german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

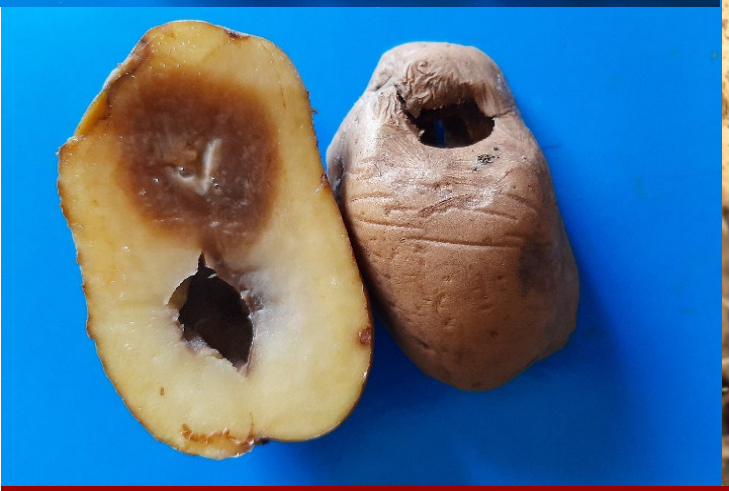
CIP INTERNATIONAL POTATO CENTER
CGIAR

Minader
Ministère de l'Agriculture et du Développement Rural
Ministry of Agriculture and Rural Development

IRAD

BEST PRACTICES FOR REDUCING POTATO POST-HARVEST LOSSES IN CAMEROON: A TRAINING MATERIAL

June 2023



CIP CAMEROON

Best practices for reducing potato post-harvest losses in Cameroon: A training material

Potato Value Chain Development Project in Cameroon, funded by the German Cooperation

DOI: 10.4160/cip.2023.07.003

International Potato Center
P.O. Box 1558, Lima 12, Peru
cip@cgiar.org • www.cipotato.org

Correct citation:

Nkengla D., Wauters P., Harahagazwe D., Fornkwa V., Teguefouet P., Nkuidjin G.J. (2023). *Best practices for reducing potato post-harvest losses in Cameroon: A training material*: International Potato Center. https://doi.org/10.4160/cip.2023.07.003

June 2023

CIP also thanks all donors and organizations that globally support its work through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders

TRAINING MATERIAL OUTLINE

INTRODUCTION

Module 1: Some generalities about potato PHLs

Module 2: Factors contributing to PHLs of seed and ware potato

Module 3: Harvesting practices

Module 4: Post-harvest practices

Module 5: Packaging and transportation

Module 6: Seed potato storage

Module 7: Ware potato storage

Module 8: Financial management of potato stores and marketing of potato

Module 9: Ware potato processing and regulations

Module 10: Waste management of PHLs

INTRODUCTION

- **Potato post-harvest losses (PHLs) in Cameroon**
  - Lack of adequate technical know-how on how to manage potato appropriately during and after harvest by producers and other value chain actors + low level of processing → high PHLs
  - Recent study: PHLs of seed (29%) and ware (19%) potato occur between harvesting and planting (seed)/consumption (ware) stages
  - Notable factors attributed to PHLs that harm the sector and cause concern include:
    - Quantity and quality of planting material leading to ↓ yields
    - Income earned at all levels along the potato value chain
    - Overall food security
  - This training material is meant to strengthen capacity to promote the adoption of proper potato post-harvest management practices to ↓ PHLs, to ↑ food availability, and alleviate food shortage problems

Module 1: Some generalities about potato PHLs

- **Potato PHLs**
  - Measurable reduction in quantity or quality of the potato from the harvesting stage to the planting (seed)/consumption (ware) stages
  - Arise from the fact that potato tubers are living organism → they breathe and undergo changes during post-harvest handling
  - Due to a wide variety of factors:
    - Growing conditions
    - Physical damage (cuts, bruises, …) during harvesting, handling, transport and storage
    - Physiological decay due to respiration
    - Water loss in storage by evaporation
    - Storage unit not adapted
  - Occur during harvesting (lack of second round of harvesting), sorting, handling and packing, transportation, storage, distribution/marketing and cooking/processing

Module 1: Some generalities about potato PHLs

- **Types of potato PHLs**
  - Physical vs economic losses:
    - Physical losses: potato unfit for human consumption, no alternative use/residual value
    - Economic losses (affect only what is marketed): reduction in the monetary value due to lower quality and quantity (partially spoiled, discounted market price, alternative use)
  - Quantity vs quality losses:
    - Quantity losses: reduction in weight and volume
    - Quality losses: loss in physical, physiological, nutritional and microbiological quality
- **Impact of potato PHLs**
  - Significant financial, nutritional, health and social impacts for all actors along the potato value chain (income ↓, profitability ↓, food security ↓, stress ↑, discouragement of producers ↑)
  - National level: supply ↓ leading to ↑ food prices
  - Not only a waste of food, but also a waste of human efforts, farm inputs, investments and natural resources (land, water, …)

Module 1: Some generalities about potato PHLs

Santa, T. Nicascius


Bafoussam, D. Nkengla

Module 2: Factors contributing to PHLs of seed and ware potato

- **Distinct genetic makeup of varieties**
  - Different resistance to viruses and other diseases (in the field, in the store)
  - Different maturity period (time needed in the field until potato is ready to harvest)
  - Different dormancy period (time needed in store to develop sprouts)
  - Different characteristics (tuber size, shelf life, dry matter ↑ → susceptibility to bruising ↑)
- **Health status of seed potato**
  - Refers to the presence or absence of disease-causing organisms in seed potato
  - Healthy seed potato:
    - Seed potato without any disease or physical damage
    - Highly dependent on the source and integrity of supply (virus and bacterial infections can't always be detected from the skin)
  - Health status of seed potato has a great impact on the vegetation and quality of the harvested tubers and their post-harvest life

Module 2: Factors contributing to PHLs of seed and ware potato

- **Cultural practices that mitigate PHLs**
  - **Site selection:** limited slope; fine soil, loose texture, free from rocks and well-drained; limited disease and pest pressure; no risk to water run-off; not shaded; protected from free entry of animals
  - **Variety selection:** see distinct genetic makeup of varieties
  - **Crop rotation:** to prevent the build-up of pests, weeds, and diseases; to maintain or improve the soil health by cycling crops from different plant families
  - **Tilling:** to loosen the soil to enhance root establishment and stolon development; to incorporate organic matter from the previous crop prior to planting
  - **Fertilization:** use of recommended fertilizers and dosages produce high yields and quality tubers; overdose or use of fertilizers not suitable for potato results in high water content and easy deterioration after harvest; organic manure, e.g., cow dung or pig manure, that is not well decomposed contains pathogens and can lead to PHLs
  - **Planting:** respect of cultural calendar; planting at the onset of the rains to maximize water utilization, moist soil but not too wet

Module 2: Factors contributing to PHLs of seed and ware potato

- **Cultural practices that mitigate PHLs (continued)**
  - **Hilling:** mounding earth around potato plants to ensure stolons produce tubers rather than above-ground stems; to increase the number of tubers; to reduce exposure of tubers to sunlight which turns the tubers green as well as exposure of tubers to pests (potato tuber moth)
  - **Weed management:** to control virus vectors (aphids, white flies) that infect tubers and transcend into storage (hilling and weeding are mostly done at the same time)
  - **Spraying:** safe use of chemicals to control pest and diseases
  - **Dehaulming:** killing the plant above the soil 2-3 weeks before harvesting; to stop tuber growth for seed production; to harden the skin for protecting the tubers from handling and transport injury, as well as postharvest diseases; seed potato → chemical dehaulming for large-scale producers, mechanical dehaulming for small-scale producers

Module 2: Factors contributing to PHLs of seed and ware potato

- **Pest & disease management**
  - **Pests:**
    - Potato tuber moth: attacks potato both in fields and stores, larva causes tunnels in tubers filled with excreta, the wounds lead to secondary infection by fungal and bacterial diseases leading to rotting
    - Aphids: infest leaves, flowers, stems and sprouting tubers, cause physical damage but are also carriers of virus diseases
  - **Late blight:** fungal disease, causes crop failure by damaging the leaves, stems and tubers, symptoms → brown spots with yellow halo are formed on leaves and stems
  - **Bacterial wilt:** a soil and seed-borne disease, causes plants to wilt and can lead to total failure of the crop, most important measure to avoid bacterial wilt → healthy soil and seed
  - **Soft rot:** caused by bacteria that causes stems to turn black, tubers to become soft from rotting and smell bad
  - **Viruses:** many types of viruses, in most cases, the field or the plant is infected by more than one virus causing compound effects. This doesn't kill the potato plant but reduces yield and tuber quality, symptoms → distorted and bubbling leaves, short and bunchy plants, yellowing leaves

Module 2: Factors contributing to PHLs of seed and ware potato

Potato tuber moth

Potato tuber moth

Potato tuber moth

Aphid

Late blight

Late blight

Module 2: Factors contributing to PHLs of seed and ware potato

Bacterial wilt

Bacterial wilt

Soft rot/Blackleg

Soft rot

Dwarfing

Potato leafroll virus

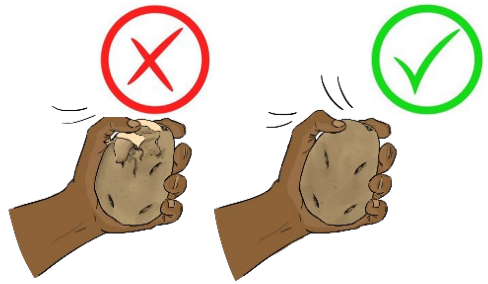
Module 2: Factors contributing to PHLs of seed and ware potato

- **Soil health**
  - Continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans
  - Unhealthy soil, e.g., due to bacterial wilt, lowers potato yields and results in high PHLs
- **Weather/climate**
  - Suboptimal growing conditions (no cool conditions with temperatures ranging from 10 to 23°C and rainfall of 900-1,400 mm per year)
  - Abiotic factors, such as drought and high temperature, limit tuber yield and affect tuber quality
  - Climate change can cause PHLs: too much rain can cause the rot of tubers; rains can disappear before the crop matures
- **Maturity**
  - The senescence of leaves sets the stage for tuber skin set and physiological maturity
  - Immature tubers are highly susceptible to bruising and skinning during handling that may lead to pathogen infection and premature tuber dehydration
  - Mature tubers heal faster and resist weight loss associated with dehydration

Module 3: Harvesting practices

- **Planning of harvesting**
  - Check availability of all items and resources needed (harvesting tools, buckets/baskets/crates for the collection of the tubers, packaging materials, tarpaulins to cover packed potato in the event of rain, labor required, storage capacity, transportation means, potential markets, …)
  - Proper training and supervision of laborers

- **Time of harvesting**
  - Check size and maturity: marketable size, skin does not slip taking one tuber in your hands and rubbing the potato between thumb and index fingers
  - Harvesting should be done in dry weather
  - Harvesting should be done when soil is moist (→ easier to pull), not when dry or wet and heavy (→ can damage tubers: skinning & bruising)



Bruised potato

Potato skinning

Module 3: Harvesting practices

- **Harvesting methods and tools**
  - Harvesting methods affect tuber quality: mechanical injuries may lead to pathogen infection reducing the tubers' post-harvest shelf life
  - Skinning, bruising, and cuts are the most common defects occurring when digging potato tubers up during harvest
  - Harvesting methods mostly used in Cameroon are hands and hoes:
    - Hands: takes longer, labor intensive, will produce good quality tubers
    - Hoe: less time-consuming and labor intensive, can damage/cut tubers
  - Disinfect tools before use
  - Do second round of harvesting to avoid many tubers remaining underground in the field

Harvesting with a hoe

Module 3: Harvesting practices

- **Alternative harvesting tools**
  - Garden fork: causes less damage to tubers than the hoe
  - Animal drawn digger: is faster, results into less damage and exposes more of the tubers in a field
  - Mechanical harvesters

Garden fork

Harvester made locally

Module 4: Post-harvest practices

- **Purpose: to maintain the quality of the potato, not to improve!!**
- **Drying, cleaning and curing**
  - Dry potato immediately after harvest to remove excess moisture from the surface of the tubers
  - Dry (ware) potato under the shade because exposure to the sun causes greening of the tubers
  - If by accident rain fell on the tubers during harvesting/drying, let the tubers dry afterward
  - Potato tubers are cleaned by drying and shedding off the soil adhering to the surface of tubers
  - Curing (if storage afterward): to repair any skin injuries and to promote the formation of stronger skin for more resistance to diseases and less water loss during storage (dark place, good ventilation, room temperature, 85-95% relative humidity, 2 weeks) → to determine relative humidity, use a portable hygrometer
  - Use wood ash for rapid healing of bruised and wounded tubers

Module 4: Post-harvest practices

- **Sorting**
  - Removal of unwanted rotten, damaged, diseased, green, cut or odd-shaped tubers, clods, stones, and other foreign bodies such as crop remains or pieces of wood
  - Treat potato tubers sorted out according to their condition:
    - Injured potatoes can be used for home consumption
    - Moderately rotten potatoes can be fed to animals
    - Potatoes unfit for any further use should be destroyed by fire or disposed of in a purification pit to prevent environmental pollution
    - Green tubers are unsuitable for human consumption because they contain a toxin/poison called Solanine

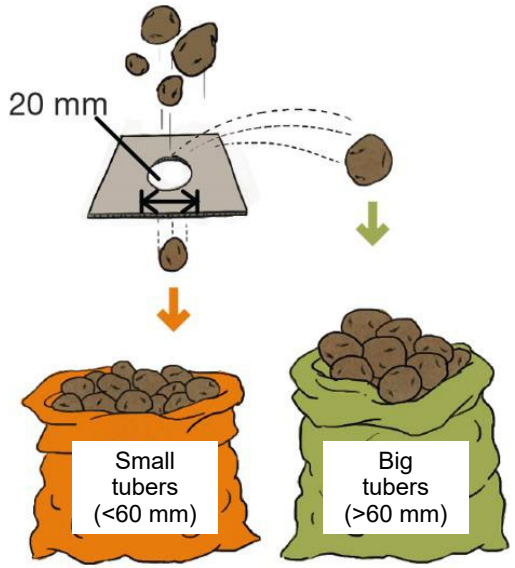
Module 4: Post-harvest practices

Drying and sorting

Module 4: Post-harvest practices

- **Grading**
  - Separating the healthy tubers according to their size (small ↔ big)
  - Is done both by hand as well as by graders
  - Graded tubers should be bagged differently and marketed with respect to their grade
  - In general, drying, cleaning, sorting and grading go on simultaneously
- **Sanitation**
  - After harvest, the potato plot should be sanitized by gathering and destroying harvest remnants such as foliage residues, rotten tubers, etc.
  - Further field sanitation must continue in the following seasons by removing volunteer plants

Size depending on what market wants



Volunteer plants

Module 5: Packaging and transportation

- **Packaging**
  - Seed potato:
    - Use of crates/baskets made from local materials (raffia) to avoid breakage of sprouts
    - Limit weight of crates/baskets to 25 kg (for easy handling)
  - Ware potato:
    - Common but bad practice: extended nylon bags weighing between 130-180 kg
    - Use of jute or sisal bags (very strong, allow air circulation, can carry heavy weight easily, long lasting, cost-effective), not polythene bags (easily torn, no air circulation)
    - Good practice: sales in bags of 50 kg (for easy handling)
    - Fill bags to the brim to avoid bruising

Ebay

Module 5: Packaging and transportation

Santa, T. Nicascius

Wouru Sangue, Ashou

Northwest Region, M. Mbom


Nkongle, R. Menkemambu


Bamendjou, P. Nzongang

Module 5: Packaging and transportation

- **Transportation**
  - Various transport means: bikes, pick-ups, trucks, …
  - Rely upon professional transporters
  - Loading:
    - Avoid loading wet crates/baskets (seed), wet bags (ware) or loading under the rain
    - Handle with care to limit shocks which can result in damage and rot
    - Avoid mixing potato with other produce during transportation
    - Avoid overloading: causes bruises and heating in bags accelerating the rotting of tubers; vehicles move slowly, increasing the transit time

Module 5: Packaging and transportation

- Transportation:
  - Clean and disinfect transport vehicle before use
  - During transportation, potato should be protected from rain (tarpaulin)
  - Transport loaded trucks at night when temperature is lower, and traffic is less
  - Open the cover from time to time to ventilate the potato
- Off-loading:
  - Handle with care to limit shocks causing bruising
  - Avoid off-loading under the rain

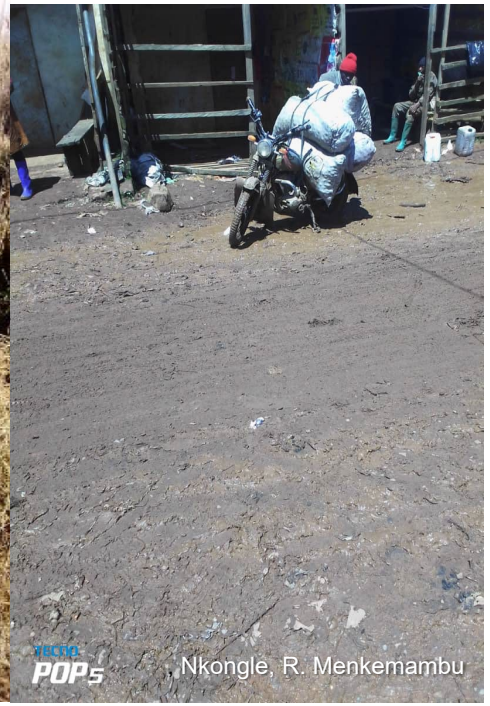
Module 5: Packaging and transportation

Local transport


Tadu, O. Bah

Djuttitsa, E. Tiozang


Northwest Region, M.Mbom

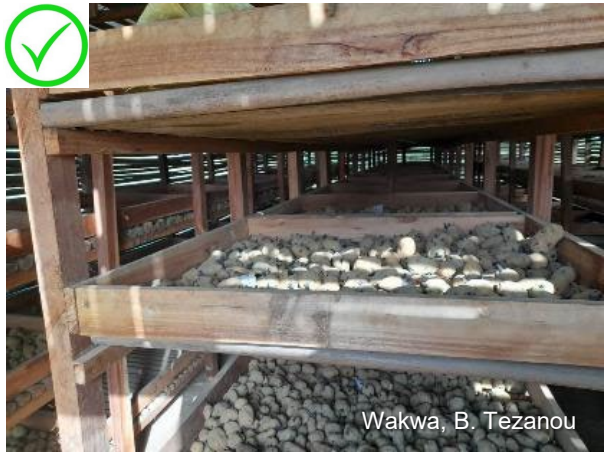


Nkongle, R. Menkemambu

Module 6: Seed potato storage

- **Purpose: to maintain the quality and viability of seed tubers being held until the next production season**
- **Storage principles**
  - Storage in a diffused light store (DLS) for normal germination: the development of many strong and short sprouts
  - Diffused light: results in short, strong and colored sprouts ↔ darkness: results in long and etiolated sprouts that are susceptible to damage
  - DLS:
    - Can be made of locally available materials
    - Roofing: alternate iron + transparent sheets
    - Protection with insect-proof net to prevent transmission of viruses by winged aphids and infection by potato tuber moth (can be counterproductive!!)
  - Seed stored in a DLS has better emergence, more uniform growth, and better plant establishment resulting in ↑ yield compared to seed stored in traditional store/burlap sacks

Module 6: Seed potato storage

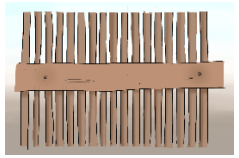


Module 6: Seed potato storage

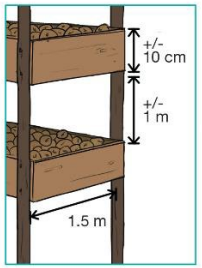
- **Storage management in a DLS**
  - Only store healthy tubers, never diseased tubers
  - Store seed potato in thin layers on shelves or in crates (+/- 3 tubers so that each tuber receives enough light and diseased tubers can be detected without touching → risk for disease transmission)
  - Label potatoes from different varieties and plots
  - Ensure good ventilation to avoid heat build-up due to respiration + high relative humidity to prevent tuber shrinkage due to dehydration
  - Ensure good storage hygiene (prior disinfection using 0.25% sodium hypochlorite, basic physical cleaning/removal of dust and dirt generally suffices during storage)
  - Regularly check the tubers for signs of diseases and remove rotting tubers
  - Check for pests such as aphids and potato tuber moth in and outside the store (→ install insect traps)
  - Distribute fresh leaves of *Lantana camara* above the tubers to control potato tuber moth and other insects (*Lantana camara* is a natural repellent as it has repulsive effects on insects)
  - Spread a layer of green banana leaves over tubers (this promotes sprouting)
  - Use of organophosphorus insecticides to kill larvae and the adults of the potato tuber moth

Module 6: Seed potato storage

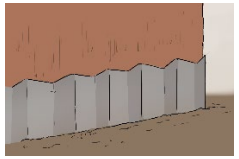
Insect proof net



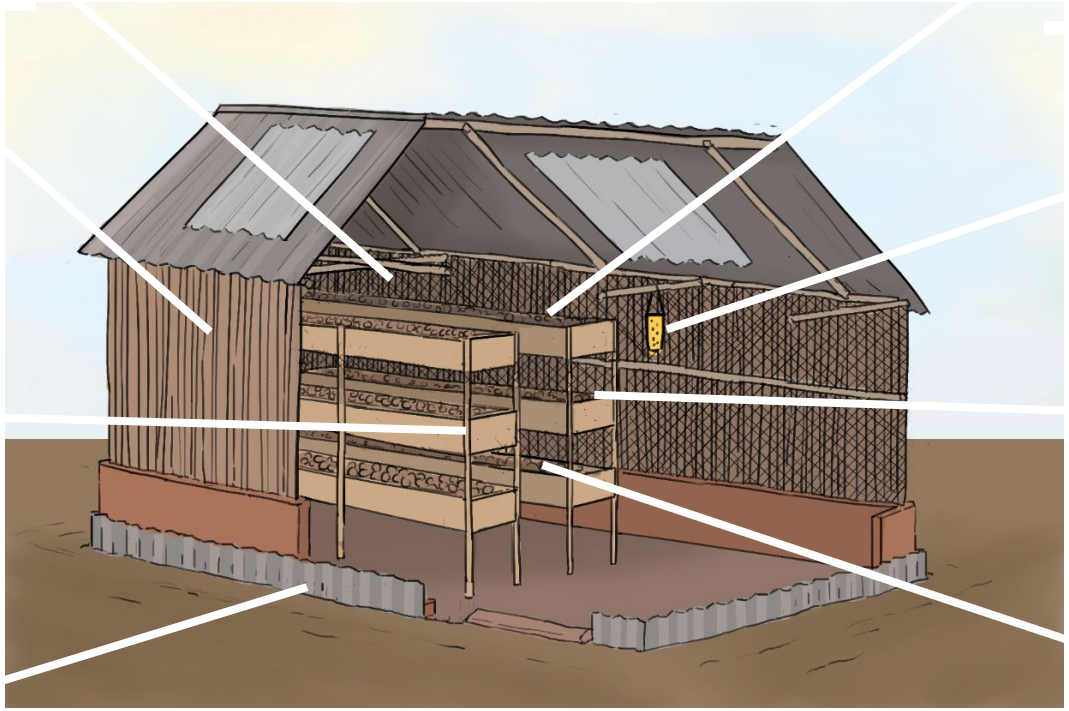
Locally available materials



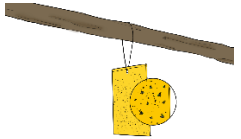
Shelves



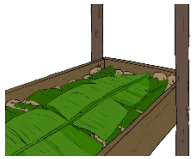
Sheet metal bands preventing rodents from climbing



Lantana camara



Insect trap



Banana leaves

Organophosphorus insecticide

Module 7: Ware potato storage

- **Purpose: to make the crop available for consumption or sale over an extended period of time**
- **Storage principles**
  - Well-designed ambient storage facilities allow ware potato to be stored for several months in tropical highlands without significant losses when:
    - Variety has long dormancy/storability
    - Potato tubers are free from diseases
    - Good storage conditions are available
  - Good storage conditions:
    - Darkness (greening ↓)
    - Low temperatures of 7-10°C (weight loss due to respiration and development of microorganisms causing rotting ↓) → to determine temperature, use a thermometer
    - High relative humidity of 90-95% (weight loss due to transpiration ↓) → to determine relative humidity, use a portable hygrometer
    - Adequate airflow (heat build-up ↓)

Module 7: Ware potato storage

- **Control air temperature, relative humidity and ventilation using natural weather**
  - Wind vent open during the night to allow sucking out warm air while cool air coming in
  - Wind vent closed during the day to retain cool night air
  - Buckets of water on the floor to regulate relative humidity


Nyambaka. ENIS SARL


Badeng. ENIS SARL


Bamendjou, P. Nzongang

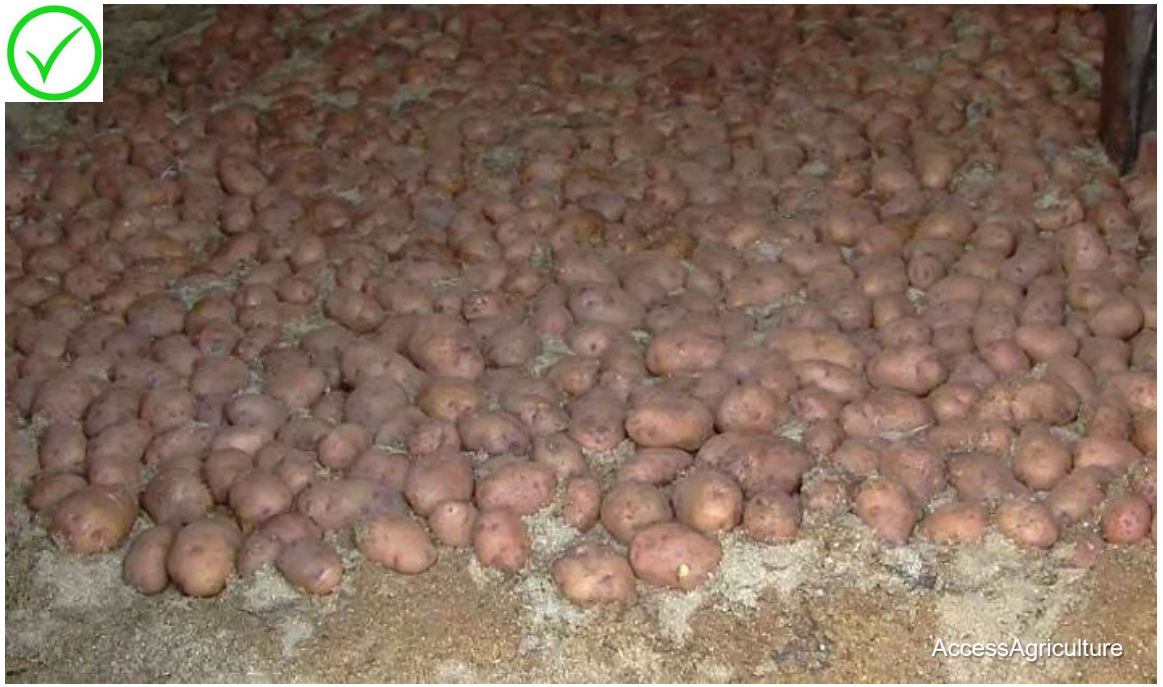
Module 7: Ware potato storage

- **Storage management in an ambient store**
  - ❑ Organization of how to run a store to match volumes of potato stored, storage duration and tuber quality to market expectations (store management plan, store management committees if group store)
  - ❑ Only store dry (no washing!!) and healthy tubers
  - ❑ Disinfect the store prior to storage and ensure good overall hygiene during storage (basic physical cleaning/removal of dust and dirt generally suffices)
  - ❑ Placement of the potato:
    - Ensure free flow of air through the tubers to minimize heat build-up, which can result in rots
    - Ensure easy movement through the store for monitoring and off-loading of the store
    - Use crates (long-term storage) packed on top of each other to optimize space
    - Jute bags can be used for short-term storage, not polythene sacks (→ don't allow tubers to breathe, leading to reduced shelf life), storage in bags in an upright position, avoid overloading
    - Ensure proper labelling of stored potato with variety names and origin
  - ❑ Use rat traps in the store
  - ❑ Do not open the store unnecessarily in order to maintain the cool ambient conditions
  - ❑ Monitor the stored potato regularly for any quality deterioration (sprouting, rotting, molds, pest and rodent damage), and remove rotten/diseased/damaged potatoes and those adjacent to them

IndiaMART

Module 7: Ware potato storage

- **Use white sawdust**
  - Low-cost preservation technique
  - Sawdust helps to increase the shelf life of stored ware potato up to several months by providing a cooler environment
  - Alternate layers of moist sawdust and potato
  - Make sure to leave a little space between each potato tuber to allow airflow
  - Be sure the sawdust is not too dry (makes potato prone to pests) and not too wet (makes potatoes rot)



Module 7: Ware potato storage

Module 8: Financial management of potato stores and marketing of potato

- **Business plan:**
  - Roadmap for how to structure, run, and grow a business (goals, management strategy, financing strategy, marketing strategy, workplan, financial analysis)
- **Financial analysis (know whether you are doing a good business):**
  - Costs (money-out) ↔ revenue (money-in):
    - Fixed costs: money spent on investments (store, tools, equipment, …), do not increase with increasing storage operations
    - Variable costs: money spent on storage operations (maintenance, rent, cost of potato at time of harvest, labor, chemicals, communication, transport, …), increase with increasing storage operations
    - Revenue: money generated by sales of potato after storage
  - Record keeping: registration of all costs, revenue, potato flow in/out on a day-to-day basis
  - Good record keeping is the basis for evaluating if business is good or bad
  - Calculation of profit or loss: (Money-in) - (Money-out)
    - Money-in > money-out → gross/net profit → good business
    - Money-in < money-out → loss → bad business
  - Other benefits: customer satisfaction due to constant supply, job creation for managing staff

Module 8: Financial management of potato stores and marketing of potato

➢ Registration of costs

Date	Description of cost	Unit (XAF or working hours)	Unit price (XAF)	Quantity	Total (XAF)

➢ Registration of potato flow in/out

Date	In/out	Grade (Large, medium, small)	Batch code (Variety/date/grade)	Quality (Good, deteriorated, spoiled)	Quantity (Kg)	Unit price (In: farmgate price; out: selling price) (XAF/Kg)	Total (XAF)

Module 8: Financial management of potato stores and marketing of potato

- **Marketing of potato**
  - Knowing the market dynamics, preferences and opportunities (location of market, potential buyers, quality and volumes required, tuber characteristics, selling prices, …) by (social) media, networking, extension services, …
  - Prices are lowest at times of abundance and highest at times of scarcity (off-season) → money lost due to PHLs could have been invested in adequate storage to take advantage of fluctuating market prices
  - Quality product → better price!!

Module 8: Financial management of potato stores and marketing of potato

- **Collective marketing → many advantages for farmers and buyers**
  - Farmers:
    - Attracts bigger markets/buyers (potentially without middlemen)
    - Spreads marketing costs over a large volume
    - Reduces market uncertainty by establishing long-term relationships with buyers
    - Encourages contract farming (farmer ↔ processor)
    - Increases negotiating/bargaining power → selling price ↑
    - Brings cooperation/information sharing among farmers
  - Buyers:
    - Reduces transaction costs
    - Improves stable supply + traceability

Module 9: Ware potato processing and regulations

- **Potato processing:**
  - Preparation of convenience potato products
  - Purpose: to prevent PHLs, to increase storability and regular supply, to export to long distances, to add value
  - Processed products: chips (fresh/chilled/frozen ready-cut, fried ready to eat), crisps, dehydrated potato (flakes, flours to make doughnuts, cakes, …, granules, shreds), starch for industrial and pharmaceutical products, beverages, household soap, …


toutComment

Torino Food


Eximcan


MB Distribution

Module 9: Ware potato processing and regulations

- **Quality criteria:**
  - Quality of fresh tubers:
    - Mature tubers (tuber yield and dry matter accumulation are at maximum level)
    - Few/shallow eyes, smooth skin, free of bruises/injuries, no sprouting, no greening
    - Shape: round (crisps) or oblong (chips) tubers
    - Size: big (40-55 mm for crisps and > 55 mm for chips)
    - Dry matter ≥ 20% (high dry matter → less water → less energy use + oil absorption during processing)
    - Reducing sugar content (starch breakdown): low → dark-colored spots and bitter flavor ↓, acrylamide ↓ (health risk!!)
  - Quality of processed potato:
    - The evaluation of the quality of processed potato products can be either subjective (influenced by personal tastes/opinions) or objective (not influenced by personal tastes/opinions)
    - Subjective: taste, color, texture, smell, touch, crunchiness, size (at least 4 cm long for chips)
    - Objective: physical quality (dry matter, fry color), nutritive quality, microbiological quality

Module 9: Ware potato processing and regulations

- **Management of leftovers**
  - Waste from peeling, slicing, and washing + small potatoes → animal feed
  - Greened and sprouted potato → seed potato
- **Public regulations**
  - Employment (working conditions)
  - Food safety and quality of the finished product (hygiene of building, equipment & personnel, contaminants, microbiological and biochemical requirements)
  - Local standards for processed products (essential materials, ingredients, additives)
  - Packaging (materials, weights and measures, labeling, expiry date)
  - Management of liquid effluent
  - Inspection by ANOR (Agence des Normes et de la Qualité)


Yaoundé, D. Harahagazwe

Packaging Digest

Module 9: Ware potato processing and regulations

- **Processed potato products made in Cameroon**

Potato flour

Crisps

Chips

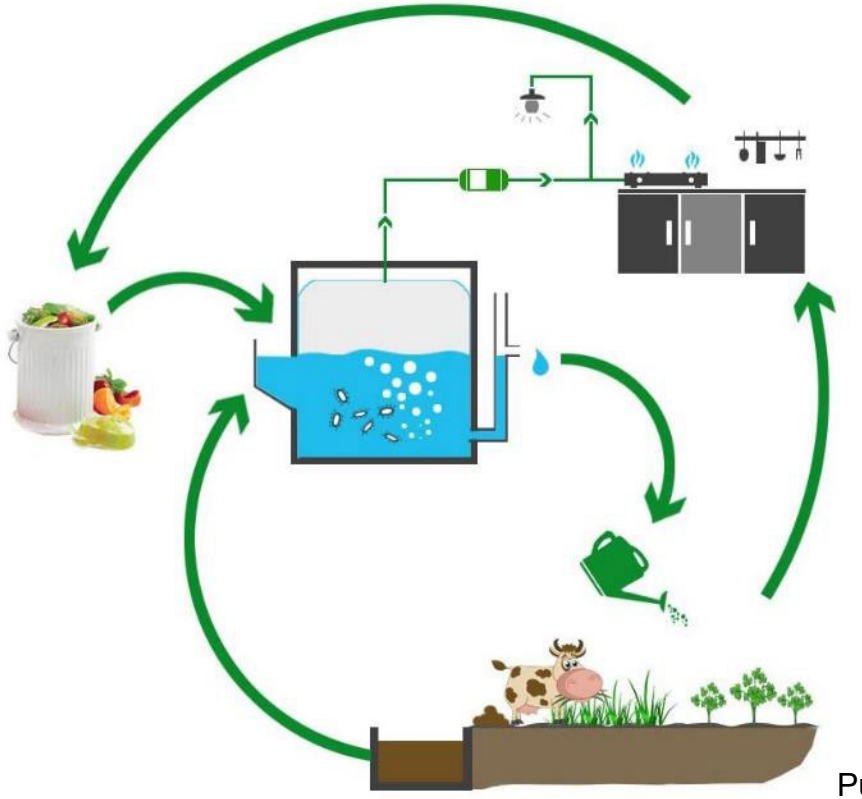
Soap Nou'Nyanga

Module 10: Waste management of PHLs

- **Burial in a pit or destruction by fire**
  - Prevents spread of disease causal agents in the environment/running water
  - Purification pit with quicklime
- **Composting**
  - In combination with other vegetative material → moisture, micro-organism activity and turning for aeration generate organic manure (be aware of source of potato waste to limit the spread of diseases!!)
  - Compost from potato waste should be used to grow crops that are not of the Solanaceae family
- **Animal nutrition**
  - Incorporation of potato waste (peels, pulp, unmarketable potatoes) into animal feed formulations
  - Feed for pigs: steaming of potato waste to improve digestibility, animal health and economy of pig production
  - Feed for cattle: dry pellets, excellent source of energy while being low in protein and calcium (avoid spread of diseases by their manure!!)

Module 10: Waste management of PHLs

- **Biomass for biogas production**
  - Biogas (methane): gas made from anaerobic digestion of kitchen waste; has a great potential to be utilized as a renewable energy source to supply heat and electricity
  - Potato waste is starchy and produces a decent amount of gas
  - After extracting the gas, the waste material left behind is utilized as a nutrient-rich fertilizer



Puxin

THANK YOU FOR YOUR ATTENTION

The International Potato Center (CIP) was founded in 1971 as a research-for-development organization with a focus on potato, sweetpotato and Andean roots and tubers. It delivers innovative science-based solutions to enhance access to affordable nutritious food, foster inclusive sustainable business and employment growth, and drive the climate resilience of root and tuber agri-food systems. Headquartered in Lima, Peru, CIP has a research presence in more than 20 countries in Africa, Asia and Latin America.

www.cipotato.org

CIP is a CGIAR research center, a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centers/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector.

www.cgiar.org

CIP thanks all donors and organizations which globally support its work through their contributions to the CGIAR Trust Fund. https://www.cgiar.org/funders/