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FINAL YEAR PROJECT

A NOVEL SOLAR POWERED FOUR CHAMBERED GRAIN STORAGE SILO FOR SMALLHOLDER FARMERS.

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*A final year project proposal submitted to the Department of chemical and Processing Engineering in partial fulfillment of requirements for the award of **Bachelor** of Science in Agro-Processing Engineering.*

3rd/01/2023

Declaration

We Mukama Musa, Mugalya Brian, Niwahereza Ishameil, Wanyama Paul and Mwanyi Ian, declare that this project work is our original effort and has never been produced in part or whole for any academic award in any university, college or institution of learning.

Mukama Musa

Date: 07/02/2023

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Approval

This final report has been submitted to the Department of Agro-Processing Engineering for examination with approval from the following supervisors

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Dedication

We dedicate this report to our dear Parents for their support towards our academic advancement.

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Authors Contributions: All authors equally contributed towards the construction of the different parts of the project and assembling of these parts to come up with a single standing project. However, the work was divided among authors in the following ways.

Name	Activities
MUKAMA MUSA	Design of silo, its chambers and other components
MUGALYA BRIAN	Ergonomics and aesthetics and ladder design
WANYAMA PAUL	Silo monitoring system design
NIWAHEREZA ISHAMEIL	Sizing of the PV system
MWANYI IAN	Manufacturing processing, tools and equipment

Contents

List of acronyms

1. SMS – silo monitoring system
2. ERF- ergonomics risk factors
3. LED- light emitting diode
4. LCD- liquid crystal display
5. IEA- international ergonomics association
6. PV – Photovoltaic

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1.0 CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

The production of diverse sorts of grains has improved progressively due to employment of advance production practices however, because of inappropriate storage facilities massive volumes of grains have been spoiled (Singh et al., 2018). Grain losses owing to poor storage practices in maize for example can reach 20-30 % under reasonable conditions.(Olorunfemi & Kayode, 2021). These storage losses are mainly due to the smallholder farmers with poor storage practices. Despite the fact that these smallholder farmers use poor storage technology which lead to sufficient grain losses, there is a need to store these grains in that storage of food after harvest is very important for smallholder farmers as it mutually guarantees them with food security and also protects them from exploiting food-merchants who want to buy the food cheaply at the time of harvest(Zachary et al., 2015). Smallholder farmers carry out inter-cropping (where they can grow more than one kind of crop on the same piece of land) on pieces of land less than 2 hectares where they are able to harvest to about 1.5 tons (of maize) per hectare and they contribute to one-third of the worlds' food(Omotilewa et al., 2018). These farmers mainly grow food for home consumption then the surplus can be sold off if the prices are favorable. The main reason therefore for food storage at smallholder farmer level is to keep food up to when the subsequent harvest starts for instance in some cases, maize is stored for nearly seven months till the next harvest jerks(Manandhar et al., 2018). Despite that fact that these smallholder farmers need to store food for about 7 months or more up to the next harvest, they still use traditional storage practices such as traditional granaries, hips in residence houses, woven polypropylene bags among others. However, traditional storage facilities such as granaries, cribs and woven polypropylene bags may prompt the grain to different deterioration agents and cannot guarantee the protection of stored grains for longer periods; thus, such grain losses are considered as one main cause of food insecurity for smallholder farmers in developing countries.(Costa, 2015; Duguma, 2020). Grain storage loss is a major contributor to post-harvest losses and is one of the main causes of food insecurity for smallholder farmers in developing countries.(Manandhar et al., 2018).

A study by (Zachary et al., 2015) reveals evidence that metal silo technology is effective against main storage pests and that its adoption can significantly improve food security in rural

6.0 REFERENCES

Almazrouei, A. (2019). *Solar Charge Controller Datasheet*. 6.

Aradwad, P., Kumar, A., Dubey, A., & Mani, I. (2021). *Development of microcontroller-based data logger for real-time monitoring of drying and storage of food grains*. *November*. https://doi.org/10.52151/aet2021451.1528

Basyoni, M. S. S., Basyoni, M. S. S., & Al-Dhlan, K. (2017). Design, Sizing and Implementation of a PV System for Powering a Living Room. *International Journal of Engineering Research and Science*, *3*(5), 64–68. https://doi.org/10.25125/engineering-journal-ijoer-may-2017-23

Bhatia, A. (n.d.). Design and Sizing of Solar Photovoltaic Systems. *Continuing Education and Development, Inc*, *877*, 2–125.

Blockley, D. (2016). *Analysis of structural failures*. *August*. https://doi.org/10.1680/iicep.1977.3259

Boac, J. M., Casada, M. E., & Maghirang, R. G. (2010). *M i p s g o m d p*. *53*(4), 1201–1216.

Bwambale, J., Durodola, O. S., & Nabunya, V. (2020). Development and evaluation of an improved maize silo to advance food security in Uganda. *Cogent Food and Agriculture*, *6*(1). https://doi.org/10.1080/23311932.2020.1834666

Carson, J., & Craig, D. (2015). Silo design codes: Their limits and inconsistencies. *Procedia Engineering*, *102*, 647–656. https://doi.org/10.1016/j.proeng.2015.01.157

Chang, W., Huang, Y., & Chang, C. (2015). *Straight ladder inclined angle in a field environment : The relationship among actual angle , method of setup and knowledge*. *March 2016*. https://doi.org/10.1080/00140139.2015.1115897

Costa, S. J. (2015). Taking it to Scale: Post-Harvest Loss Eradication in Uganda 2014-2015. *Project Implementation Report*, *December*, 1–25. https://documents.wfp.org/stellent/groups/public/documents/reports/wfp289790.pdf

Dal-Uyen, D., Yaptenco, K., Peralta, E., & Suministrado, D. (2019). Microcontroller-based control system for safe grain storage in silo. *IOP Conference Series: Earth and*

Environmental Science, *230*(1). https://doi.org/10.1088/1755-1315/230/1/012020

Duguma, H. T. (2020). Indigenous Knowledge of Farmer on Grain Storage and Management Practice in Ethiopia. *Food Science and Nutrition Technology*, *5*(4), 1–14. https://doi.org/10.23880/fsnt-16000224

Eisenmann, B. (2013). *Integrating Sensor Technology with the Arduino UNO Microcontroller for Object Detection*.

Ejiofor, O. S., Benneth, N. D., Uche, O., & Celestine, U. (2019). Design and Development of a Charge Controller for a PhotoVoltaic System. *International Journal of Innovative Research in Electronics and Communications*, *6*(3), 0–8. https://doi.org/10.20431/2349-4050.0603001

Farahani, H., Wagiran, R., & Hamidon, M. N. (2014). *Humidity Sensors Principle, Mechanism, and Fabrication Technologies: A Comprehensive Review*. https://doi.org/10.3390/s140507881

Friedenberg, J., & Bertamini, M. (2015). *Aesthetic Preference for Polygon Shape*. https://doi.org/10.1177/0276237415594708

Golenko, A., & Students, F. (2010). *Fundamentals of Machine Design A Coursebook for Polish and Foreign Students*.

Hekkert, P. (2014). *Design aesthetics : Principles of pleasure in design*. *May*.

Into, T. A. P., & Sun, T. H. E. (n.d.). *No Title*.

Kumar, D., & Kalita, P. (2017). Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries. *Foods*, *6*(1), 1–22. https://doi.org/10.3390/foods6010008

Maithili, P., & Kanakaraj, K. (2019). A charge controller techniques for solar PV system. *International Journal of Engineering and Advanced Technology*, *8*(6 Special Issue 3), 2015–2017. https://doi.org/10.35940/ijeat.F1282.0986S319

Manandhar, A., Milindi, P., & Shah, A. (2018). An overview of the post-harvest grain storage practices of smallholder farmers in developing countries. *Agriculture (Switzerland)*, *8*(4),

13–20. https://doi.org/10.3390/agriculture8040057

Mobolade, A. J., Bunindro, N., Sahoo, D., & Rajashekar, Y. (2019). Traditional methods of food grains preservation and storage in Nigeria and India. *Annals of Agricultural Sciences*, *64*(2), 196–205. https://doi.org/10.1016/j.aoas.2019.12.003

No Title. (1988). *20850*(October).

Nteka, N. E., & Kanyarusoke, K. E. (2020). Trnsys Validation of a 1.5 Axis Tracking Concentrated Solar Photovoltaic Thermal System. *SSRN Electronic Journal*, 43–49. https://doi.org/10.2139/ssrn.3658921

Olorunfemi, B. J., & Kayode, S. E. (2021). Post-Harvest Loss and Grain Storage Technology- A Review. *Turkish Journal of Agriculture - Food Science and Technology*, *9*(1), 75–83. https://doi.org/10.24925/turjaf.v9i1.75-83.3714

Omotilewa, O. J., Ricker-Gilbert, J., Ainembabazi, J. H., & Shively, G. E. (2018). Does improved storage technology promote modern input use and food security? Evidence from a randomized trial in Uganda. *Journal of Development Economics*, *135*(July), 176–198. https://doi.org/10.1016/j.jdeveco.2018.07.006

Onibonoje, M. O., Nwulu, N. I., & Bokoro, P. N. (2019). A wireless sensor network system for monitoring environmental factors affecting bulk grains storability. *Journal of Food Process Engineering*, *42*(7), 1–11. https://doi.org/10.1111/jfpe.13256

Patel, S., & Patel, V. (2019). *Design and Analysis of storage vessel (Silo)*. *4*(5), 101–119.

Post, R. A. G., Blijlevens, J., & Hekkert, P. (2013). *The influence of unity-in-variety on aesthetic appreciation of car interiors*. 2943–2948.

Rowe, N. E. (2020). *Themes , Color , Tone , and Aesthetics Themes , color , tone and aesthetics*. *May*. https://doi.org/10.1007/978-3-319-61280-5

Selki, H. M. (2017). *A Literature Review of Ergonomics Programs*. *2017*(12). https://doi.org/10.23918/iec2017.21

Selvam, R., Clement, G., & Muthiralan, V. (2018). *Study of Steel Silo Used for Material Storage*. *13*(5), 2271–2275.

Singh, V., Kumar Verma, D., & Prakash Srivastav, P. (2018). Food Grain Storage Structures: Introduction and Applications. In *Engineering Interventions in Foods and Plants* (Issue November). https://doi.org/10.1201/9781315194677-8

Surface Finish Measurement Objectives. (n.d.).

Tedla, T. B., Bovas, J. J. L., Berhane, Y., Davydkin, M. N., & Shaji James, P. (2019). Automated granary monitoring and controlling system suitable for the sub-Saharan region. *International Journal of Scientific and Technology Research*, *8*(12), 1943–1951.

Universitario, C. (2001). *THE S ILO W ALL P RESSURES Generating Model for Discharge Analysis*. *127*(October), 1067–1074.

Viola, A. (2017). *Scaling Up Post-Harvest Losses Interventions in Uganda Through Market Forces*. 57. https://www.hks.harvard.edu/sites/default/files/degree programs/MPP/files/17 3 MPP_PAE_Agustin Viola_Scaling Up Post-Harvest Losses Interventions in Uganda Through Market Forces.pdf

Wang, H., Xiao, Q., Xu, J., Wang, H., Xiao, Q., & Xu, J. (2018). *Direct-Contact Heat Exchanger Direct-Contact Heat Exchanger*. *April*.

Zachary, G., Hugo, D. G., & Tadele, T. (2015). Metal silo grain storage technology and household food security in Kenya. *Journal of Development and Agricultural Economics*, *7*(6), 222–230. https://doi.org/10.5897/jdae2015.0648

Zdravkov, L. (2017). *Some specific features of design of steel silo with capacity v = 110 m3*. *November*.