end, there should be a provision for the supervisor to sign and the date he signed.

5. **Dedication**

   As the word sounds, this gives you the opportunity to dedicate your report to a person or group of people such as family members, spouses, friends or even the community. It's more of an expression of courtesy showing people politeness and proper manners.

6. **Acknowledgement**

   It allows you to thank (recognise) specific contributions that you think professionally as well as personally helped you by giving advice, funding, mentorship, and editing your work or even practical support; i.e. this is just more than expression of courtesy.

7. **Preface**

   Preface is a short introductory statement that states why the learner wrote the project report. It draws the attention of readers by offering information about what is contained in the book.

8. **Table of contents**

   The table of contents is put just before chapter one of the report. The purposes of the content are to give the reader an overview of the report content and how it is organised and to also allow the reader go directly to the page(s) of his or her interests.

   Following is the structure of the chapters.

CHAPTER ONE

1.1 Background of the crop you are planting

This includes the following subheadings;

1.2 Origin

How the plant came into existence and how it reached Uganda.

1.3 Botany

This is the study of plant life. It gives a brief explanation of the kingdom, phylum, class, order, family, genus and species of the plant.

1.4 Varieties

This should include the varieties of the plant common/popular in the locality.

1.5 Geographical distribution

The student must name all the areas in the country where the crop does well and why it mostly grows

in those places and places where it does not do well and why and how it can be supported to grow in such areas.

1.6 Ecological requirement

Students should write short notes on the growth requirements of a given horticultural crop as cited from relevant texts, for example, temperature, rainfall, soil and soil pH.

1.7 Economic importance

The student should write about the benefits from growing the selected horticultural crop.

1.8 General pests and diseases

The student should research on all the pests and diseases that affect that selected crop irrespective of the variety he/she is going to plant.

NB: Other challenges other than pests and diseases can also be captured here.

CHAPTER TWO

2.1 Production report on the horticulture crop

This will include a range of activities from a business plan for the selected vegetable; seed selection; site selection; nursery bed preparation and management; seed bed preparation; planting; field management practices; field management practices; harvest and marketing.

CHAPTER THREE

3.1 Problems encountered

This should include all the challenges encountered in producing the selected horticultural crop.

3.2 Solution to the problems

Students should write strategies that were used in solving the above problems.

3.3 Recommendation

Here, basing on the project work done by the student, he or she should give advice or way forward for further improvement of Paper V project work.

Following is how references should be made.

REFERENCE

- It entails different sources where the information was got from.
- Use APA format

Books

Authors Last Name, Initials. (Year). Title of the book. City, State (Country). Publishers

Example: Beinempaka, A.B., Kato, H., Mulera, D. B., Obwol-Ameto, T. (1989). Principles and Practices of Agriculture. Vol. 1. Kampala, Uganda. Macmillan Publishers Ltd.

Government document

Name of Organisation (Year). Title of the document (Document Publication Data/Number). City, State: Publishers.

Example: Ministry of Agriculture, Animal Industry and Fisheries (2020). War against Locusts (Publication No. 7). Kampala, Uganda. Macmillan Publishers Ltd.

Articles with volumes

Last name, Initials. (Year). Title of the article. Name of the journal, volume, page number

Obong, D., Okello, G., Wasilwa, J. (2021). Students plot Guide. Journal of National Teachers' Colleges, vol. 001, pp. 10

Articles paginated with issue

Last name, Initials. (Year). Title of the article. Name of the journal, volume (issue), page numbers

Obong, D., Okello, G., Wasilwa, J. (2021). Student Plots Guide. Journal of National Teachers' Colleges, vol. 001(01), pp. 10-12.

Magazine or news letter

Last name, Initials. (Year, Month, day). Title of the article. Name of the magazine/Newsletter, volume #, and page number #s

Obong, D., Okello, G., Wasilwa, J. (2021, March 24). Student Plots Guide. VVOB Monthly Magazine, vol. 4, pp. 4-8.

Newspaper Article with named author

Last name, Initials. (Year, Month, day). Title of the article. Name of the Newspaper, section and page(s)

Obong, D. (2021, March 3). Student Plots Guide. NTC Unyama Young Farmers' eye. A2, pp. 23.

Newspaper Article with unnamed author

Title of the article. (Year, Month, day). Name of the Newspaper, page(s)

Student Plots Guide (2021, March 3). NTC Unyama Young Farmers' eye. pp. 5.

Edited book

Editor's name(s) (Year). Title of the book. City, State: Publisher.

Okello, G., & Obong, D. (Eds). (2021). Horticulture production in National Teachers' Colleges, Kampala, Uganda. McMillan Publishers Ltd.

Article in an edited book

Last name, Initials. (Year). Title of the article. In editor's names (Eds). Title of the book (pp. #s). City, State (Country): Publisher.

Wasilwa, J. (2021). Student Plots Guide. In G. Okello & D. Obong (Eds), Horticulture production in National Teachers' Colleges. (pp. 10-15). Kampala, Uganda. McMillan Publishers Ltd.

Thesis and dissertation

Last name, Initials. (Year). Title of the thesis. Unpublished type of thesis/dissertation, Name of the University, location

Ogwal, S. (2021). Genetic diversity and resistance to cassava brown streak diseases in central Uganda. Master's Thesis, Kyambogo University, Uganda.

Regular Television series

Last name, Initials (Producer). (Year). Title of the program. City, State: Publisher

Muyanja, G. (Producer). (2021, March 20). Seeds of Gold. Kampala, Uganda. NTC Mubende MASTA Club Publishers.

APPENDICES

- **Record of activities**

  These contain all the records of the activities carried out in the course of producing the select horticulture crop.

- **Business Module Canvas for the crop**

  It should have the list of inputs, their quantity and projected time when they are to be used.

- **Ground map for the nursery bed.**

  The map should be attached and the student should locate his or her nursery bed site on the map.

- **Ground map for the seedbed**

  The map should show the lay out of the plots. The student should locate his or her seedbed on the map.

- **Photos taken during different activities**

  All the photographs taken while carrying out different activities should be attached.

Annex 5: Guidelines for assessing Paper V report on crop production practicals

1. INTRODUCTION

- Literature on the crop
- Botany
- Ecological requirements
- Geographical distribution in Uganda
- Economic importance
- Uses of the crop
- Diseases
- Pests

Any 8 points at 2½ marks each **(20 marks)**

2. FIELD OPERATIONS

A report should be made on field operations such as:

- Nursery bed preparation
- Seedbed preparation
- Planning (spacing, planting dates, etc.)
- Manuring
- Weeding
- Pests
- Diseases
- Yields given in terms of kg/ha to be compared to data already published
- Note that reasons for any deviations should be given.
- Marketing
- Gross margin analysis records

Any 10 points at 6 marks each **(60 marks)**

3. PROBLEMS ENCOUNTERED **(8 marks)**

4. SUGGESTED SOLUTIONS / RECOMMENDATIONS **(8 marks)**

5. REFERENCES **(4 marks)**

The number of words for the report should be:

- 2000 – 2500 for Diploma in Education Primary.
- 4000 – 5000 for Diploma in Education Secondary.

Annex 6: NTC guidelines for assessing crop production practicals (continuous assessment)

NURSERY BED

Nursery bed preparation and management involves the following practicals:

- Providing shade
- Watering
- Mulching
- Erosion control
- Weeding
- Pricking – out
- Manuring
- Soil preparation (e.g sterilisation)
- Site selection
- Pest and disease control

Any 10 points at 2 marks each (20 marks)

SEEDBED PREPARATION

Quality of seedbed

- Bush clearing
- Depth of tillage
- Size of tilth
- Weed free
- Erosion control measures, e.g. ploughing along the contours.

Any 5 points at 2 marks each (10 marks)

Transplanting

- Hardening off
- Time of transplanting
- Transplanting procedure
- Management of seedlings prior to and immediately after transplanting (e.g. watering temporary shed)

Any 5 points at 2 marks each (10 marks)

Field management

- Recommended spacing (plant population) row alignment
- Gap filling
- Thinning
- Mulching
- Manuring
- Weed control
- Pruning (where applicable)
- Staking (where applicable)
- Disease control

- Pest control
- Signs of maturity
- Harvesting (methods)
- Market efficiency (Technical and economic efficiency)
- Records – production records
- Timeliness of field operations

Any 12 points at 5 marks each **(60 marks)**

Here follows an example of an assessment rubric: Mulching assessment rubric.

Activity / Steps	Mark award (0.5 mark each)
1. Put on protective gear	
2. Identify and cut mulching materials	
3. Select / sort mulching material	
4. Measure distance of mulches from plant(s)	
5. Mulch using appropriate technique	
6. Determine mulch depth	
7. Collect tools, equipment and materials	
8. Clean work area and tools	
9. Store tools, equipment and materials	
10. Keep records	

Annex 7: Student plot coursework marking guide

Student's name:		Registration No:	

Date	Stage	Activity	Activity specification	Marks
	Site selection and primary cultivation	Locate the site of a nursery bed	Good site selected	2mks
		Dig to the required depth	Required soil depth reached	5mks
		Prepare a suitable soil tilth for the nursery bed	Suitable tilth produced	3mks
	Nursery bed preparation	Measure 1m x 2m and prepare the bed in a north-south direction in the space given.	Required measurement and orientation followed	2mks
		Raise the soil to a height of 15cm	Soil raised to the required height.	1mk
		Prepare the planting line according to the recommended crop in question.	Required planting lines made	1mk
		Plant the right quantity of seeds and cover with thin layer of soil.	Recommended quantity of seeds used	2mks
		Mulch the bed to cover the soil	Mulching done adequately	1mk
		Remove the mulch after germination	Mulch removed timely	1mk
		Prepare a slanting shade of 1m and 0.75m from east to west direction	Slanting shade with the required height and orientation	1mk
		Fence the nursery bed to protect it from pests	Fencing done	1mk
	Nursery bed management	Water the seedlings as recommended	Water applied to the required moisture level	2mks
		Weed the seedlings	Timely weeding done	1mk
		Loosen the soil to encourage aeration	Loose soil on the bed	1mk
		Practise soil conservation measures	Soil conserved	1mk
		Employ pest and disease control measures	Pest and disease control measures in place	1mk
		Practise good nursery bed hygiene	Clean surroundings of the bed	2mks
		Carry out pricking out and thinning as recommended	Correct plant population in the bed	2mks
	Field production (a) primary tillage	Dig the bed to required depth	Required depth dug	1mk
		Prepare a suitable soil tilth for the seed bed	The right tilth prepared	1mk

	(b) secondary tillage	Break the clod to the required size	The right size of clod prepared	1mk
		Prepare the field depending on a particular crop to be planted	The right nature of the field prepared	1mk
	Transplanting	Water the bed heavily in the morning before transplanting	The bed watered heavily in the morning before transplanting	1mk
		Scoop the seedlings with some soil using a hand trowel and take care not to damage the roots	The seedlings are scooped with some soil and the roots are not damaged	1mk
		Put the seedlings in a basin containing some little water to prevent the seedlings from withering	The bed is put in a container with little water	1mk
		Carry out the recommended spacing between plants and between rows	Recommended spacing followed.	1mk
		Water the plants during dry spell	Watering done during dry spell	2mk
		Carry out gap filling to maintain correct plant population	Correct plant population achieved	2mks
		Weed the plant to reduce competition	Timely weeding done	2mks
		Practise soil conservation measures	The soil is well conserved	1mk
		Employ pest and disease control measures	Pests and diseases controlled	2mks
		Maintain good field hygiene	Infected plants and plant parts are removed from the field	1mk
		Stake the plants depending on the crop	Staking well done	1mk
		Harvest the crop at the right time	Harvesting done at the right time	2mks

Annex 8: Example of a student portfolio

Components:

- An introduction, including the background, vision and mission, and core values
- Objectives
- Work plan(s)
- Reflection reports
- Register(s)
- Report (s) of agronomic practice(s)
- Environmental sustainability plans
- Overview of implemented safety measures
- Report(s) of the innovation(s) implemented
- Project report

Annex 9: Crop record sheet – template

1. Student identification

1.1	Name: _____
1.2	Course: _____

2. Crop

2.1	Name of the crop(s): _____
2.2	Name of the variety(ies): _____

3. Land preparation

Date(s) of land preparation: _____

Describe the type of land preparation (deep ploughing, tools used, etc.):

_____

_____

_____

Total surface of land prepared: _____

4. Nursery bed (in case of direct planting this can be ignored)

4.1. Raising the nursery bed

Date when the nursery bed was raised: _____

Dimensions of the nursery bed: _____

Describe the method of disinfection:

_____

_____

_____

Describe the method and quantity of fertilisation:

_____

_____

_____

Observations:

_____

_____

_____

4.2. Sowing seeds in the nursery bed

Quantity of seeds sown: _____

Explain how the seed was sown in the nursery bed (spacing, depth):

_____

_____

_____

Describe the method of pest control (if chemicals have been applied, add type, date and quantity):

_____

_____

_____

Observations:

_____

_____

_____

5. Transplanting from the nursery bed to the seedbed

5.1. Seedbed preparation

Date(s) of seedbed preparation: _____

Dimensions of seedbed: _____

Total surface of seedbed: _____

Describe how the seedbed was prepared:

_____

_____

_____

5.2. Transplanting

Date of transplanting: _____

Number of healthy seedlings transplanted: _____

Number of unsuitable seedlings: _____

Describe the method used for transplanting:

_____

_____

_____

Which spacing was used in the seedbed? _____

6. Mulching

6.1. Date of mulching: _____

6.2. Mulching materials used: _____

6.3. Date of second mulching: _____

6.4. Mulching materials used: _____

6.5. Observations:

_____

_____

_____

7. Weeding

7.1. Date of first weeding: _____

7.2. Method of weeding: _____

_____

_____

7.3. Date of second weeding: _____

7.4. Method of weeding: _____

_____

_____

7.5. Date of third weeding: _____

7.6. Method of weeding: _____

_____

_____

7.7. Observations: _____

_____

_____

8. Pest and disease control and general crop management

8.1. Field observations and actions taken:

Date	Symptoms observed	Probable cause	Action taken

8.2. Remarks

_____

_____

_____

9. Harvest

9.1. Date(s) of harvest: _____

9.2. Yield:

Crop	Unit (kg, piece, sac, …)	Quantity	Observation

10. Post-harvest handling

10.1. Which post-harvest activities did you carry out (bundling, putting crop in bags, transport to store, etc.)?

_____

_____

_____

10.2. Estimation of production and post-harvest losses (spoilage, theft, etc.):

_____

_____

_____

10.3. Other observations

_____

_____

_____

11. Marketing

11.1. What did you do with the produce?

Destination	Date(s)	Quantity
Own consumption		
Given away for free		
Sold		
Others (Specify): _____		
Total		

11.2. Describe your customers and your commercial transactions.

_____

_____

_____

Annex 10: Record keeping sheet – filled out hypothetical example

1. Student identification

1.1. Name: Thomas Okello

1.2. Course: Year 1 Agriculture

2. Crop

2.1. Name of the crop(s): Cabbage

2.2. Name of the variety(ies): Gloria

3. Land preparation

Date(s) of land preparation: from 8th to 28th September 2021

Describe the type of land preparation (deep ploughing, tools used, etc.):
Using a panga, I cleared the bushy area from 8th – 10th September. Two and a half weeks later, starting on the 27th of September, I started ploughing using the hoe. During ploughing, I incorporated the debris so that it could decompose in the soil to increase the soil fertility. Ploughing was finished on the 28th of September.

Total surface of land prepared:
I prepared 100 m^2, which is the surface of my plot (10m x 10m). Furthermore, I helped my colleague in preparing his plot as well.

4. Nursery bed (in case of direct planting this can be ignored)

4.1. Raising the nursery bed

Date when the nursery bed was raised: 2nd of October 2021

Dimensions of the nursery bed:
Together with my fellow students we made three nursery beds for cabbage. Each nursery bed measured 3m x 1m x 15 cm.

Describe the method of disinfection:
Together with my fellow students, we mulched the nursery bed first and then burned the mulching to disinfect the soil of the nursery bed. This was done on the 2nd of October 2021.

Describe the method and quantity of fertilisation:
Together with my fellow students, we prepared three buckets of compost manure, using goat manure from the goat farm and compost from the compost heap. Each nursery bed received one bucket of compost that was mixed with the nursery bed's soil.

Observations:
We also protected the nursery beds from the sun by installing a shed to protect the seeds from the direct sunrays.

4.2. Sowing seeds in the nursery bed

Quantity of seeds sown:
Together with my fellow students, we used 30 grams of cabbage seeds, or 10 grams for each nursery bed.

Explain how the seed was sown in the nursery bed (spacing, depth):
Using a finger, lines of approximately 2 cm deep were opened in the nursery bed. Between each line was a distance of 30 cm. Each line was 1m long. In each line a moderate quantity of seeds was dropped. After that, the line was closed again with soil, using our hands. Finally, the nursery bed was watered using a watering can.

Describe the method of pest control (if chemicals have been applied, add type, date and quantity):
Every day in the morning I came to inspect the nursery beds. Whenever I would find pests (mostly caterpillars and aphids), I would remove them by handpicking. I also treated the cabbage nursery beds on the 9th of October with a biological pesticide based on hot pepper, tobacco, garlic and neem leaves. I diluted the solution by adding 20 l of water. Then I applied it using a knapsack sprayer.

Observations:
The biological pesticide reduced the number of caterpillars and aphids, but it did not totally eliminate them. I still had to do handpicking as well.

5. Transplanting from the nursery bed to the seedbed

5.1. Seedbed preparation

Date(s) of seedbed preparation: 23rd – 25th October 2021

Dimensions of the seedbed:
In total I prepared six seedbeds on my student plot, each measuring 9m x 1.20m x 20cm.

Total surface of seedbed: 6 x 9 x 1.20 = 64.8 m^2

Describe how the seedbed was prepared:
Using a rope, sticks, a hoe and a rake I raised the seedbeds to their dimension (see above). I did this together with my neighbour, whom I also assisted in preparing the seedbeds in his plot.

5.2. Transplanting

Date of transplanting: I transplanted my seedlings on October 26th

Number of healthy seedlings transplanted:
In total I transplanted 180 healthy seedlings to my plot. Each seedbed took 30 seedlings (2 lines of 15), multiplied by six seed beds.

Number of unsuitable seedlings:
Less than 5% of the seedlings were unsuitable (damaged leaves, damaged roots, too small, etc.). In total 15 – 20 seedlings were not suitable for transplanting and were disposed of.

Describe the method used for transplanting:
Transplanting was done in the early morning (6:00 AM). Seedlings were carefully removed by hand from the nursery bed. They were inspected for irregularities, especially their roots. Seedlings with irregularities were discarded, but they were not many. Using a stick, holes were opened in the seedbeds. Each hole was approximately 5 cm deep. In each hole a seedling was carefully planted by hand, taking care that the root was planted straight. Afterwards the hole was filled again with soil and a little compost manure. After transplanting, the seedbeds were watered using a watering can. To protect the seedlings from the sun, they were covered with leaves. The leaves were removed the next day.

Which spacing was used in the seedbed? 60cm x 60cm

6. Mulching

6.1. **Date of mulching:** October 27th 2021

6.2. **Mulching materials used:** dry banana leaves from the banana plantation

6.3. **Date of second mulching:** November 23rd 2021

6.4. **Mulching materials used:** combination of dry banana leaves and dry grasses

6.5. **Observations:**
Mulching had to be renewed on the 23rd of November because some of the mulching materials had been removed. There were gaps through which weeds had started developing. Since the quantity of dry banana leaves did not suffice for the second mulching, dry grasses were also used. Special care was taken to remove the seeds from the grasses before mulching them, in order to avoid germination of grass seeds.

7. Weeding

7.1. **Date of first weeding:** November 23rd 2021

7.2. **Method of weeding:**
The first weeding was combined with the second mulching. Before completing the mulching, weeding by hand was done to remove upcoming weeds that were competing with the crop.

7.3. **Date of second weeding:** December 18th 2021

7.4. **Method of weeding:**
This time only hand weeding was done. The mulch remained in place and did not need to be renewed.

7.5. **Date of third weeding:** January 21st 2021

7.6. **Method of weeding:**
This time only hand weeding was done. The mulch remained in place and did not need to be renewed.

7.7. **Observations:**
Overall, the combination of mulching and weeding proved effective to suppress weed development. The seed beds mulched with banana leaves showed less weed development than the seed beds mulched with grass. The latter ones required more weeding.

8. Pest and disease control and general crop management

8.1 Field observations and actions taken:

Date	Symptoms observed	Probable cause	Action taken	Result
November 7th 2021	Yellow colouring of the leaves	Nitrogen deficiency	Urea was applied in a dose of 22kg/ha. I applied 150 g to my seedbeds.	Yellow colouration of leaves disappeared after one week.
December 18th 2021	Leaves of about one in three cabbages showed signs of infestation (holes)	Caterpillars	Handpicking was done, in combination with treatment with a biological insecticide based on neem oil	Caterpillars remained present in the garden, but their numbers were reduced to acceptable levels. There was permanent need for handpicking.
January 23rd 2022	In one seedbed 20 heads of cabbage were missing	Theft	An investigation was made.	The thief was identified and was made to pay for the damage caused.

8.2 **Remarks**

The crop did well, thanks to the irrigation system that was able to provide ample water for growth. The caterpillar infestation was brought under control through a combination of permanent hand picking and using a biological insecticide. The insecticide was used by all students so that the whole garden was protected.

9. Harvest

9.1. Date(s) of harvest: 2nd of February 2021

9.2. Yield:

Crop	Unit (kg, piece, sac, …)	Quantity	Observation
Cabbage	heads	130	20 heads were lost to theft. Another 30 heads were lost to caterpillar infestation.
/			
/			

10. Post-harvest handling

10.1. Which post-harvest activities did you carry out (bundling, putting crop in bags, transport to store, etc.)?

Immediately after harvesting, the cabbages were graded into two categories: big size and normal size. Out of the 130 heads harvested on my student plot, 100 were normal size and 30 were big size cabbages.

A bag can contain either 20 big size cabbages or 25 normal size cabbages. I filled 4 bags with normal size cabbages (4 x 25) and one and a half bags with big size cabbages (1.5 x 20).

10.2. Estimation of production and post-harvest losses (spoilage, theft, etc.):

As explained above, I lost 20 heads to theft and 30 heads to caterpillar infestation. This means that I lost 50 heads out of a total of 180 heads, which is a loss of 28%.

10.3. Other observations

I obtained the bags from a friend. I paid 500 UGX for each bag.

11. Marketing

11.1 What did you do with the produce?

Destination	Date(s)	Quantity
Own consumption	2nd – 9th of February 2022	5 big size cabbages
Given away for free	2nd of February 2022	5 big size cabbages
Sold	3rd of February	1 bag of large size cabbages (20 heads) and 4 bags of normal size cabbages (100 heads)
Others (specify:_____)	/	/
Total	/	100 normal size cabbages and 30 large size cabbages

11.2 Describe your customers and your commercial transactions.

I sold one bag of normal size cabbages to the college canteen for 12,500 UGX: 1 bag x 25 heads/bag x 500 UGX /head = 12,500 UGX.

Three more bags of normal size cabbages were sold to a market woman from Gulu for 37,500 UGX: 3 bags x 25 heads/bag x 500 UGX/head = 37,500 UGX.

One bag of large size cabbages was sold for 12,000 UGX to the same lady: 1 bag x 20 heads/bag x 600 UGX/head = 12,000 UGX.

In total my revenue was 12,500 + 37,500 + 12,000 = 62,000 UGX.

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