Renewable energy research projects of the University of Kassel in SSA countries

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
AGRARTECHNIK WITZENHAUSEN
ÖkologischeAgrarwissenschaften UNI KASSEL

Overview

- Developing appropriate technologies to address the problem of aflatoxin contamination of maize under harvest conditions in Kenya
- Sweet potato storage
- Utilizing diurnal fluctuations for cold storage
- Solar spray drying of milk

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Addressing the role of engineering in mitigating post-harvest aflatoxin contamination of in Kenya

Introduction

- Over 75% production small-scale (5<acres)
- Maize as staple food, but insecure
- aflatoxicosis with severe health like cancers, suppressed immunity, stunted growth

Aflatoxins? – toxic metabolites produced by strains of the *Aspergillus flavus* and *Aspergillus parasiticus* fungi in moist foods.

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
AGRARTECHNIK WITZENHAUSEN
ÖkologischeAgrarwissenschaften UNI KASSEL

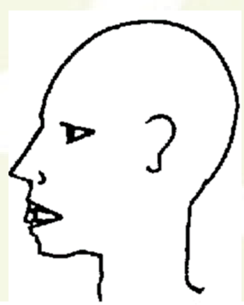
Aflatoxins: The response

PICS bags
Photo: Dieudonné Baributsa

- Stakeholder workshops - GAPs
- Standards-manuals
- Biotic control - Atoxigenic fungi – promising for pre-harvest
- hermetic storage: PICS bags, metal silos.
- Mobile dryer imports –shelled maize – pre-drying on-farm or in cribs - delayed harvest

Store-ready tests in rural villages: Imprecise – unreliable – insensitive - inadequate for detection of long term storage requirements

rattling



biting

Salt test etc…

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL
AGRARTECHNIK WITZENHAUSEN

Aim of the project:

Identification of energy saving and cost cutting strategies in cobed maize drying by characterising cob drying

- computational sensor psychrometrics for the digitization of convective cobed maize drying
- Characterisation of the Composite Convective Drying Dynamics of Cobed Maize
- Assessing the impact of husking and shelling maize depletion of safe capacity and sophistication of drying in deep and shallow beds

Provide appropriate low cost solutions for maize drying; integration of the informal Jua Kali* sector is conceivable

* local “street doctors”, keeping things alive and working (http://migrationology.com/2011/07/jua-kali-kenyan-informal-labor-sector/)

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Results

- Low temperature, in-store drying (<45°C)
- Minimal risk of moisture rebounding when kernels are over-dried to 12 %wb
- Optimal conditions for extreme wet (43%wb) cobed maize drying: temperature 43±2℃, surface airflow > 3 m/s.

Recommendation

Low cost moisture detection kits – next frontier for innovation.

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Design and Development of a Low-cost PV Powered Ventilated System for Storage of Sweet Potato under Tropical Conditions

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering

Background

- Sweet potato (*Ipomoea batatas* L.) is an important high-value crop in many countries in Africa
  - However, full exploitation of the crop is constrained by its perishability especially in tropical and sub-tropical climates
- The main cause of post-harvest losses has been attributed to lack of suitably designed storage systems
- In rural areas for instance, harvested roots are often stored in bulk using:
  - Pits, heaps or house floors

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Problem

- mold damage may occur especially if the roots are not ventilated during bulk storage or ventilation lacks of non-uniform air distribution

Approach

- Simulation studies using Computational Fluid Dynamics (CFD) techniques
  - Simulation of pressure and velocity
  - Design of a DC axial fan wit h a low startup current based on the simulation data

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering

Mud storehouse construction based on CFD simulations

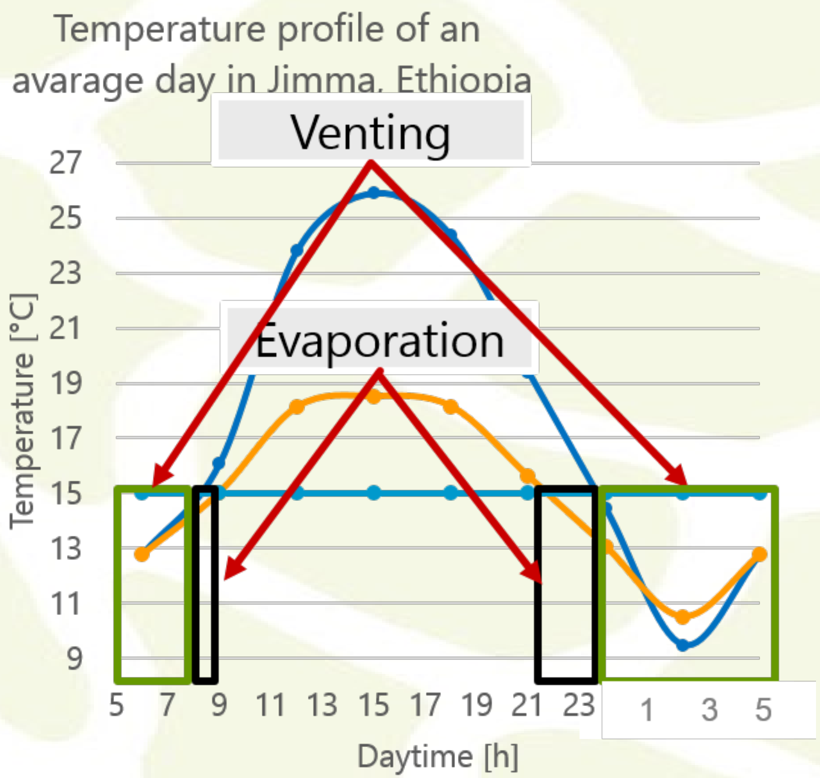
A 10.72 m^3 mud store structure was built, simulating the most common storage systems in most rural areas of SSA.

Need for evaporation cooling

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Utilizing diurnal fluctuations for cold storage

Tropical climate conditions only allows effective evaporative cooling during short time during the day.



Evaporative cooling times:

- Morning (very limited)
- Late evening

During the night:

Venting of the store house

During the day :

Insulation of the store house

Attention: seasonal variability

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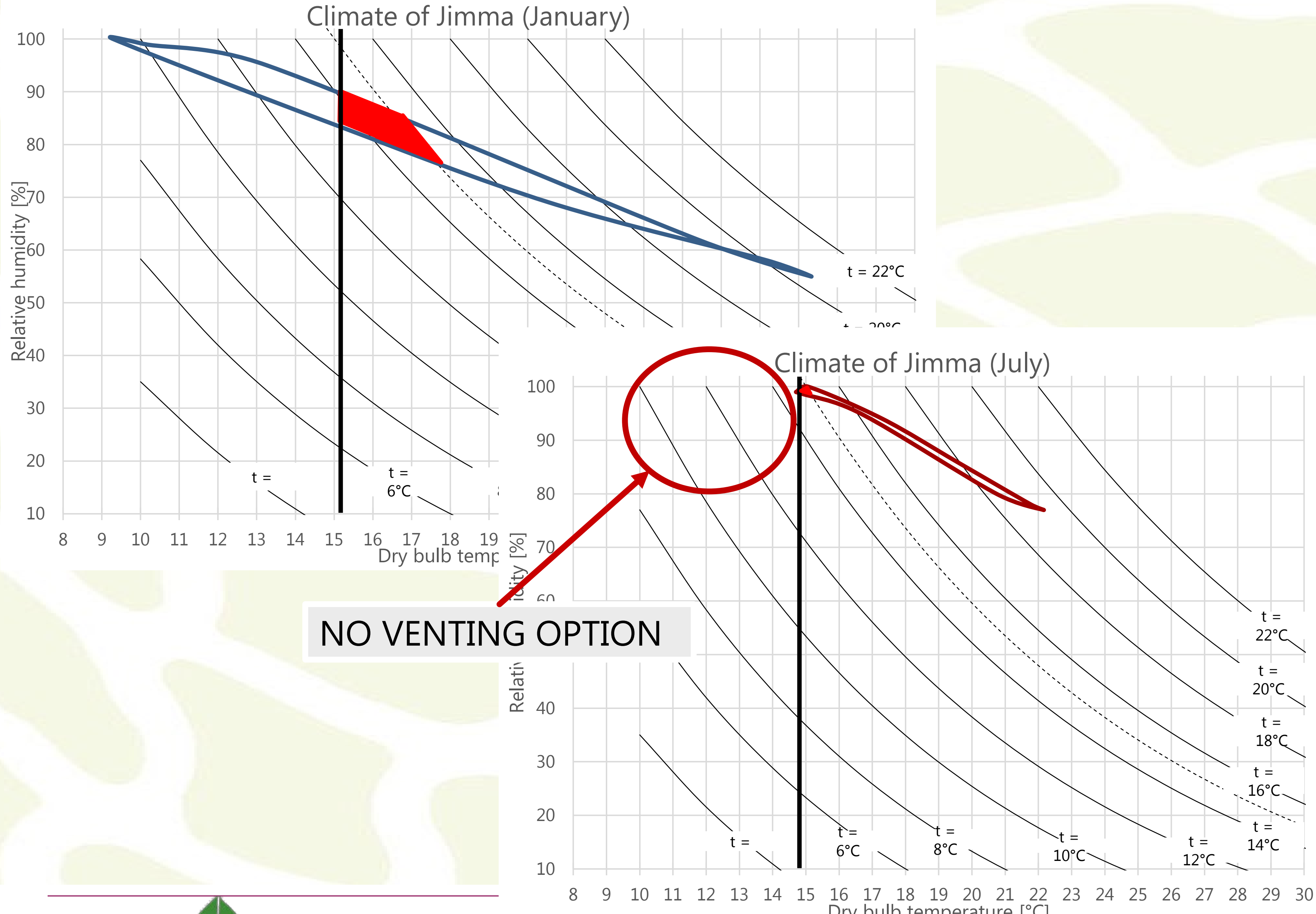
Department of agricultural engineering



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Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Successful cooling (15°C + max. 0,5°C during the day) depends on

- tropical climate conditions
- season
- insulating material

    e.g. coffee husks as a very cheap ressource with a low thermal conductivity

- Keep the door closed in the daytime

    loading and unloading management

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Solar spray drying of milk

Background: Solar Technology in the dairy Industry….

- In Australia, utilization of solar energy in over 80 % o f the heat demanding processes between 60 and 80 °C
- In india, Arun solar concentrators have been used in steam and hot water generation for pasteurization of milk

Approximately 4 kilo tonnes of oil/year and 4 million US dollars can be saved when solar is used in Spray drying of milk

Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL
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Challenges in spray drying

- Spray drying is an energy intensive process - need for a constant power supply for efficient operation and the production of quality milk powder products.
- The high prices and unreliability of grid electricity in developing cause problems for small scale dairy farmers.
- need for reduction of energy in Dairy processing plants

Use of Solar thermal systems in the dairy industry

Solar (evacuated tube and flat plate) collectors can be used in heating applications in a milk spray drying

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL

Engineering is a service to humanity

Thank you for your attention!

AGRARTECHNIK WITZENHAUSEN
Gardis von Gersdorff, MSc agrar.
Department of agricultural engineering
ÖkologischeAgrarwissenschaften UNIKASSEL