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Translating Research in Agriculture into Practice Solutions at Kapasa Makasa University: A Collaboration between Librarians and Teaching Fraternity

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ABSTRACT

At Kapasa Makasa University (KMU), students conduct numerous experiments in the natural laboratory, focusing on enhancing crop growth and yield through organic soil treatments. Unfortunately, these research reports often remain on library shelves, primarily serving as references for other students on previously explored topics and report writing techniques. This paper aims to bridge that gap by addressing the challenges of adapting research-led knowledge to community levels and offering practical measures to overcome these obstacles. Through a collaborative effort between university librarians and teaching staff, the paper examines findings from two student agricultural research projects: the production of soybeans and the propagation of Mukula tree (Pterocarpus chrysothrix) seedlings.

It argues that translating such research-based knowledge into practical agricultural applications within communities can significantly boost agricultural productivity and create value. By implementing improved techniques for soya bean production and Mukula seedling propagation, rural livelihoods can be enhanced through income generation from products such as cooking oil, livestock feed, poultry and fish feed, as well as supporting those interested in developing nurseries and tree plantations. The paper highlights the potential for increased agricultural productivity and economic benefits through the practical application of student research findings, thereby fostering a stronger connection between academic research and community development.

KEYWORDS: *Adaptation of Research Outputs, Kapasa Makasa University; Agricultural Products, Value-Addition; Job Creation; Economic Empowerment. Muchinga Province.*

1.0 Introduction

The Eighth National Development Plan (8NDP) (2022) recognizes the agriculture sector as a key driver of Zambia's economic growth, given that the sector provides livelihoods for more than 70 percent of the population. However, the sector faces challenges such as low productivity, limited mechanization, and heavy dependence on rainfall. As such in between 2011 and 2020, it was reported that agricultural growth averaged only 0.4 percent annually, with its share of GDP at 5.8 percent. This growth rate falls below the annual national population growth rate of 2.8 percent, leading to declining incomes for households reliant on agriculture. To address these constraints, the 8NDP emphasizes the need to increase agricultural production and productivity through enhanced research and development. The plan proposes developing improved varieties and breeds of crops, tree crops, livestock, and fish.

It must also be pointed out that climate change, land degradation, and a declining national economy create significant challenges for the agricultural sector, hindering its growth and the improvement of livelihoods. It is therefore crucial to provide farmers with scientific, research-based knowledge to enhance their capacity. This necessitates the adaptation of science-led innovations to boost agricultural productivity and improve the livelihoods of rural populations (Anantha et al., 2016). Kearney (2009) underscores that knowledge generated by research is the foundation of sustainable social development.

Globally, universities lead in mobilizing knowledge for sustainable growth and development by applying research through participatory approaches. However, in Zambia, universities have made limited efforts to adapt research-generated knowledge and technologies to initiatives that enhance livelihoods, particularly in rural communities. In response, librarians and teaching staff at Kapasa Makasa University (KMU) have collaborated to create a program aimed at translating agricultural research into practical solutions. The program seeks to enhance agricultural productivity and improve local livelihoods by leveraging the insights and innovations derived from university research.

1.1 Background About KMU

KMU named after the late freedom fighter and politician, Mr Kapasa Makasa (born Robert Speedwell Makasa), is located in Chinsali, Muchinga Province of Zambia. It was opened on 10th October 2016, as a campus of the Copperbelt University (CBU). The campus initially had two teaching departments, namely, Information Communication Technology and Agriculture and Aquatic Sciences offering Bachelor of Science in ICT with Education, Bachelor of Science in Animal Science; Bachelor of Science in Fisheries and Aquaculture; and Bachelor of Science in Agroforestry.

In June 2021, KMU officially separated from CBU and established the School of Applied Sciences and Technology, which comprises three teaching departments: Education and Open Distance Learning, Information and Communication Technology, and Agriculture and Aquatic Sciences. The university maintained the three programmes in Sustainable Agriculture, Animal Science and Fisheries and Aquaculture. Meanwhile, the Bachelor of Science in ICT with Education was restructured to include minors in Biology, Chemistry, Physics and Mathematics, and a new programme, Bachelor of Science in Cyber Security was introduced with its first students admitted in 2022 academic year.

As a pioneering institution of higher learning in Muchinga province, designed to be a centre of excellence in natural sciences, KMU offers degree programs focused on harnessing natural resources and agriculture. KMU graduates are equipped with skills to develop natural resources identified as alternative growth points for the national Gross Domestic Product (GDP). KMU produces a cadre of graduates that can make a difference and contribute towards job creation and entrepreneurship, which will in turn lead to wealth creation, poverty reduction and economic development. With such human resource, Zambia stands to create realise their initiatives aimed at diversifying the economy away from its reliance on copper exports.

1.2 Statement of the Problem

As noted above, the degree programmes offered at KMU border on harnessing natural resources and agriculture. Apart from classroom theories, students do a lot of experiments in the natural laboratory as well as experiential learning in the field. Agro-forestry students, for instance, have researched on how to improve growth and increase the yield of different crops using organic treatment on soils. Such research outputs can be practically applied to increase the yields of farmers in Chinsali, and elsewhere in the country, who cannot afford chemical fertilizers, which in any case continuously deplete soils and eventually result in decline of crop yields. However, these research outputs have largely remained theoretical, ending up on library shelves without real-life application. There is a need to translate this knowledge into practical solutions to benefit the country in general and local communities in particular.

1.3 Aims of the Paper

The aims of this paper are:

1. To exemplify the translation of research in agriculture at KMU into practice solutions to improve agricultural production and better the livelihoods of the people of Chinsali, thus contributing to the national agenda for economic transformation.
2. To highlight constraints and challenges involved in adapting research-led knowledge and techniques to community levels.
3. To propose measures for anticipated challenges and constraints.
4. To advocate for funds allocation to adaptation of research output programmes and increased funding of research and innovations.

2 0 Methodology

This paper is based on two studies that students at KMU conducted in the natural laboratory and produced research reports in partial fulfilment for the award of bachelor degrees of the university. The authors decided on agriculture because of its significance to the country's economic transformation agenda. A full list of student research project reports available in KMU library was used to select research topics that were appropriate for adaptation to the local communities around the university. The reports were reviewed to identify literature relevant to the investigation, providing a broader understanding of the subjects. The two research projects examined were:

i) Evaluating the effects of improved compost on the growth and yield of Soya beans, done by Isabel Kamanga in 2019.
ii) A comparative study of the germination rate and growth rate of Pterocarpus Chrysothrix (Mukula) sown in four different growth media, done by Henry Zulu in 2019.

Study 1

In the study to evaluate the effects of improved compost on the growth and yield of Soya beans, an experiment was conducted using three soil treatments. One sample was treated with normal compost, another with improved compost and the unamended control.

a. Preparation of Normal Compost

Chicken manure, soil and plant residues were laid in layers, in a repeated order to form a compost heap. This was covered with a plastic and watered to provide moisture needed for the decomposition process. The heap was turned after one month in order to mix the different layers of the compost. After two months, all the materials mixed could not be differentiated which indicated that the compost was ready for use.

b. Making the Improved Compost

The normal manure was improved by adding wood ash which was obtained from the combustion of different twigs from different plants.

c. The Experiment

An area of 6m by 6m was prepared for the field experiment. The Safari variety of Soya bean from SEEDCO was inoculated and planted. Rows of Soya beans were subjected to the three different treatments, namely, normal compost, improved compost and the control and each treatment was replicated five times. The first application of the treatment was done two weeks after germination and the next application was done two weeks later. The crop was weeded every two weeks and sprayed with an insecticide to control pests. Data collection was done immediately the plant started flowering (i.e. eight weeks after germination). The parameters that were observed and measured were; the leaf area, number of flower clusters, number of leaves per plant, the number of flowers per plant, number of pods per plant, the pod weight and the final pod yield.

Study 2

In the study on the germination rate and growth rate of Pterocarpus Chrysothrix (Mukula) sown in four different growth media, the first step was to create a greenhouse in order to control the temperature. The greenhouse was open sided with an environmental control shade net which was rolled up and down to regulate the temperature.

a. Source of Material Used

Mukula seeds were collected from different healthy Mukula mother plants within Mulakupikwa area in Chinsali. Four growth media, namely, Coco peat, compost, sawdust and topsoil were collected from various places within Chinsali.

b. The Experiment

To measure the germination and growth rate of Mukula, Coco peat, compost, sawdust and topsoil as a control, were used in the experiment. The four treatments were replicated six times and small cuts were made in the Mukula seeds before planting. This was done to make the seed coat permeable to water and air to initiate the germination process. Watering in the greenhouse was done two to three times a week. Data was collected through observation of parameters such as the emergence, germinating percentage, seedling height, and number of leaves.

3.0 Key Findings

In the study involving the application of improved compost on Soya bean, it was evident from the results that there were significant increases in growth as could be seen from increase in leaf area, flower clusters and number of pods. The yield also increased as can be seen in Table 1.0 below.

Table 1.0: Soya bean treated with improved compost

S/No.	Treatment	Leaf area	No. of Flower clusters	No. of pods	Average Yield
1	Normal Compost	19cm²	5	8	0.592 ton/ha
2	Improved Compost	20cm²	6	10	0.704 ton/ha
3	Unamended	17.7cm²	5	7	0.584 ton/ha

Results of the study on the germination rate and growth rate of Pterocarpus Chrysothrix (Mukula) sown in four different growth media indicated that germination of Mukula seedlings was shortest in Coco peat, followed by sawdust and topsoil and finally compost. It was observed that coco peat growing media gave a germination rate of 83.3%, sawdust was at 66.7%, topsoil had 50% with compost trailing at 16.7% germination rate. Mean height values revealed that maximum seedling height of 12.3cm was recorded in sawdust by week nine, followed by topsoil with a mean height of 10.8cm, then Coco peat at 9.4cm and compost had the least mean height at 8.4cm. The number of leaves on the seedlings sown in different media were observed and recorded starting from week two, week four, six and eight. In the eighth week, it was observed that the seedlings grown in Coco peat were in the lead with an average of ten (10) leaves per plant, followed by seedlings growing in sawdust and soil which averaged eight (8) leaves per plant. Seedlings grown in compost trailed at five (5) leaves on average per plant. Table 2 below portrays these findings.

Table 2.0: Germination and growth rate of Mukula seedlings

S/No.	Treatment	Germination Period	Germination Rate	Mean Height	No. of leaves by week			
Week					2	4	6	8
1	Coco peat	14 days	83.3%	9.4 cm	2	4	7	10
2	Sawdust	17 days	66.7%	12.3 cm	2	3	6	8
3	Topsoil	17 days	50%	10.8 cm	2	2	5	8
4	Compost	20 days	16.7.%	1.4 cm	0	2	4	5

4.0 Discussion

The findings of the study on the effects of improved compost on the growth and yield of Soya beans were collaborated by different researches on use of wood ash, compost or a combination of the two (Ajala, et al, 2017; Desforge and Meyers, 1992; Keyser and Li, 1992; Orellana et al, 1990; Demeyer et al, 2001; Singh and Chaudhari, 2006). These studies indicated that potassium in large quantities is essential for flower and fruit growth and also helps plants fight disease. Muse and Mitchell (1995) asserted that ash has both macro and micro nutrients in different quantities such as calcium, potassium, aluminium, magnesium and various traces of elements such as iron, phosphorous, manganese, sodium and nitrogen while compost is a rich source of major elements such as nitrogen, phosphorous and potassium. Fanuel and Gifole (2013) observed that compost on its own has limited content of micronutrients needed for growth, while wood ash on the other hand had been used as a liming material and fertilizer to grow different crops. Thus the use of compost in combination with ash can be viewed as a balanced source of nutrition for the plant resulting in better yields. Shivakumar and Ahlawat (2008) also affirmed that 'the addition of ash to compost increases yield by influencing a number of growth parameters such as branches per plant, flowers per plant and produces more vigorous growth and development.

Observed results in the study on germination and growth of Mukula, are similar to others that had been conducted earlier (Khan et al., 2013; Gasco, 2005; Rizzardi et al., 2009; Trivedi et al., 2016; Smith et al., 2011; Logendra et al., 2001;). The above researches explain why certain media could facilitate germination and growth of the Mukula seedling. Factors such as availability of nutrients, adequate moisture content or lack of it, good porosity and aeration which increases metabolism through respiration which in turn increases growth. Mori and Marjenah (2013) observed that coco peat is a best media that support quick germination, but due to the quick depletion of essential nutrients, it is a slow growth media. Mukula sown in sawdust attained the highest seedling height due to its ability to retain water which is much needed by the plant at the seedling stage (Logendra et al., 2001). Furthermore, sawdust showed better growth rate than any other media because it had good porosity and high air spaces (Jong Myung et al., 2000).

5.0 Implications for Policy and Practice

KMU must apply research-generated knowledge and technologies to enhance the livelihoods of surrounding local communities. This necessitates that the university's research publications and innovations policy incorporate guidelines for applying research findings to address practical issues and problems. Various Knowledge Translation Models such the CIHR Model of Knowledge Translation, the Ottawa Model of Research Use, the Knowledge-to-Action Process Framework and the Coordinated Implementation Model (Sudsawad, 2007) can be examined in order to select the most appropriate for each implementation.

In practice, the knowledge produced from the two student researches for instance can be used to transform the lives of villagers in Chinsali. The research dealing with increasing the production of soya beans, can significantly improve the livelihoods of many residents of Chinsali because soya beans is a rich source of protein that can serve as good nutrition for children. It is also an appetizer and thus can help curb malnutrition in children. In addition, soya can be used to generate incomes for rural communities. Above all, Soya contributes to soil fertility by fixing back atmospheric Nitrogen.

In the second research, although value-addition of the Mukula tree may take several decades, communities in Chinsali can still benefit from propagation of seedlings as these can be sold to individuals and groups wishing to start up plantations. This in turn will ensure the availability of the Mukula tree in generations to come and allay fears that the tree will become extinct. With assured propagation of the Mukula tree, factories can be set up for processing the full grown trees into timber and timber products such as tables, chairs, cupboards, beds, kitchen units etc. Job creation is a sure outcome. Institutions, government offices and individuals can order such products from within the province and contribute to the economic empowerment of the people of Chinsali and Muchinga Province as a whole, hence contributing to the "Socio-economic transformation for improved livelihoods" as envisaged in the Eighth National Development Plan 2022-2026. It should be noted that this paper is not advocating for indiscriminate cutting of Mukula tree by greedy individuals and exporting it to China or elsewhere, but for discrete use within the province and the borders of Zambia so that institutions should not order furniture from China which was made from Zambian Mukula tree.

6.0 Translating Research Knowledge at KMU

The communities can be organized for participation in the knowledge translation process. KMU can use the Knowledge-to-Action Process Framework to translate the research knowledge from its research output whether from students' or members of staff. However, there will be constraints and challenges of adapting research-led knowledge and technologies to community levels. The University must identify such constraints and seek to overcome them. Major challenges are discussed below:

i) Communities are Predominantly Gatherers

Residents in the villages of Chinsali are predominantly gatherers of forest products such as wild fruits, mushrooms, and caterpillars which they sell to earn a living. These products are supplemented by harvesting of domestic fruits like mangoes, pawpaw, guava, avocado, bananas and lemons, which do not demand a lot of time and attention from the farmer before they produce fruit. When forest products and domestic fruits are out of season, they turn to fish business. The issue then is how to get people who are gatherers by nature to settle for agriculture which will take several months and a lot of care to yield results.

ii) Maize Cultivation the Major Agricultural Activity

Like the rest of Zambia, maize growing for the production of mealie meal for home consumption, is the normal farming activity in Chinsali. The challenge that is there is how to persuade the residents to embark on soya production for commercial purposes.

iii) The Belief that you cannot Grow Crops without Chemical Fertilizers

There is a common belief that one cannot grow crops without use of chemical fertilizers because you will yield nothing if you do. There is need to dispel this belief by demonstrating that crops can successfully be grown with organic manure.

iv) Resistance to Change

Any change is normally met with resistance, more so changing people's set ways and life styles. The challenge here is to get target communities to adopt research-based knowledge and technologies as their own.

v) Limited Resources

KMU has limited financial resources at the moment which can be disbursed toward financing research and adaptation of research-based knowledge. The human resource also needs reinforcement because currently there is only one technician for sustainable agriculture and another for fisheries and aquaculture.

7.0 Measures to address identified Challenges and Constraints

i. Demonstrate that Agriculture is Profitable even without Chemical Fertilizers

In order to change the mind-set of the people so that they can see agriculture as a profitable venture even without the use of chemical fertilizers, librarians and teaching staff at KMU have teamed up to implement participatory Technology demonstration plots, for the cultivation of Soya beans and Mukula seedlings, using the methods stipulated in the two researches mentioned in this paper. They have identified three recent graduates living in Chinsali and incorporated them in the pilot program. The surrounding communities will notice what is going on in the university and may on their own set up similar plots to try out the techniques.

ii. Convince Local Communities that Farming can Improve their Standard of Living

The residents need to be convinced that farming is not all about maize for mealie meal and food crops such as sweet potatoes, vegetables, and pumpkins for home consumption for a while, but rather something that can improve their standard of living, if they diversified into growing cash crops. Chinsali is endowed with plenty of virgin land and favourable rainfall pattern, with the season starting in November and ending in April. The demonstration program mentioned above will take advantage of these favourable conditions to attain increased yields per lima that will show surrounding communities that agriculture can be a profitable venture for sustainable livelihood.

iii. Help Communities Adopt and Adapt Research-Based Knowledge and Technology

Communities surrounding the University should be helped to view efforts to adapt and adopt the knowledge and technology from research as their own project that can benefit them and transform their lives. The newly graduated students who have been incorporated in the Technology demonstration program can serve as farm facilitators and help sensitize the participants to develop ownership of the program rather than seeing it as a KMU venture.

iv. Write and Submit a Project Proposal for Funding

The University has some funds for research which can be accessed to use in the Technology

Demonstration project. Library staff and their teaching counterparts will prepare and submit a project proposal for the university to fund. The target is to submit the proposal well in advance so that any funds to be disbursed can be done before the onset of the rains.

8.0 Conclusion

The paper has argued that research in agriculture at KMU can be translated into practice solutions to increase yields of small-scale farmers in Chinsali, and that increased production of soya beans can significantly improve people's livelihoods as they can use the soya for child nutrition, sell the excess to generate income or add value by producing cooking oil, or feed for livestock, poultry and fish, all which can be sold for a good price and result in increased household incomes. In addition, propagation of the Mukula tree through growing nurseries and plantations will ensure its availability for generations to come. Furthermore, discrete utilization of the grown Mukula trees for industrial local markets will result in job creation, leading to the economic empowerment of the people of Chinsali and Muchinga Province as a whole, hence contributing to the "Socio-economic transformation for improved livelihoods" as envisaged in the Eighth National Development Plan 2022-2026. The challenges and constraints identified can be overcome with proper planning and application of the proposed measures coupled with commitment from the institution and government support. The research grant should be disbursed independently of the usual annual government funding for the university and such funds should be utilized solely for research purposes. The recommended approach to the Technology Demonstration program, if prudently carried out, will make translation of research in agriculture at KMU into practice solutions to improve agricultural productivity and value creation, a reality.

9.0 Recommendations and way Forward

In order to effectively implement the measures outlined above, KMU, through the authors of this paper, should do the following:

i) Invite farmers from surrounding communities to participate in all stages of the activity. This is important so that they follow all procedures in order to attain desired results.

ii) Engage village headmen to organize meetings where the program will be unveiled with explanation of the purpose, different components of the program, the role of the villagers and benefits of participating.

iii) Encourage voluntary participation and make it clear from the inception that participants' willingness to share responsibilities is a cardinal requirement to be part of the program.

iv) Invite interested persons to register in the program of their choice (i.e. Soya Bean growing or Mukula seedling growing) and to commit themselves to participate at every stage starting from:

   a. Making the compost using chicken manure, soil and plant residues.
   b. Gathering wood ash from heaps that villagers create from the ash generated during every day cooking.
   c. Gathering sawdust.

d. Setting up the demonstration fields.

e. Planting.

f. Managing (watering, weeding and monitoring growth).

g. Harvesting.

h. Assessing the yield.

v) Encourage participants to replicate parallel plots of their own in their fields at home so that at the end of the demonstration program, they will also have something of their own.

vi) Show farmers how to add value to the Soya by turning it into cooking oil or feed for livestock, poultry and fish.

vii) Allow farmers participating in the Mukula tree nursery to decide whether to sell the seedlings or start out plantations.

viii) Expand the program and make it on-going by incorporating it into farmers' field days and introducing farmer field schools, cluster-village level training, and awareness campaigns. (Anantha et al., 2016).

ix) Create a budget line for adaptation of research-based knowledge and technologies. This will ensure the sustainability and continuity of the program.

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