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University of Clermont Auvergne
University of Pavia

MASTER THESIS

**Problem Based Learning for University level in Sub-Saharan
Africa**

Muhammad Ali Anwer
Supervisor: Professor Dr. Maria Sassi

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Statutory Declaration

“I herewith declare that this Master Thesis entitled ‘Problem Based Learning for University level in Sub-Saharan Africa’, is my original work for the Erasmus Mundus Joint Master's Degree in International Development Studies GLODEP. I confirm that the work contained herein is my own, except where explicitly stated otherwise in the text through references or acknowledgements. Furthermore, I declare that the submitted written (bound) copies of the present thesis and the version submitted on a data carrier are consistent with each other in contents.”

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Jméno a příjmení: **Muhammad ALI ANWER**
Osobní číslo: **R190727**
Studijní program: **N1301 Geography**
Studijní obor: **International Development Studies**
Téma práce: **Problem Based Learning for University level in Sub-Saharan Africa**
Zadávací katedra: **Katedra rozvojových a environmentálních studií**

Zásady pro vypracování

Project based learning is an educational strategy whereby the learning process is organized in a manner that students are actively engaged in finding answers by themselves. The question of engaging students largely depends on the situation and the demographic of students. However, concepts like “learning by doing” and or “experimental learning” suggests utilizing the traits including curiosity, in which students actively explore real-world problems and challenges and acquire a deeper knowledge. The curricula are designed in a manner where problem scenarios are central to student learning. The lectures, seminars, workshops or laboratories support the inquiry process over and above the simple subject based learning (Kolmos, n.d.).

The spread of problem-based learning in the fields of medical, economics, architecture, forestry, law, education and social work has been rapid. Proponents of this approach argue that it leads to student motivation, an in-depth learning of the subject, acquisition of higher cognitive learning, development of cooperative skills and helping learners to apply knowledge in real life setting and making the learning process itself relevant. The nature of agricultural learning complements PBL greatly as students learn by applying solutions to individual home-farms, school-farms and community farm projects (Kibett & Kathuri, 2007). In fact, another study claims that demonstration method had significant effect on students’ achievement than those taught with the conventional lecture method (Noah Ekeyi, 2013).

However, an initial investigation of literature reveals that PBL has largely been scarce in terms of its application in agriculture field studies. Especially, with respect to agricultural entrepreneurship in Sub-Saharan Africa. There is scant yet some interesting research including one in Kenya by (Njura, Kubai, Taaliu & Shem Khakame, 2020). They have explored the importance of understanding the relationship between agricultural teaching approaches and food security. Using a combination of interviews and questionnaires from teachers, they were able to gather qualitative data. A simple regression analysis was conducted to assess the statistical relationship between teaching approaches and food security. This is a recent paper and data was collected through primary means. Another analysis by (Kibett & Kathuri, 2007) investigated the effect of PBL on student performance of higher cognitive skills in higher school agriculture. A total of 354 students drawn from ten randomly selected higher education schools in Nakuru District of Kenya were assigned to three treatment groups based on the location of the projects (HFP, SFP and CFP) and one control group. The results revealed that students in project-based learning groups outperformed their counterparts in regular classrooms. In both cases primary data was collected as official data sources with respect to such analysis is in dearth making generalization of PBL in agricultural business difficult.

Statement of the problem: The main question that this thesis will aim to address is to understand the application of PBL at university level in SSA and derive best practices.

Proposed methodology: An internship with AgriSCALE project will allow me to collect primary data thorough design of a comprehensive questionnaire. The AgriSCALE project will allow to develop a contextualized PBL education method appropriate in SSA. The project addresses the strategic bottleneck of the higher education institutes to equip graduates with an entrepreneurial mindset and competences to solve complex development challenges in the agricultural sector. The data collection and subsequent analysis will be instrumental in deriving best practices for PBL in agricultural entrepreneur curricula at university level in SSA.

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L.S.

doc. RNDr. Martin Kubala, Ph.D.
děkan

doc. RNDr. Pavel Nováček, CSc.
vedoucí katedry

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List of abbreviations

HEIs	Higher Education Institute
PBL	Problem Based Learning
SSA	Sub-Saharan Africa
Unipv	University of Pavia
SDGs	Sustainable Development Goals
CAADP	Comprehensive Africa Agriculture Development Programme
WAP	Working Age Population
GDP	Gross Domestic Product

Abstract

This study is largely motivated by the Erasmus+ Programme of the European Union 'AgriSCALE' which is an initiative between six partner Higher Education Institutes (HEIs) in Africa and three HEIs in Europe. The aim of this study is in line with this paper for implementing Problem Based Learning (PBL) to promote agri-entrepreneurial skills amongst the university students in Sub-Saharan Africa (SSA). Development of entrepreneurial skills particularly in agriculture are crucial to the socio-economic development of SSA and in particular to its youth. However, the application of PBL in agricultural entrepreneurship is still at an embryonic stage due to lack of common understanding of definitions, frameworks, guidelines and unavailability of research to further strengthen empirical investigation. Consequently, this study proposes a framework for implementation of PBL in Agri-entrepreneurship curriculum and also proposes two questionnaires as part of an effective evaluation tool kit.

Key Words: Problem Based Learning, Agriculture, Entrepreneurship, Framework, Questionnaire, Sub-Saharan Africa.

Introduction

This study is part of a larger range of work under the AgriSCALE joint initiative which is co-funded by the Erasmus + Programme of the European Union. The initiative aims to reform agri-entrepreneurship education in Sub-Saharan Africa. The aim of this project is to equip the university level students with relevant entrepreneurial competences through teacher training, localized Problem Based Learning (PBL) methodologies and digital learning platforms. There are six partner Higher Education Institutes (HEIs) in Africa and three HEIs in Europe. The nine partner universities are operating in Kenya, Uganda Zambia, Italy, and Finland. The University of Pavia (Unipv) and the other HEIs aim to develop a contextualized PBL education method appropriate in Sub Saharan Africa (SSA). The aim is to equip graduates with an entrepreneurial mindset for catering to multifarious agro sector problems prevalent in SSA. Professor Maria Sassi is the head of the Unipv team.

This study proposes a comprehensive definition and conceptualization of a framework and research instruments for advancing and evaluating problem-based learning for university students in Sub-Saharan Africa, which aim to enhance sustainable and inclusive development of entrepreneurial skill. The development of entrepreneurial skills can address the prevalent issues of food insecurity, poverty and lack of economic opportunities especially for the youth. The main body of the study is organized in different chapters. The first chapter provides background with an explanation of the Sub-Saharan economy and analyzes the differing characteristics including demographics, problems and socioeconomic conditions of Sub-Saharan Africa and the need to develop and harness the potential of the African youth and their entrepreneurial capabilities. The second chapter extensively discusses the state of the art in the academic literature while the third chapter maps the principles and objective of the PBL teaching activity in Sub-Saharan Africa as well as the need for developing a PBL methodology for Agri entrepreneurship. It also provides an extensive analysis of existing PBL model definitions. The fourth chapter proposes a framework for comprehensive and multidimensional PBL integration into the curriculum and provides a robust questionnaire based on the suggested framework to analyze PBL models and activity and

further advance research inquiry in the field. Finally, the fifth chapter concludes with remarks to future research for PBL.

Chapter 1 Background

1.1 Sub-Saharan Africa Population growth and Urbanization challenges.

The 2030 Sustainable Development Goals (SDGs) are the driving force for policy makers to realize a better quality of life by tackling many key issues from poverty alleviation to climate change. Some goals have a direct impact on the topic of interest including ending chronic poverty and hunger, providing access to quality and inclusive education for everyone, and promotion of sustained and inclusive economic development and productivity for all. Agriculture and food are at the heart of SDG number 1 & 2 that seek to end all forms of poverty and strives to achieve food security, end hunger, improve nutrition intake and sustainable agricultural practices. SDG 4 targets equitable and inclusive quality education for everyone including the target 4.4 “which deals with substantially increasing the number of young people and adults who have the necessary skills, including technical and professional skills, for employment, decent work and entrepreneurship”. SDG 8 and particularly target 8.3 which gives credence to entrepreneurial skills states to “Promote development-oriented policies that support productive activities, the creation of decent work, entrepreneurship, creativity and innovation and encourage the training and growth of micro, small and medium-sized enterprises, including through access to financial services”(THE 17 GOALS | Sustainable Development, n.d.). All 17 SDGs and their 169 sub goals are important for improving the quality of life and they have become a significant agenda on the development table for most developing and developed countries. The scope of this paper, however, deals with the relevance of education and contributes to the epistemology of PBL with regards to curriculum. The continent is seeking to promote education and skills of small-scale food producers to double the productivity and income of this group along with the development of systems of sustainable food production and economic activity (Sakho-Jimbira and Hathie, 2020).

The region of Sub Saharan Africa is rich in resources however, it is host to multiple problems for several decades including rapid population growth, unmet educational needs at all levels, unplanned urbanization and chronic food insecurity. These problems instigated the incorporation

of SDGs in the development agenda and the localized and regional plans. The Maputo Declaration in 2003, agreed by African Union Heads of State; adopted the Comprehensive Africa Agriculture Development Programme (CAADP). The was adopted to Improve food security and nutrition situation and accentuate the income and quality of agriculture-based economy. The CAADP increased the allocation of agriculture budget by at least 10 percent to achieve an output growth of at least 6 percent. In addition to the Maputo, the African Heads of state made commitments in 2014 through the Malabo Declaration to achieve accelerated growth and improvement in the indigenous livelihoods (Sakho-Jimbira and Hathie, 2020). Amongst, the commitments were a resolve to end hunger by the year 2025 through means of doubling the productivity, improving the nutrition intake, and cutting the post-harvest losses by at least half.

Despite these commitments, Sub-Saharan Africa presents complexities for policy makers around the world. Globally, the region has the fastest growing population rate despite decreasing global fertility. In fact, according to estimates from FAO (2017), the population of SSA are projected to increase to between 1.5 and 2.5 billion and estimates place more than 4 billion people in that region by the year 2100. With this projection, SSA could account for half of the global population growth between the years of 2020 and 2050. In fact, the population growth rate of Sub-Saharan Africa of 2.8 percent a year is double the rate of South Asia, 50 percent higher than MENA region and 4 times higher than East Asia and Pacific. (ibid). Although, the total fertility declined from approximately 6.3 births per woman to roughly 4.6 births per woman between the period 1990 till 2019, this region still has the world's highest total fertility. The decrease in fertility is not that great, and the rapid population growth can be attributed to a couple of factors including delayed demographic transitions, lower education and contraceptive awareness, and comparatively lower decline in fertility (Bongaarts and Casterline, 2013). Indeed, rapid population growth means more mouths to feed and it culminates into an increased demand for food. Development of Agriculture and increasing capacity of farmers are especially important to satiate this growing demand for food.

In terms of Urbanization, SSA (40 percent urbanization rate) is globally second only to Asia. Currently, half of Africa's population is expected to be in urban dwellings by the year 2035 and is predicted to increase even further (AUC/OECD. 2018). Despite these figures, Africa is nevertheless home to majority of the world's rural population. According to the 2018 World

Urbanization Prospects, both Africa and Asia harbor 90 percent of the global rural population which is projected to increase at a rate of more than 1 percent per annum by 2050. It is estimated that there will be additional 350 million rural dwellers between 2015 and 2050 in Africa (AfDB, OECD, UNDP 2016). Moreover, the rapid urbanization of SSA is shaping the transition in the food demand including a shift in markets and the distribution systems and presenting new challenges. According to FAO (2017) report, the dollar value of the Urban Food Markets will reach approximately USD 500 billion from USD 150 Billion between the years of 2010 and 2030. Expected rural to urban migrations and the growth in the urban dwellers will give rise to higher value-added processed food and agricultural products (Reardon and Timmer, 2014). The public and private sector along with the local entrepreneurs have a key role to play in ensuring the production, distribution, supply chain and managing the marketing activities. Presently, Africa has a youth bulge and a large informal economy, especially in the rural sector. This youth bulge could mean demographic dividends that can be facilitated by youth centered paradigm shift in development.

1.2 Youth Bulge and Potential Demographic Dividends.

The last decades has seen a significant youth bulge in Africa. Youth Bulge is a common phenomenon in many developing countries. It is characterized as a stage where infant mortality is reducing but overall mothers have a high fertility rate. This leads to a relatively higher share of children and young adults which is the case in Africa where, approximately 40 percent of the population is under the age of 15 (LIN, 2012). The WEF 2017 report estimates that 70 percent of the population is aged below 30 and approximately more that 200 million people live between the age group of 15 and 24. This makes African population one of the youngest globally. It is estimated that the working age population (WAP) in Africa will increase by a significant 450 million people between 2015 and 2035 representing a 70 percent increase (WEF, 2017). Moreover, it is predicted that the region will harbor 362 million people in WAP bracket by the year 2050 (ibid). According to the OECD report 2018, the number of working age population in Africa is extraordinary with on average 29 million people turning 16 every year until the year 2030 (AUC/ OECD 2018).

In the right circumstances including employment opportunities and inclusive policies, this youth bulge can yield significant demographic dividends for the countries in SSA. Demographic

dividend refers to the economic benefit resulting from a significant increase in the ratio of WAP to dependents. In addition to the falling dependency ratio, there are observed higher savings, productivity gains and lessening in the social services costs (WEF, 2017). Policy actors and economists have the case of the economic take off the China and one of the determinants of that take off was the relatively high demographic dividend (Feng, 2011). Similarly, The Asian Tigers experienced tremendous economic growth due to investment in education and facilitative policies encouraging the younger population. Research indicates that apposite policies and preparations by the government and the institutional actors including investments in capital; human and physical, good governance, strong leadership, clear plans and export-oriented policies paved the way for the yielding of the demographic dividend (Sarel, 1996). In fact, according to Bloom and Williamson (1998), the demographic dividend had approximately 20 percent input towards the economic growth between 1960 and 1980. Quality education and investment in human capital were the hallmarks of the growth. Africa has very much the same conditions for benefiting from the youth bulge and significantly benefiting from demographic dividends (Eastwood and Lipton, 2011).

Despite this youth bulge, the continent has not been able to achieve demographic dividend due to ill placed policies and lack of prior investments in key sectors including education, health, human capital, SMEs, governance and entrepreneurship (Bloom, Canning, Fink and Finlay, 2007). An additional issue that must be highlighted is the issue of employment. Africa having the youngest population in the world and not enough jobs implies that there are more people suffering from unemployment. The ILO Annual 2017 report estimates approximately three out of 5 young people are unemployed. Even the most skilled must be content with lower remuneration opportunities. This high level of unemployment presents lower opportunities for the demographic dividend to occur and could cause the youth to engage in illegal activities and armed conflict and terrorism activities. This unemployment could be attributed to many features. Chief amongst them are the mismatch between training requirements and educational quality, lack of skills development programs, low penetration of technology and unharvested entrepreneurial skills (ILO, 2018).

The policy makers must keep in mind the future perspective and design educational policies and training methods that lessen the unemployment burden. Moreover, the food insecurity situation and the unemployment decree a consensus amongst the policy makers on rethinking the school

and academic training. This needs to account for developing the skills of the students to meet the needs of the employers and address the prevalent issues at hand.

1.3 Agri entrepreneurship in SSA.

The nation of Sub Sharan Africa accounts for approximately 14 percent ¹ of the world population but only contributes approximately 2² percent to the global Gross Domestic Product (GDP) in terms of US dollars. These problems are exacerbated by persistent poverty, burgeoning food crises, adverse climate change and lower productivity in output. In addition, Africa's economic portrait has been stained by the blemish of lower development of human capital and technical capacity development. Technical training and practical education remain a significant challenge due to lack of management and funding (UNESCO, 2011). These problems are contributing to youth unemployment and shortage of relevant skills. In this respect, the development and economic transformation of SSA holds promise for catalyzing growth and providing employment to the significant youth bulge. Moreover, the literature points out that agricultural sector contributes proportionally more to reduction of chronic poverty than other sectors (de Janvry and Sadoulet, 2009; Christiaensen, Demery and Kuhl, 2006; Omotayo, Ayomitunde, Omolola and Georgina, 2019). Indeed, for countries like Ethiopia, where 85% of the people live in rural areas and depend on agriculture for sustaining livelihoods, the importance of investment in agriculture is undeniable. Both Ghana and Ethiopia have seen improvements in economic growth and poverty reduction through policies aimed at this sector (Economic Importance of Agriculture for Poverty Reduction, 2010). This means that the need for agribusiness in the context of Africa is undeniable. It is a viable means of income and employment for the people living in rural areas accounting for approximately 63 percent of the population (Sakho-Jimbira and Hathie, 2020). Development of the potential of Agribusiness or entrepreneurship will drive economic growth, provide employment opportunities, improve livelihoods and reduce the levels of poverty. It can also lead to an improvement in the social outcomes.

The development of Agri entrepreneurship is contingent upon context specific skills training to develop the capacity for recognizing opportunities, increase product value, drive their businesses

¹ Authors Calculations using World Bank Data for population 2019.

² Authors calculation using World Bank Data for GDP US \$ 2019

and strengthening of backward and forward industrial linkages. Comprehensive networks that link farmers to markets will need to be developed and strengthened with promotion of services including agro processing, storage and distribution, value chains along with logistical support services (Elkan, 1988). In this case young people need to be trained and relevant skills need to be developed for the training of the agribusiness so that the sector can be compatible with the continent's needs.

1.4 The need for Defining Agricultural Entrepreneurship

Before we proceed, it is important to give a definition to agricultural entrepreneurship. There are several important aspects to analyze in the literature pertaining to agricultural entrepreneurship due to the multifaceted environment in which the associated agents engage. There has been a wide interest in the agricultural sector and entrepreneurship in the 18th and 19th centuries (Vik and McElwee, 2011). Despite this curiosity, there is a lack of empirical research in this sector and more attention has been given for manufacturing, industries, high technology and services sector (Alsos, Carter, Ljunggren and Welter, 2011). This was primarily due to agriculture being perceived as low technology intensive with small farming units (family owned) and operating in an environment of heavy government regulation and financial dependence on the government (Green, Covin and Slevin, 2008). Since the last decade however, agriculture has shown tremendous expansion and transformation. Agriculture development is now perceived as an incredible tool for raising people out of poverty and feeding 9.7 billion people by 2050. The growth in incomes of the poor is 2 to 4 times greater in agriculture as compared to other sectors (World Bank, 2020). Approximately, 65 percent of poor working adults made a living through agriculture in 2016 and in 2018, this sector contributed to 4 percent to global GDP in some developing countries. In the case of some developing countries, it even contributed up to 25 percent of GDP³. Policy makers and researchers have rekindled their interest of exploring this sector as there have been significant revolutionary advances towards high technology since the last century (Sassenrath et al, 2008). The literature points out that there are several discussions and debates on a concrete definition of entrepreneurship and there are wide variety of definitions out there. The term is often used interchangeably with that of business owner, sole trader, self-employed and initiator. A farmer by

³ Agriculture and Food World Bank. <https://www.worldbank.org/en/topic/agriculture/overview>

this interchangeability can also be confused to be an entrepreneur. However, this confusion of position vs behavior has caused lack of operational definition that has not been properly explained by the agricultural literature. The definition of entrepreneurship is either based on the ideas of the classical economic expert Shumpter who developed a portrait of an entrepreneur in 1934 (Munier, 2013) or either from the psychological studies of McClelland (1967).

There has been an observed growing consensus in the last few years to define the distinctive aspects of entrepreneurship. According to Shane and Venkataraman (2000) the distinctive features of entrepreneurship are focused towards identification, evaluation and pursuit of entrepreneurial opportunities. According to the authors, these features of classical entrepreneurship are particularly attractive for defining agricultural entrepreneurship due to the following reasons:

- 1) The study on agricultural entrepreneurship is not limited by specific situations.
- 2) It puts focus on the behavioral aspects and the failure to pursue entrepreneurial activities is not attributed only to lack of capability and experience.
- 3) The broader working environment including stakeholders such as farmers family, competitors, employees and chain partners are important as the entrepreneur does not engage with the opportunity in isolation.

There are many debates and discussions by researchers as the definition of entrepreneurship incorporates the development and or expansion of agricultural and non-agricultural business activities by farmers, and the development of novel products and innovations in the process, distribution and marketing for selling (Pindado and Sánchez, 2017). A definition of an entrepreneur should go beyond merely attempting to define who the entrepreneur is or what are his activities since the quality of opportunities identified by different people are not considered under this definition (Shane and Venkataraman, 2000) According to Thurik and Wennekers (2004) the fundamentals of entrepreneurship are in the behavioral and attitudinal characteristics of persons as compared to occupations. This implies that entrepreneurs tend to respond to situational signals of opportunities rather than having a common and stable characteristic across situations.

One of the distinctive topics that is part of entrepreneurship is pertaining to innovation. Despite being dominated by smaller family farms with competitors and traditional output, the liberalization of agricultural trade and policy since the last decade has paved the way for the market-oriented

activities in agriculture (Giannakis and Bruggeman, 2015). Now entrepreneurs are developing new products of higher quality. Additionally, agricultural firms are becoming more industrious by incorporating modern technology although the scale and nature of technology incorporation are dependent upon the size of agricultural unit (Rogers, 2004). Thus, innovation is an important part of agricultural entrepreneurship because it may lead to development of new products or improvements in process, distribution and marketing. An additional aspect that is discussed in the literature pertains to the diversification or increasing sources of income apart from the core farming. In this respect, there is some distinction made between on farm diversification as part of existing business entity and off farm diversification which includes new business projects outside of farming (pluriactivity). Diversification in this context should be defined in context with the on-farm activities and output based on farm resources and should not be confused with pluriactivity. pluriactivity simply is an umbrella term for income generation and diversification of general income generating activities (Vik and Mcelwee, 2011).

1.5 Agricultural Entrepreneurship Definition

At this point it is also important to discuss about what differences constitute between farm business management and entrepreneurship. The former focuses on efficiency and improvements in planning, implementation, management and control of the various aspects. Whereas entrepreneurship constitutes pursuit of opportunities, developing a vision for growth and undertaking risks. Entrepreneurs have certain special characteristics. According to FAO, these can be categorized into six categories including problem solving, core values, flexibility, confidence, drive, and competition. These characteristics are not homogenous in each farmer entrepreneur but are present to various degrees and they allow the farmer to seek out opportunities, generate and execute new idea, combine the resources, set goals and motivate to reach those goals (Kahan, 2012). In addition to these characteristics, knowledge and skills are pivotal for understanding an agricultural entrepreneur. Moreover, the research indicates there are three main levels of entrepreneurial skills including opportunity skills, strategy skills and cooperation and networking skills. These skills are not uniquely effective but rather integrated. The opportunity skills include being able to recognize business opportunities and include a measure of market and customer orientation, awareness of external and internal threats, and the aptitude towards innovation and taking risks. The strategy skills include the development and evaluation of business strategies

including two-way feedback and reflection. These also include goal making, strategic planning, decision making, monitoring and evaluation skills. Whereas the networking skills include the ability to communicate and network with stakeholders as well as communicate in teams by cooperating particularly with other farmers. Having leadership is also key to networking skills (Kahan, 2012).

In retrospect, the focus of agricultural entrepreneurship is the identification and pursuit of opportunities and it emphasizes creativity and innovation, proactiveness, focus, risk-taking and networking (DeTienne and Chandler, 2004). For the purposes of this study the definition of Agri entrepreneurship is based on the skills, characteristics and special considerations. Agri entrepreneurship can be defined as a strategic enterprise that recognizes opportunities and combines factors of production and offer innovating solutions to existing needs and create new opportunities. It is the sum of all operations involved in the manufacture and distribution of farm supplies and production operations and the storage, processing, marketing and distribution to the market. Recognizing opportunity is key as the definition has undergone transformation to one that is more oriented towards market centric as opposed to only farm centric. This definition captures relevant characteristics and skills of agricultural entrepreneurs and is similar to other definitions where an Agri entrepreneur is one that caters to existing value chains through effective management, innovation and networking through the management of natural resources (Payumo, Lemgo and Maredia, 2017).

Chapter 2 Literature Review.

The literature that directly deals with the application of problem-based learning to agricultural entrepreneurship is rather scarce. The scarcity of literature is the novelty which allows the formation of this paper. PBL may take different forms dependent upon the institutions and the contextual settings. However, there are certain general principles that are common across. These principles are, authentic problems or scenarios, relevance of the problems being discussed, students are active participants seeking to learn critically in teams and discuss the results and facilitative role of the teachers to promote learning (Wood, 1994). In the article ‘A taxonomy of problem-based learning methods’, Barrows (1986) explains that when it comes to problem based learning, it does not come down to one teaching method but depends entirely upon the employment

of educational method and the teaching skills therefore leaving them with a vast variety of problem based learning techniques. These varieties are discussed within this article at great length so that the teachers may choose the type of objective they might want to achieve with PBL. One of the many tedious objectives that otherwise cannot be achieved with common educational methods include structuring the knowledge so that it can be used in clinical context. It is often said that education is highly effective when it is taught keeping the context of future tasks in mind (Glaser, 1982). This means that learning should be done in a way that is driven by challenge of practice and is curated in a manner that it helps promote the solving of problems. Such an integration helps structure knowledge which sponsors practice (Schmidt, 1982).

This paper presents several systematic PBL implementation evaluations and its literature. Scrutinizing the literature indicated that some of the confounding variables that occur in the implementation process occur due to way those PBL methodologies are implemented, the design of problems and curriculum and other human factors. Amongst the many issues that came forward included instructional designs such as Models of PBL. When implementing PBL strategies, factors such as the nature of the courses, learning targets and cognitive readiness of self-motivated learning skills of the students can become interfering factors. This is the reason several models of PBL are created and practiced (Kaufman, 2000; Rothman, 2000; Savery, 2006). Even though the broad spectrum of PBL model variations is what makes it more applicable however, it is also the reason that several confounding variables that lead to variations in result. It is also said that the line between problem-based learning and project-based learning is somewhat blurred and when it is used loosely by researchers, attempts in understanding its effectiveness can become difficult (Blumenfield et al., 1991).

2.1 Epistemology of Problem Based Learning

Problem-based learning was pioneered and applied as a curriculum in the medical field at the McMaster University in the 1960s. The primary purpose of the application was to prepare future doctors in the field to think critically and solve the complex medical issues. The purpose of this was the expansion of medical knowledge and simultaneously improve the alignment of traditional classroom learning approaches with those used in medical practice. The traditional approaches were oriented towards the application of the bucket theory (Wood, 1994). This theory was based

on the belief that medical students equipped with the learning foundations would be able to strategically extract the relevant subsets of useful information and address the problems of the clinical practice. However, the problems with the application of the bucket theory is that the proverbial bucket might be inadequately filled, leaking and or overflowing. Consequently, the adoption of PBL approach required an educational paradigm shift in the strategic system of learning from teacher centered to student centered learning. In PBL case, effective pedagogy was rooted in complex case histories typical of real patients. The application of the PBL required that students depend on a cohesive, multidisciplinary knowledge foundation with an aim to enhance collaboration in teams, self-regulated and reflective learning (Wood, 1994).

Once a case was made for PBL, it was necessary to identify an idealized learning cycle at least in the case of the medical profession. According to Engle (1999), the university student's effective pedagogy is based on working on realistic or practical problems by working in teams. Students engage with multiple stages of complex medical cases that are challenging and provide the right context for learning. The process starts by students defining the scope and the constraint of the problems, and then identify and organize relevant ideas and learning. This allows them to identify gaps in their knowledge, develop questions and research outside the classroom in small teams. The students then reorganize and integrate their findings and knowledge into the problem context. The movement along the stages of the complex problem stimulates the pursuit of new learning for a solution. In this case, a successful solution involves an accurate diagnosis and recommendation of successful treatment of the patient. This idealized learning cycle can be adopted for the Agri-entrepreneurship curriculum design

2.2 Effectiveness of PBL with regards to Traditional teaching methods

The preliminary research on the effectiveness of PBL with respect to other teaching methods does not consistently provide definitive answers on which method is superior. The initial meta-analysis by various authors including Vernon and Blake (1993) and Albanese and Mitchell (1993) indicated that PBL has modest or little beneficial impact as compared to the traditional methods. Problem based learning although being very famous in the educational settings, has managed to gather much skepticism amongst theorists. Many researches have been conducted to answer the simple question that whether PBL is effective. Amongst the many meta-analysis that were conducted that studied

the effect of PBL on aspects of learning outcomes such as problem solving skills, domain knowledge acquisition, group processing, psychological and social soft skills etc. majority of the results failed to be conclusive rather had many contradictory results (Albanese and Mitchell, 1993; Berkson, 1993; Colliver, 2000; Neville, 2009; Norman and Schmidt, 1992; Vernon and Blake, 1993). Due to factors such as ignoring human cognitive architecture and cognitive load principles, PBL was seen to be an ineffective method (Kirschner et al., 2006). However, the soundness of PBL was proved by Schmidt et al., (2007) who presented evidence on cognitive science principles and empirical evidence. It has also greatly been argued that even though PBL might not be effective in all aspects of student learning, however it is effective in some aspects of learning such as promoting problem solving skills (Albanese & Mitchell, 1993; Dabbagh & Denisar, 2005; Strobel & van Barneveld, 2009). However, another systematic review of 13 researches conducted to analyze the long-term effects of PBL found that very little evidence was seen to suggest that PBL improves problem solving skills (Koh et al., 2008). However, wondering on why the results showed great level of inconsistencies, it was noticed that all the previous researches conducted studies analyzing elements on two ends where the theoretical conception and its outcome on students learning were analyzed without considering the processes which is how the PBL was actually implemented. When research is done in naturalistic settings instead of in a controlled and manipulated laboratory conditions, several known and unknown factors come forward that are not controlled and could leave an impact the student's learning outcome. Thus in his paper 'Theory to reality: a few issues in implementing problem-based learning', Hung (2011) discusses how to eliminate the debate on how effective PBL is by also analyzing the outcomes and ignoring the processes which would only paint half the scenario, it is important to analyze the implementation of PBL which would also help us understand why the results that were yielded are the way they are, and in turn would also help strategize the improvement PBL strategies to come up with those outcomes of learning that also align with what the theory presents.

An interesting study by Dochy, Segers, Van den Bossche and Gijbels, (2003) had identified a statistically significant positive effect from PBL on the skill set of the students and surprisingly students in PBL remembered more acquired knowledge as compared to the students exposed to more traditional approaches. After analysis of these studies, it can be argued that the earlier meta-analysis only captures exam recall dimension of knowledge which does not consider the richness of the PBL method (Vernon and Blake, 1993). In fact, other authors have pointed out that when

analysis is done based on the knowledge of clinical practice or the ability to apply knowledge in the clinic after graduation, the medical students with PBL experience tend to perform on average better than their traditional counterparts (Albanese and Mitchell, 1993; Gijbels, Dochy, Van den Bossche and Segers, 2005; Vernon and Blake, 1993). It is relevant to point that PBL is a different trend in the area of teaching where complex and real-world problems are taken as examples so students may understand the main concepts or principles as opposed to mainstream learning methods of presenting concepts or facts. This learning method not only enhances critical thinking, but invokes problem solving skills in individuals to a greater degree than traditional classroom methods. (Duch et al, 2001).

Other factors that come forward is the PBL design and the curriculum. Due to its nature of being time consuming and research intensive, literature has shown that designing effective PBL curriculum can be a bit of a challenge for the teachers (Angeli, 2002; Goodnough & Hung, 2008). The fact that whether PBL has been effective in navigating the students to study the required content knowledge is another question that puts its effectiveness to question.

Lastly, human factors that can correspond with the research objectives and hinder the results include students' behaviors, the behavior of facilitator, resources and workload, small group learning etc. In a research it was noted that it is quite a challenge to maintain student's interest in engaging in the required cognitive processes (Taylor & Mifflin, 2008). Glew (2003) noted that facilitator's low attendance in the sessions is also one of the major reasons for why PBL failed to deliver its promises. Another possible factor was the failure of teachers to properly implement the guidelines when developing curriculums. Researches have also shown that when implementing PBL strategies, having a group size of 10-30 students, the main intent of collaborative learning starts degrading. Studies have shown that there has been an insufficient student-teacher ratio primarily with more than 12 students per group (Moust et al, 2005). However, this paper not only focuses on the problems but also provides appropriate solutions that might help improve the applicability of PBL strategies. These solutions include defining and clarifying the PBL model properly, having proper assessments such as triple jump assessment (Smith, 1993), Clinical reasoning exercise (Wood et al., 2000) etc., having proper instructions, teaching the PBL processes and philosophy unequivocally, giving proper scaffolding, pushing students to be responsible when it comes to active learning could actually help and improve the implementation.

2.3 Application of PBL Features to Agricultural entrepreneurship

The literature review has pointed out several facets of ‘problem-based learning’ and by now it must be clear to the reader of this paper that this term does not refer to a specific educational method. It can have many different meanings depending on the design of the educational method employed and the skills of the teacher or the environment in which it was implemented. Essential features of PBL include relevant practical activities, discussion of principles and goals, ill-structured problem scenarios, collaboration of students, decision making in groups and assessment by participants and feedback (Savery, 2021). Moreover, analysis by Newman (2005) has pointed out 5 critical features that are key to the development and execution of problem-based learning. The first feature pertains to the role of the teacher as a facilitator where commonly they are relatively more knowledgeable amongst the community. From a sociocultural perspective, the facilitators inculcate language, values and attitudes of the community, internalize them and integrate the culture of the community in the learning process itself. The many variables and instruments through which the teachers intervene can lead to possible variations in quality and in the educational objectives that can be achieved. A taxonomy is proposed to facilitate an awareness of these differences and to help teachers especially in the universities in Sub-Saharan Africa to choose a problem-based learning method most appropriate for their students. From a cognitive perspective, the role transmutes into one that focuses on the cognitive development of the student and building skills and knowledge of the community. The literature of PBL points towards multitudes of personae that can be adopted by the teacher to increase his interactions with the students. Developing this persona and implementing require clear institutional support and resources and recognition for the high skills needed for applying them.

The second feature relates to the use of an explicit process to facilitate learning. In this respect 8 steps are proposed (Newman, 2005). These are

1. Explore the problem by clarifying terms and concepts that are not understandable, create hypotheses and identify issues.
2. Identify information and knowledge which is known already, and which is relevant.,
3. Identify information and knowledge not known,
4. As a group, prioritize the learning needs, set learning goals and objectives, allocate resources. Group members identify which task they will undertake,
5. Engage in a self-directed search for knowledge,
6. Return to the

group and share new knowledge effectively to integrate new information amongst group members.

7. Apply the knowledge; try to integrate the knowledge acquired into a comprehensive explanation,

8. Reflect on what has been learned and the process of learning itself.

The third feature of PBL is to contextualize and integrate the process of learning by use of problems. According to the author, effective use of scenarios can initiate the learning cycle. These scenarios play a crucial role in the learning environment in the following three ways: the discussion of the problem scenarios can help stimulate and encourage students to recall the pertinent prior knowledge, activate the students' interest and subsequently their intrinsic motivation to learn, and sets a context for the learning of knowledge similar to that in which future use of the knowledge will be required. The fourth feature is about learning within small groups. The design of PBL should incorporate potentially both positive and negative actions. The positive actions result when students learn about team cooperation, which does not by itself initiate as a natural phenomenon. Whereas the negative actions for example conflict and disagreement inevitably occur during the routing work of the group. The "structures" embedded within small groups combined with the tutorial process and the use of problem scenarios, help the students understand the process of learning in groups and additionally how to anticipate, prevent, cope with, and deal with the difficulties that they might experience (Newman, 2005). There are differences of opinion that accrue towards the ideal size for a PBL small group. However, some researchers indicate that development of communication skills, collaboration and knowledge is best done in groups of between five and ten members. The fifth critical feature is about assessment and problem-based learning. PBL advocates that assessment drives learning and that is a need for symmetry between the objectives of a PBL program and what is assessed. However, the consequences of this view are interpreted differently. Some writers suggest that response format is of less significance than content and test design. While others posit that both the response format and the content of the test must be appropriate to PBL. Multiple-choice questions have been perceived to be suitable for only lower levels of taxonomic cognitive function and have therefore been frequently vetoed for use in PBL programs. Others argue, however, multiple-choice questions can be aptly used in PBL. These are various assessment format available including progress test which employs multiple choice format. There is also the Modified essay questions (MEQS) method that if properly designed can lead to intelligent guessing which can mirror the realities of practice. Additionally, there is the triple jump exercise method which is the most widely used in the PBL methodology. This method

is widely conducted in jumps including the structured oral examination which can be based on one or more scenarios of entrepreneurship, a time-limited assignment in relation to the problem scenarios in the first oral inspection, and a repeat oral inspection in which the quality of self-learning around the assigned topic is assessed. The Triple Jump Exercise is currently used in several PBL exercises; however, critics have argued that it can be costly to administer with questionable results.

2.4 The Need of PBL in Agricultural Entrepreneurship

The spread of problem-based learning in the fields of medical, economics, architecture, forestry, law, education and social work has been rapid. Proponents of this approach argue that it leads to student motivation, an in-depth learning of the subject, acquisition of higher cognitive learning, development of cooperative skills and helping learners to apply knowledge in real life setting and making the learning process itself relevant. The nature of agricultural learning complements PBL greatly as students learn by applying solutions to individual home-farms, school-farms and community farm projects (Kibett & Kathuri, 2007). In fact, another study claims that demonstration method had significant effect on students' achievement than those taught with the conventional lecture method (Noah Ekeyi, 2013). However, investigation of literature reveals that PBL has largely been scarce in terms of its application in agriculture field studies. Especially, with respect to agricultural entrepreneurship in Sub-Saharan Africa. There is scant yet some interesting research including one in Kenya by (Njura, Kubai, Taaliu & Shem Khakame, 2020). The authors have explored the importance of understanding the relationship between agricultural teaching approaches and food security. Using a combination of interviews and questionnaires from teachers, they were able to gather qualitative data. A simple regression analysis was conducted to assess the statistical relationship between teaching approaches and food security. This is a recent paper and data was collected through primary means. Another analysis by (Kibett & Kathuri, 2007) investigated the effect of PBL on student performance of higher cognitive skills in higher school agriculture. A total of 354 students drawn from ten randomly selected higher education schools in Nakuru District of Kenya were assigned to three treatment groups based on the location of the projects (HFP, SFP and CFP) and one control group. The results revealed that students in project-based learning groups outperformed their counterparts in regular classrooms. In both cases primary

data was collected as official data sources with respect to such analysis is in dearth making generalization of PBL in agricultural business difficult.

Another research in the area of PBL was done in the background of agricultural sales. Hawley, Hall and Pate (2017) conducted this research on 40 students who were enrolled in Utah state university to understand and implement problem based learning strategies in their agribusiness sales course and to understand how the children saw this methodology and what was their viewpoint of it. The students were presented with a problem in selling certain goods or services and then in pairs, they had to do a semester long project where they not only wrote a sale plan but also delivered the sales pitch and written plan to a prospective customer. Post this project, they were asked to fill out a survey where their motivation was rated to see how readily they are willing to learn with problem-based learning, and how did they view the learning outcomes of the project. In order to eliminate all chances of biasness, this survey was carried out by a graduate student and not the instructors or their assistants. Out of the 36 responses that they got, majority of the students who were enrolled in primarily in agricultural studies and a few in other majors. The results of the research exhibited that at least half (53%) of the students recommended problem-based learning, 16% remained neutral whereas only one individual that is 3% disagreed with problem-based learning. The participants stated that problem-based learning is such an effective method that it should replace lectures for they not only actively learned but also controlled their own learning along with learning from others. The second objective of this research was to see how the students perceived these learning outcomes. The students were settled on the fact that this project did help them comprehend the course material better. Similar to these findings were the findings of Sulaiman (2010) and Chambee and Morgan (2009) who also found through their research that problem-based learning not only significantly helped with comprehension but also helped with the students finding the information much more relatable. Spronken and Smith (2005) also observed that students support the idea of problem-based learning and find that it is highly beneficial for not only learning but also to enhance developmental skills.

The research conducted by Moss et al. (2002), is also relevant as it discusses various learning styles and compares them to see their performance in agricultural economics. For this purpose, they administered Gregorc Style Delineator on 186 undergraduate students who were enrolled in their agricultural economics class. Following this a student-centered learning environment was formed

which is a form of problem-based learning technique so that students may comprehend fundamental economic concepts to maximize success in subsequent courses. During the course, web-based problems were available, and students were encouraged to participate in discussions so that they may have the opportunity to solve problems and cases in groups. Active learning method was also used where students solved case problems from previous classes and finally had to complete a test where they had to score 100% but could be done over multiple trials as well. The techniques were rated on Likert scale and how much the students enjoyed those courses. Analysis of data via ANOVA F-test exhibited that in comparison to traditional learning methods, active learning and problem-based learning methods can leave a significant positive impact on student learning. This learning when improved, can significantly improve the performance of the student in the courses which in this case was agriculture, resources and food.

One of the fundamental problems with a theory is that its success does not rely on how perfectly accurate it sounds but on whether it is applicable or not or what the practical implications of it are. For the longest time, discussions have been done on problem-based learning (PBL) that emphasize on its effectiveness but somehow have missed implementing this theory into practice. For this purpose Hung (2011) conducted a research to fill out the literature gap and provide a better frame of PBL along with looking at the implementation practices on it and understanding the confounding variables that could possibly affect the results and contribute to the inconsistencies in the research. Hung (2011) supported the theory and empirical evidence suggest that PBL is an effective pedagogical method that can be implemented in various fields including agricultural entrepreneurship. Problem based learning enables students to gather information, organize resources and putting learning to practice and can be aptly called experiential learning. It can be theorized that effective incorporation of PBL will lead to higher efficiency in performance, teamwork and higher output per input in agricultural entrepreneurship and promotes student learning and pupil tutor relations. The use of PBL methodology for agriculture still needs more research and experimentation as this is an evolving area.

Chapter 3 PBL Principles, Objectives, Models

Due to its success in the medical field, PBL has largely been adopted in other professional fields, where it was adopted to the environment and the process needs. Due to its wide adoption and the approach in various fields, the precise definition, principles, models and a conceptual framework have become convoluted. The design of the of the PBL framework has to keep in mind the plethora of dilemmas which now face the sector including newer audiences, the university students of agricultural universities, teachers and other stakeholders in Sub-Saharan Africa and the emergence of new training needs. Therefore, it is imperative to define the principles and models for the subsequent analysis.

3.1 PBL Principles

There are differences at the concrete model level, however there are common learning principles that cross PBL models and are captured at basically three levels including Learning, Contents and Social (Graaff and Kolmos, 2007)

The Cognitive Learning approach is centered around the notion that learning is organized into problems and can be carried out in smaller groups in projects. Graaff and Kolmos (2007) also show that students are motivated as the problem is the initial point of learning process, is context specific and basis the learning around the practical experience. The task at hand or scenario may present complex problem analysis, problem solving strategies, and a time frame to consider solving the problem. The contents approach is built on interdisciplinary learning which may cover the traditional pedagogy and methods. It is considered exemplary because the learning outcomes are archetypal of the objectives of the curriculum. The PBL approach supports the connection between theory and practice as it embeds analytical approach by using theoretical knowledge in the analysis of problems and methods. The Social approach is based on team-based learning where the learning process is deemed as a social act involving extensive discussion and communication. Students in addition to learning from each other also learn to share the knowledge and organize themselves for collaborative learning experience. The concept of participant directed learning is also incorporated because students learn about collective ownership of the pedagogical process, especially the formulation of the problem. The table 1 below summarizes the contents of PBL Learning Principles

Table 1 PBL Learning Principles as Defined by Graaf and Kolmos (2007)⁴

Collaborative Learning	Teams, participants, directed
Cognitive Learning	Problem, Context Scenario, Experience, Project
Contents	Interdisciplinary, Exemplary, Theory and practice

3.2 PBL Objectives Applied to Agricultural entrepreneurship

The following section highlights the various objectives that are common in various fields. Certain elements of these objectives can be adjusted to construct the framework of PBL and applied to Agri-entrepreneurship

The first objective pertains to the development of effective clinical reasoning process (CPR) which constitutes problem solving skills that are perfected via constant practice and changes brought upon by consistent feedback. This means that all the skills involved in the generation of hypothesis, data analysis, problem synthesis etc. should be done to not only acquire basic science information but also clinical knowledge as well. Such methodologies ensure that both knowledge and problem-solving skills can go together in clinical settings (Simon, 1980; Glaser, 1982; Feltovich et al., 1983). CPR objective can be adjusted to Agri entrepreneurship whereby students learn problem solving skills through consistent feedback and apply their skills to more practical entrepreneurial avenues. The development of effective self-directed learning skills (SDL) is another important objective. SDL suggests that when students have self-assessment or self-directed learning skills, they become sensitive to their personal needs for learning and that is when they use appropriate resources to locate relevant information. These are essential skills for farmer entrepreneurs, as this sector is constantly facing new information and challenges including climate change and other new problems and concepts, never predicted by teachers, will have to be understood and applied (Barrows, 1986).

Katona (1940) argues that motivation improves student learning which gives us the increased motivation for Learning (MOT) model. When the student faces challenges of problem solving, it

⁴ The table displaces the three learning approaches that area widely used in the PBL approach and are derived from the summary of study of Graaff and Kolmos,(2007)

is then that their motivation is improved. These are some of the most crucial objectives that can be achieved with PBL. There are other objectives of PBL that are adjusted based on the context and curriculum. For instance, learning driven by the challenges of future and which stimulates the integration of reasoning and evaluation tools to cater the future entrepreneurial challenges (Glaser 1982; Schmidt 1982).

3.3 PBL Models

Various models are adjusted according to the objectives of the PBL including the insights of knowledge, learning, student-teacher roles, problems and the assessment. Although, the starting point of any problem is the epistemology. The literature points out to various models that need to be defined.

In this context Savin-Baden work proposes five different models of PBL learning. In comparison to Barrows (1986), these models are comprehensive and effectively align the various elements in the model. The models are as follows; attainment of knowledge, PBL for professional work, PBL for interdisciplinary understanding, PBL for cross discipline learning and PBL for critical competencies. (Savin-Baden 2000). A pivotal point is the alignment of the learning objectives with the correct types of problems.

The six dimensions in the five models emphasize that implementing PBL does not equal to change in the learning methodology. In fact, it is the combination of learning procedure, knowledge construction and scientific approach. Consequently, adoption of full scale PBL methodology impacts the scientific approach as the students are learning and training to incorporate research methodologies and question the propositional knowledge that is derived from academia. Solving problems and analyzing them requires pragmatism in the relationship between theory and practice.

Table 2 discusses the 5 PBL models derived from Savin-Baden (2000)

Model I PBL for epistemological competence	Knowledge: propositional knowledge Learning: use of this propositional knowledge
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	<p>Problem Scenario: Limited problems with known solutions</p> <p>Students: recipients of propositional knowledge</p> <p>Facilitators: Chaperon to understand the correct knowledge</p> <p>Assessment: objective oriented test of knowledge.</p>
Model II PBL for professional action	<p>Knowledge: technical know how</p> <p>Learning: skills for the work-based scenarios</p> <p>Problem Scenario: real life situations</p> <p>Student: learn about practical action that is derived from real life problems</p> <p>Facilitators: They show practical skills</p> <p>Assessment: Testing for skills at the workplace and associate knowledge</p>
Model III PBL oriented towards interdisciplinary understanding	<p>Knowledge: An amalgamation between know how and know what.</p> <p>Learning: Skills and knowledge across boundaries</p> <p>Problem Scenario: Based on knowledge with action</p> <p>Students: integrators across boundaries</p> <p>Facilitators: coordinators of the relevant skills and knowledge across boundaries</p> <p>Assessment: context specific skills and knowledge</p>
Model IV PBL for Transdisciplinary learning	<p>Knowledge: to comprehend the existing boundaries</p> <p>Learning: critical thinking and comprehending the discipline borders</p> <p>Problem Scenario: dilemmas and predicaments</p> <p>Students: Sovereign thinkers with critical stance</p> <p>Facilitators: Generally flexible</p> <p>Assessment: Chance to show integration across the various disciplines</p>
Model V PBL for Critical Contestability.	<p>Knowledge: contingent, contextual and constructed</p> <p>Learning: Cross examination and investigation of frameworks</p> <p>Problem Scenario: is multidimensional and approaches alternative understanding.</p> <p>Students: Develops new hypothesis and learning while exploring the prevailing structures and belief systems.</p>

	<p>Facilitators: They are the challengers, commentators and interpreters of traditions, cultures and disciplines</p> <p>Assessment: Flexible and open ended</p>
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In addition to the principles, objectives and models it is necessary to discuss about the roles and responsibilities of the teacher. The second evaluation instrument in this research is about the evaluation of teachers and therefore it is important to have a basis.

3.4 Roles and Responsibilities of effective teachers:

The role of the teacher in Problem based learning is not authoritarian but rather as a group facilitator who also has expertise in processes in addition to content or subject expertise (Barrows 1986). In PBL, the teacher is more facilitative or activates the groups to ensure continuous interaction and progressivity with the problem. The teacher does this effectively by probing, questioning, motivating students for critical reflection, suggesting and challenging in different contexts. These also largely depend upon the student needs. Perhaps one of the most important aspects of PBL for teachers is to decide when and how to intervene? The first point that needs to be addressed is the point of intervention for an effective teacher. Woods (1996) from McMaster University (where PBL was first implemented) outlined the ways in which teachers can facilitate the students. They are (i) Ensure that students approach the problem appropriately (ii) Challenge the assumptions of students to ensure reflection and understanding of the assertions made by the students (iii) A reflection session on closing of the group in which the students are invited to ponder upon the dynamics of the team building and what has been learned through this exercise.

From this it can be inferred that the teacher must be dexterous in the following skills to facilitate the PBL process including facilitation, motivation, active listening, critical reflection and learning. The teachers must not control the session with subject specific questions and generally abstain from the session becoming a teacher led seminar. The relationship between the teachers and students should develop organically. However, some teachers who are more comfortable with the traditional teaching methods might feel threatened because they mistake the difference between authority and authoritarianism. Particularly, some teachers may fail to see that authority can be exercised in different ways (Maudsley, 1999). A differentiating facet between authoritarianism and authority needs to be addressed. In the PBL approach, authoritarianism can be detrimental as Margetson (1994) believed that PBL calls for participative, critical, reflective, informed and educational practice. Simply, students should be regarded as colleagues who are novices which requires, in some cases a radical change in perceptions.

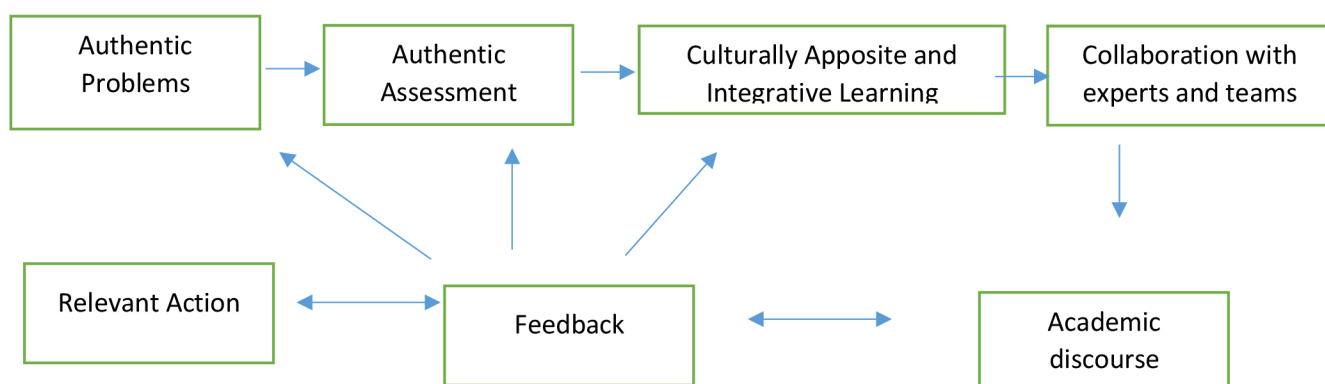
Chapter 4 Designing a Standardized Methodology for application of PBL methodology.

The arguments and information collected in chapter two and three are critical for the development of chapter four. The construction of a PBL framework requires a clear understanding of the various issues and models that are present in the literature. The framework posits that the traditional curriculum does not adequately capture the critical entrepreneurial facets and instead focuses on subject specific topics and materials. (Wee, 2004). The focus on subject based curriculum promotes silo thinking (Berry, 1993; Doyle, 1995). Students need facilitation to go above their subject based knowledge before they can solve entrepreneurial problems. Moreover, traditional classrooms rely upon a static curriculum (Berry, 1993). The curriculum covering the topics are presented through the medium of textbooks (Berry, 1993; Doyle, 1995), which makes the curriculum outdated rather quickly and could fail to address the present issues. Moreover, the curriculum itself can be lacking depth as the authors may themselves be lacking entrepreneurial skills and fail to refer to the practitioners (Denison and McDonald, 1995). Additionally, the traditional pedagogy in academic training dulls the competence and does not develop creativity and change strategies necessary (Kirby, 2004) Agricultural Entrepreneurs need to be equipped with the capability to learn on a continuous basis so that they can sustain themselves and their ventures and achieve competitive advantages. They need specific skills to tackle the various entrepreneurial task, find opportunities, act and learn from it. (Deakins, Sullivan and Whittam, 2002).

The following framework can be applied to the Universities partaking in Agricultural Pedagogy in Sub-Saharan Africa. The design principles include the following activities which can be implemented. The standard framework shown in figure 1 is based on the theoretical review of the literature and the subsequent questionnaire will be designed around these PBL principles.

4.1 PBL Framework

Figure 1 Standard PBL Framework adopted for agricultural entrepreneurship



Authentic Problems: The University students can learn essential content knowledge by focusing on collaborative problem solving that involves creative, ill-defined and real-world problems. Additionally, the input of the teacher is paramount to the design and selection of the complex ill structure real life problems by who's role is that of a facilitator (Wood, 1994). These problems should focus on the real issues of climate change and food insecurity, issues of finance and new ventures in agricultural settings and opportunities pertaining to agricultural value chains.

Authentic Assessment Tools matched to objectives of PBL: Teachers, tutors and subject experts professionally assess the students throughout the course and at the end of the course as the students develop, understand and present their solutions throughout the problem life cycle. Teachers facilitate and students indulge in self-directed learning to match the objectives of PBL to their assessment. These objectives could vary depending on the objective of the school or university and or the course.

Culturally apposite and Integrative learning: The teachers who act as facilitators utilize their knowledge of the students background including socio-economic, culture, historical and familial backgrounds to design the problems, so that the students can perceive the problems to be relevant to their practical lives and they can relate them with their prior knowledge on the subject matter (Newman, 2005).

Collaboration with experts and teams: The teachers and students collaborate to seek out expertise from the industry experts to aid in the development and design of the problems.: The teachers explicitly impart collaboration skills that students can apply to their problems. Moreover, they provide the students with complex and complicated problems that necessitate working in groups and have incentive to sustain their collaboration (Wood, 1994). It is necessary that smaller student groups are formed that allow for active brainstorming of ideas. The groups generate new ideas and knowledge based on these real-life problems.

Academic discourse: The students are provided with the academic, course relevant etymological and interaction skills that help them to engage with the industry experts. Attention must be paid not to focus too much on academic learning as it can hamper the creativity and problem-solving skills needed for entrepreneurship (Kirby, 2002).

Feedback and Leadership: Teachers engage and invite student feedback to position them as emerging pedagogical and subject experts. Their feedback is elicited into the lesson and the problem design and necessary adjustments to the classroom environment (Savery, 2001). The feedback is also taken from the lessons learned from Action stage and informs the culture and integration, the design of problems scenarios and the authentic assessments.

Action: The understanding of the knowledge deficiencies and revisiting of the scenarios for further investigation and to solve developed questions. Student groups take action to find the solution and to deepen learning from the experience and record the results. This is also derived from the PBL model II which lays emphasis on Action (Savin-Baden 2000).

4.2 Systematic Approach to Development of Evaluation Method of PBL

The framework defined above provides a comprehensive and vigorous list of elements needed for the development of a PBL curriculum for Agricultural entrepreneurship. It can be adapted according to the organizational needs. In order to evaluate the implementation of the PBL curriculum, this study also presents a comprehensive questionnaire developed specifically for the AgriSCALE project to analyze and understand the PBL application in developing the entrepreneurial skills of students in Sub Saharan Africa. The data collected will be used to propose a policy recommendation to help strengthen PBL foundations. The questionnaire has been adapted specifically for Agri-entrepreneurship, however, it can be applicable to various courses with few adjustments to create comparable results. The next section illustrates the list of indicators included in the questionnaire to measure the necessary elements.

4.2.1 Questionnaire Objectives

The questionnaires were designed to provide a holistic understanding of the ecosystem of PBL; with the purpose of identifying the relevant dimensions for the design of guidelines and recommendations for the development of a comprehensive curriculum for university level students in SSA. The central goal of the exercise is to evaluate through use of instruments the effective and successful PBL processes and principle, that are applied in the teaching methodology and improve learning outcomes in Agri-entrepreneurship.

My analysis has developed two detailed questionnaires that will form part of the evaluation toolkit and is applicable across the universities in SSA. The target of both these questionnaires are the students as PBL is a student learning-oriented approach. The questionnaire 1 is to evaluate the quality of the PBL problems themselves and questionnaire 2 are to evaluate the facilitative role of the teacher.

4.2.2 Methodology

The methodology chosen for the analysis of both questionnaires can be applied through various statistical tools available. One standard practice is to conduct the statistical analyses on class averages (Marsh and Bailey, 1993).

The tutorial averages can be used for the 17 items of the first questionnaire and the 11 items of the second questionnaire with the average scores reflecting the ratings of the same tutor across different tutorials. This is justified through Marsh's (1987) findings where the correlation between the overall ratings of different instructors teaching the same subject was statistically weaker as compared to the same instructor teaching different courses. ($r = -.05$) as compared to ($r = 0.61$). A confirmatory factor analysis can be conducted at the teacher level by computing average score the

students per teacher. An example from the second questionnaire can be utilized. The items (1 to 3) are affected by the first dimension, (4 to 5) are affected by second common dimension, (6,7) by the third dimension, (8,9) by the fourth and (10,11) by the fifth dimension. For this methodology, all items are affected by a unique factor which is the error in each variable and no pairs of unique factors were correlated. Relative fit indices can be used to control for both type I and type II errors (Hu and Bentler, 1999). The Tucker Lewis Index or non-normed fit index (NNFI), where the model fit is \geq to 0.5 and the standardized root mean square is less than 0.08. The model fit can be estimated through A Maximum Likelihood estimation which is less sensitive to the violations of the normality assumption. However, getting into the empirics is beyond the scope of this paper and this is just one methodology proposed. Future research can adjust their methodology to suit their specific needs.

The Instrument itself is dividends into sections (section I) for purposes of general administration of the research team and the (Section 2) which comprehensively covers elements of the PBL model framework and the full-length questionnaire

The sections included in the layout of the questionnaire are as below:

Section I Information to be filled by interviewer

A: Pupil Information

B: Entity or educational Institute Information

D: Objectives of the PBL curriculum

The questionnaire incorporates all the elements necessary to create a standard framework to study the PBL model. The table 3 below provides list of elements based on the proposed framework that each section of the questionnaire explores to gather empirical data for further research and lay foundations for sustainable PBL pedagogy.

Table 3 Additional List of elements measured by the questionnaires

Questionnaire Section	List of Elements
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Pupil Information	<ul style="list-style-type: none"> • Gender: • Age • Level of education • Parents occupation
Entity or educational institute Information	Location of the School Number of Students Number of Teachers Class Teacher to student ratio

Objectives of the Organization	<ul style="list-style-type: none"> • Objectives of the organization • Primary Vision and Mission
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The above table illustrates the comprehensive list of elements which the questionnaire measures to incorporate all aspects of the proposed problem-based learning framework. Special consideration is given to the parent’s occupation and the teacher to student ratio. The occupation of parents can significantly impact the choice of students to become an entrepreneur as studies found that students having parents’ entrepreneurs expressed a significantly greater resolve for risk taking (Hryshko, Luengo-Prado and Sørensen, 2011). Moreover, lower student to teacher ratios are considered better for academic achievement and learning as teachers can focus more on learning outcomes. There is however no consensus on the optimal ratio (OECD, 2020). For the purposes of this study, an optimal teacher student ratio is anywhere between 1:10 or 1: to 40 (source). This can be adjusted to suit the needs of the organization. It can provide a robust and comprehensive analysis tool for appraisal and assessment of promoting agricultural entrepreneurship in Sub Saharan Africa. The assessment is transferable to partner institutions incorporating it and other if applicable to other organizations as well. The data collected can be used evaluate the relative successful implementation of problem-based learning to achieve successful learning outcomes. The depth of the elements in the framework are vast and can be adapted for future research and for further analysis. The questionnaire can be made useful for the

research of AgriScale research and to create guidelines and recommendations for the successful implementation of PBL curriculum at the university level in SSA.

4.3 Questionnaire for the evaluation of the quality of PBL Problems.

4.3.1 Design elements of the questionnaire 1

The questionnaire developed consists of four open ended questions that invite qualitative detailed answers to describe the strengths and weaknesses of the perception of the problems that are used for the PBL curriculum. Moreover, these questions invite areas of discussions for improvement and additional comments that the students feel are relevant. A benefit of the use of the open-ended questions on the overall quality of the PBL problems is the possibility of discovering responses that respondents give spontaneously without a bias that can be influenced by the researcher (Foddy, 1993). Moreover, the use of open-ended free response format for questions allows for the assessment of the salient features of the subject and the subjective evaluation of the attributes. More importantly the salient attributes are listed by the subject themselves rather than being influenced by the respondent. The questions are designed from the literature and focus on the collaborative and cognitive learning as identified by Graaf and Kolmos (2007) in PBL learning principles. These questions are also based partly on the Model II PBL for professional action and Model V PBL for Critical Contestability reported from Savin-Baden (2000). There have been six factors that are derived from the literature of PBL and describe an effective PBL problem as a problem that leads to thinking, analysis and cognitive abilities. There are three items that cater to this. Moreover, 3 items are stored for promoting self-directed education. The next 3 questions are stored for intended contents and the follow up 3 questions stimulates the interest in the subject. The next set of 3 questions focuses on the relevance of the problem with regards to the possible future scenarios that the person might face. The last set of 3 questions focuses on how the problems are designed in a way that they match the level of prior knowledge.

The questions are directed towards the students and the problems must be discussed by them and they must give their answers on a 5-point Likert scale. The prospective participants will be asked to rate their answers on a degree of relevance for each problem with the options. (1=strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree)

Table 4 Questionnaire 1 to evaluate the quality of PBL Problems

Questionnaire	Rate the items of the questionnaire on a scale of 1-5 ricert scale. You must match the box by clicking in the appropriate box				
	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Factor 1 Stimulates the ability of thinking, scrutinizing, and reasoning in the field of agricultural entrepreneurship					
1) Use open problems including understanding of impact of climate change on food value chain to promote and sustain the discussion.					
2) Promotes understanding of links between value chains and food security.					
3) Problem has an ideal course for discussion i.e. not many and not to less					
4) There are stimulating cues in the problem.					
Factor 2: Promotes the self-Directed Learning					
5) The problems are designed so that they invite pupils to form their learning issues					
6) Problem invites pupils to research the relevant literature surrounding					

the problem including the socio-economic aspects of Sub-Saharan Africa.					
7) The problem invites pupils for discussion.					
Factor 3: learning of the intended curriculum					
8) The problem is designed to lead towards one or more objectives including but not limited to development of entrepreneurial skills and behaviour.					
9) Problem stimulates the merging of various disciplines including entrepreneurship, marketing and commerce, Agri economics and food security amongst others.					
10) Problem stimulates to consult the literature linked to the block objectives.					
Factor 4: Promotes the interest in the problem and the subject					
11) The problem is designed in a manner as to garner the subject of the pupil					
12) The terminology or jargon of the problem is aware of the perception that pupils have of their own environment					

13) The scenarios are stimulating and appealing to the pupils as they discuss relevant issues in SSA.					
Relevant to the future market opportunities and professions					
14) The problem is linked to the future professions that the pupils might undertake including but not limited to business entrepreneurs, Veterinarians, Farm Managers, Agriculture Operations Specialist, Agri finance etc.					
15) Basic concepts of development of agricultural entrepreneurship are discussed in the context of PBL					
Factor 6) Is built upon the prior knowledge and skills of pupils					
16) Problem adjusts to the previous knowledge and skills of the students. They consist of the basic elements of knowledge of language, basic farming knowledge and the other basic prerequisites					
17) Problem is aligned to the previous curriculum covered					
18) Pupils are well acclaimed with the part					

of the learning that is necessary for deliberating the problem					
Open Ended Questions					
19) What are the strengths of PBL problem with regards to your knowledge on agricultural entrepreneurship?					
20) What are the weaknesses of this PBL problem? Do you feel ready to become an entrepreneur?					
21) What are your recommendations of this problem?					
22) Any other comments?					

4.4 Questionnaire to evaluate the quality and effectiveness of teacher in PBL

The teacher plays a critical role in the PBL curriculum design and implementation. The performance of the teacher has a direct correlation with the functioning of the group (Berkel and Schmidt, 2000) The central and critical role of the tutor demands a feedback on the performance so that improvements can be suggested. There is a need for a qualitative instrument to carry out data collection for developing a base. The review from the feedback would yield should also be effectively linked to some monetary and non-monetary proceeds.

The literature points out tools for teacher evaluation including (Grave, Dolmans and Vleuten, 1998). (1998) and Dolmans, Wolfhagen, Scherpbier and van der Vleuten, (2003) that are considered reliable and valid. Both authors developed and validated a questionnaire across several key dimensions. The results from these studies point out an important about the instruments validity and reliability. The questionnaire is valid and reliable if at least six students' responses are available for one teacher. Hence, the design of these evaluation tools should allow for almost six people per teacher to insure validity and reliability. However, Dolmans and Gins (2005) point out that these existing instruments are quite long. The instrument formed by De Grave et al. contains 33 items across different dimensions and Dolmans et al. contains 22 items. Students tend to lose

their motivation and get tired for effectively giving answers for such long instruments and evaluate the teacher performance. There were approximately 3 to 5 questions per 5 or 6 dimensions. Consequently, using a smaller and well-designed questionnaire is more convenient for the students that covers the main qualities of teachers. An important facet remains whether the short questionnaires is valid and reliable.

4.4.1 Design of the questionnaire 2

Conventionally, the questionnaire developed earlier was based on the theoretical notions of a constructivist view on learning and coaching on which PBL is focused on. The common facets utilized under the constructivist view including self-reliant learning, cooperative learning, active or constructive learning and contextual learning (Barrows, 1986). Additionally, the teacher's intrapersonal behavior is critical for the study.

The design of the questionnaire is also based on these elements and insights from the Dolmans and Gins (2005). The five main topics discussed above are as follows: active/ constructive, contextual, self-reliant, collaborative and contextual learning. The length of the questionnaire was kept to two or three items per dimension to account for the interest of the students. The questions in each dimension were carefully decided after an extensive review of literature and the needs of the university teachers in SSA.

4.4.2 Elements of the Questionnaire 2

The questionnaire itself consists of 11 statements. The questionnaire will be administered at the end of each of course and students will be asked to evaluate a statement and indicate how much they agreed with a particular statement. Once again, a scale of 1 to 5 is used where (1=strongly disagree, 5= Strongly agree). An example is 'the teacher motivated us to understand the underlying theories and concepts'. Another example is 'the teacher motivated us to apply knowledge to the underlying problem'. Five dimensions are considered that represent the 11 items. This questionnaire is largely designed through the research of Barrows (1996) who considered the need role of teacher evaluation, Newman (2005) who emphasized the facilitative role of the teacher and Woods (1996) that posits teachers role in motivation of students with regards to PBL application. The names of the factors and their underlying messages are also represented in the table 5 below. Additional questions were added to measure absenteeism, appropriate replacements, the overall satisfaction with the teacher and any tips for improvement.

Table 5 Questionnaire to evaluate the quality and effectiveness of teacher in PBL

Questionnaire	Rate the items of the questionnaire on a scale of 1-5 ricert scale. You must match the box by clicking in the appropriate box				
	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Factor 1 Constructive Learning					
1) Teacher motivated us to understand the core issues and themes pertaining to development of entrepreneurship and apply them to the specific problems.					
2) Teacher motivated us to search for links amongst existing knowledge and the problems and discuss issues in the tutorial group					
3) Teacher motivates us to deepen understanding of the underlying theories and mechanisms in Agri-Entrepreneurship					
Factor 2: Self-directed Learning					
4) Teacher motivated us to identify relevant issues such as climate change, food insecurity, unemployment and lack of jobs in Sub Saharan Africa by ourselves					

5) Teacher motivated us to organize the resources by ourselves.					
Factor 3: Contextual learning					
6) Teacher motivated us to use existing learning to resolve the scenarios of development of entrepreneurial skills					
7) Teacher motivates us to extrapolate the learning on to other real situations and scenarios such as farm to market and creation of Agri value chains					
Factor 4: Collaborative Learning					
8) Teacher motivates us to give constructive feedback on the group work					
9) Teacher motivated us to evaluate the groups cooperation					
Intrapersonal Behaviour					
10) Teacher had a clear understanding of his strengths and weaknesses as a tutor					
11) Teacher displayed enthusiasm and motivation with regards to the lecture.					
Absenteeism and replacement					

12) How often was your tutor absent?	1-2 days 2-3 days 3-4 days More than 4 days
13) How often was the replacement sent to take over the absent teacher	(i) Once in a week (ii) Twice in a week (iii) Three times in a week (iv) Whenever the teacher was absent
14) Give tips to improve the learning process for the teacher.	
15) Rate the overall performance of the teacher from a grade of 1-5	1) Excellent 2) Good 3) sufficient 4) bad 5) very bad

Chapter 5 Conclusion

The analysis in this study highlights the increasing popularity of Problem Based Learning in different disciplines and professions around the worlds as a result of the inadequacy of traditional teaching method to meet the pedagogical needs of the society for provision of high-quality skills, in problem solving, enduring real-world skills, collaboration and team building, autonomous learning and analytical skills. The PBL methodology is garnering popularity in its applications, however, it is in in embryonic stage particularly in Sub Saharan Africa, where the educational quality is below the international standards especially in key subjects. The question of drastic improvement in education is then focused primarily on where and how to focus attention and investment (Conn, 2017).

The main contribution of this paper is the application of Problem based learning methodology to the development of agricultural entrepreneurship skills. The lack of a clear epistemology regarding PBL in this sector and concurrent research presents certain methodological roadblocks. The

nascence of the sector can be observed with the lack of proper definitions, frameworks and models for agricultural entrepreneurship in the region. This lack of a clear basis presents interruptions for future empirical research into this area. Therefore, the establishment of research instruments that follow a clear framework is paramount and critical to further advance the research in the field of PBL and increase understanding of the models adapted at the university level across Sub Saharan Africa.

This study adopted the technical definition from an extensive review of the literature and also the vision of the AgriSCALE project proposed by Professor Maria Sassi which concurrently focuses on definition, evaluation and promotional aspects of PBL, emphasizing that “PBL is a pedagogical constructivist approach that utilizes a different trend than the traditional teaching methodology where the primary focus is the focus on complex and real-world problems” (SOURCE?) with the ultimate goal of creating effective teaching pedagogy and benefiting the youth of Sub-Saharan Africa. This study provides broad understanding of the PBL models and principles by addressing definitions, frameworks and compositional elements of those models. Additionally, the study proposes a framework for developing standard PBL model including Authentic Problems, Authentic Assessment, Collaboration and Teamwork, Feedback and Action. It also provides two extensive and comprehensive questionnaires as a research instrument based on the proposed Problem based learning framework to analyze the overall quality of the problems and evaluate the performance of teachers who are crucial to the successful implementation of PBL, while taking SSA universities as a case. The robust and thorough research instrument developed through this study can be adapted and applied to other areas of research on PBL study areas.

The case of Sub-Saharan Africa is an interesting one because the development of agricultural entrepreneurship presents tremendous opportunities for the economic growth and youth employment in Sub-Saharan Africa. Most of the African population are engaged in some way with the agricultural sector. An increase in the productivity, economic diversity and transformation of this sector will directly lead to an increase in the rural incomes and livelihoods. Development of agricultural business activities has economic dividends in the form of spillover effects as it will contribute to access affordable and nutritious food, raw materials and burgeoning of processing and services industries. It will impact additionally lead to lower food prices that will effectively increase the real income of the urban and rural poor. Africa is in a strategic position to leverage from the benefits of a youth bulge and has similar preconditions for growth that promulgated the rise of the China. The yield from an African demographic dividend has not permeated due to a host of factors. Chief amongst them is the lack of investment on human capital and not fully realizing the potential of agricultural sector. Hence, an investment in the development of agricultural entrepreneurship is crucial for the realization of the demographic dividends and the economic transformation of SSA. The establishment of agricultural units stewarded by young entrepreneurs can help to absorb the surplus labour force especially in the rural part of the continent which hosts approximately 70 percent of the youth. (Koira, 2014).

However, a thorough database and understanding of the PBL activity and ecosystem is not available in the field of agricultural entrepreneurship due to the lack of interest and information. Historically, agriculture, has not been perceived as an economically robust sector until only

recently when the international policy has shifted to track and portray the potential, scope and status of the agricultural sector. As part of the research work under the AgriSCALE project this study provides essential elements of understanding the application of PBL and its ensuing evaluation. The primary focus of PBL is the focus on complex and real-world problems which are presented as scenarios and students learn to tackle the problem, organize themselves and in teams and understand the main principles as opposed to simply learning concepts and facts. This learning method not only enhances critical thinking, but invokes problem solving skills in individuals. The paper has attempted to construct a framework and develop an extensive understanding of PBL in relation to agricultural entrepreneurship that can be applied to and can be adapted to various educational institutions. The guidelines and recommendations for effective teaching methodology can lead to burgeoning entrepreneurs that can develop the SSA Agri economic fabric through sustainable and inclusive socioeconomic growth in the continent.

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