

**The impact of a school garden program on agriculture learning by primary school  
children in rural Uganda**

by

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## **CHAPTER 1. GENERAL INTRODUCTION**

### **Thesis Organization**

This thesis contains three chapters: 1) General introduction and review of literature, 2) a manuscript of research to be submitted to HortTechnology, and 3) general discussion and conclusions. The first chapter contains an introduction to the research and review of relevant literature. Chapter two provides the manuscript. Chapter three presents general conclusions to the research, and offers future recommendations.

### **Introduction**

The College of Agriculture and Life Sciences at Iowa State University has been involved with a school garden program in rural Kamuli, Uganda since 2006. The program includes the collaboration of The Iowa State University (ISU) College of Agriculture and Life Sciences (CALS), its Center for Sustainable Rural Livelihoods (CSRL), Makerere University (MAK), and Volunteer Efforts for Development Concerns (VEDCO), a local non-governmental organization (NGO). CALS in collaboration with MAK, offers an undergraduate course in service learning focused on a school garden program and includes student and faculty from both institutions (ISU, 2009). The focus of the school garden program is to provide a hands-on learning experience for primary school children through an outdoor learning laboratory, and also a source of plant material for home gardens, and nutritional improvement for the primary school children (ISU, 2009).

Preliminary work has been accomplished that evaluates agricultural knowledge transfer to children's home gardens (Wasko, personal communications); however, no formal evaluations on the educational impacts of the school garden program on children's academic

performance have been done prior to this study. Studies conducted throughout sub-Saharan Africa, including Uganda, have concluded that the greatest influence on education in developing countries is through a focus on individual schools, not on large-scale reform (Heneveld, 2007). School gardens offer a small-scale approach that is focused on altering the learning environment in each school, allowing for localized educational development. However, despite widespread promotion of school gardens, there is a significant gap in the literature regarding formal assessments of school garden programs and their impact on learning.

The study had the overall objective of evaluating the influence of a school garden program on the learning of agriculture by children attending primary school in the Kamuli District of Uganda. Three sub-objectives included research with primary school pupils in schools either with a school garden program or without a school garden program to 1) determine pupils' scores on the national exam section for integrated science and agriculture, 2) determine the impact of the school garden program on the learning of an agriculture topic, and 3) identify themes from survey results of the pupils' personal home life, home gardens, school gardens, and school experiences that may influence learning of agriculture topics.

The first hypothesis of this study was that through the utilization of experiential learning tools, such as the school garden, the quality of primary education can be increased and improve pupil learning of agriculture. The second hypothesis of this study was that experiences of pupils' personal lives, home gardens, school gardens, and school environment influence the learning of agriculture topics and that themes in this information can explain the effectiveness of learning activities and programs. The term garden refers to any plot of land where one or more crops are produced for consumption or livelihood.

## **Literature Review**

In the 1880's Christian missionaries established the first formal schooling system in Uganda (Ssewamala et al., 2011). In the 1920's the government of Uganda took over the education system, which was still under the British structure (Ssewamala et al., 2011). The Ugandan education system requires seven years of primary level education. Students must pass a national examination called the Primary Leaving Examination (PLE) in order to complete primary school and to move to the next level of education (Ssewamala et al., 2011). Although Uganda's education system also has secondary and tertiary levels of formal education, The Ugandan Ministry of Education and Sports (MoES) (2011) states that the majority of Ugandans do not go on to attend higher levels of schooling, but complete their formal education with primary school. It is critical to recognize the importance of the quality of primary school education because it is the predominant source of training in life-skills such as agriculture, an important facet in the livelihoods of the 82% of Ugandan citizens employed in the agriculture sector (CIA World Fact Book, 2011).

After the National Resistance Movement, in 1987 the Education Policy Review Commission (EPRC) was established to evaluate the education system in Uganda and suggest improvements (MoES, 2001). The suggested improvements to the education system included items such as promoting modern curriculum, reformulating objectives, integrating technical and commercial subjects, and reviewing the roles of qualifying exams, among others (MoES, 2001). The EPRC produced a report, which led to the Government Education White Paper of 1992, and established recommendations that would be implemented in the future (MoES, 2001). The Government Education White Paper set the framework to improve access, quality, and equity at all levels of the Ugandan education system (MoES,

2001). From the Education White Paper, the National Constitution for the Republic of Uganda was created in 1995, which stated education as a right for every Ugandan (Ministry of Justice and Constitutional Affairs, 1995; MoES, 2001).

In 1997, Uganda adopted a Universal Primary Education (UPE) policy to fulfill the goals set by MoES (Bategeka and Okurut, 2005). The goals aimed to provide all children the opportunity to attend and complete primary school without having to pay tuition (MoES, 2004). Although tuition is paid through government funding, under UPE students' parents or guardians are still required to pay fees at public school for items such as books and uniforms (Grogan, 2006).

UPE has dramatically increased the school attendance of poor and low-income children (Ssewamala et al., 2011). UPE has also successfully increased literacy rates in children by over 16% and decreased the education gap generated by income (Ssewamala et al., 2011; Deininger, 2003). In addition, UPE has greatly increased enrollment of female students, predominately those from lower income families. The attendance of lower income female students increased from 28% in 1992 to 66% in 1997 and UPE has largely eliminated gender gaps in the education of Ugandan children (Deininger, 2003). UPE has also successfully decreased educational gaps between rural and urban settings (Deininger, 2003).

Because of limited resources, the dramatic increase in the number of students in primary school grades as a result of UPE and a high birth rate of 4.7% (CIA, 2011), has led to a decrease in the quality of primary education in Uganda. The number of pupils enrolled in primary school increased from 3.1 to 7.5 million from 1996 to 2007 (MoES, 2008). Due to the rapid increase, classroom resources such as school facilities, teachers, and teaching materials were insufficient (Ssewamala et al., 2011). Despite increased enrollment and huge

government strides towards UPE as a means of poverty eradication, quality of education has suffered. Studies by the National Assessment of Primary Education Performance have indicated that pupils' knowledge and skills in science have decreased since the introduction of UPE (Bategeka and Okurut, 2005). Primary education, specifically in rural areas, still needs significant improvement in order to ensure a quality education (Hanson, 2010).

There are also challenges to UPE that are of social and economic origin. Despite free public education, government run rural schools tend to have poor infrastructure, which can make them ineffective as learning institutions due to social perceptions (Ssewamala et al., 2011). Another challenge is the difficulty faced by impoverished families in regards to paying the extra fees associated with school, despite tuition assistance (Ssewamala et al., 2011). Social factors also present a challenge to UPE because children are often needed or expected to stay home and work in impoverished families (Ssewamala et al., 2011). The literature indicates that school fees are the primary influence on drop-out rates or incompleteness in primary-aged pupils (Nishimura et al., 2008). Drop-out rates of primary school children are estimated to be as high as 66%, with less than 40% of the students who enter primary one completing all grades through primary seven (Ssewamala et al., 2011; UN, 2007). Another cultural reason that has been associated with primary delinquency is a lack of value for education (Ssewamala et al., 2011). In order to increase the quality of education these factors must be considered in conjunction with the important economic and human capital challenges faced by Uganda.

In 2000, the United Nations Millennium Summit brought together unprecedented international cooperation with the goal of eradicating extreme poverty worldwide. This global cooperation created the Millennium Development Goals (MDG's), which address

eight areas of development around the globe to end extreme poverty and ensure basic human rights for all by 2015. These basic human rights are defined as health, education, shelter, and security (UN, 2006).

High rates of food insecurity, low incomes, and malnutrition in sub-Saharan Africa make it one of the most challenging regions to address hunger and livelihood issues, and the region suffers from the greatest shortfall for meeting the MDG's (UN, 2006). Uganda is pursuing the MDG's, but has also set a goal of reducing countrywide poverty to 10% by the year 2017 (Uganda Ministry of Health, 2005). According the world hunger index (WHI) for 2011, Uganda has a global hunger index score of 16.7 (IFPRI et al., 2011). The WHI score of 16.7 is based off of data collected by the UN between 2004 and 2009, and indicates that 19% of the population receives inadequate nutritional intake, 16.4% of children under the age of five are underweight, and 12.8% of children under the age of five die (IFPRI et al., 2011). These factors indicate that Uganda has a serious hunger challenge (IFPRI et al., 2011). The government recognizes that to increase income and encourage economic growth, education is an indispensable component, particularly primary education, which has shown to be highly economically beneficial to the country (Uganda Ministry of Finance, 2005).

Economics and livelihoods of Uganda are primarily based on agriculture (CIA, 2011). The agriculture sector makes up over 20% of Uganda's GDP, provides 80% of the employment countrywide and is the staple livelihood for the 87% of Uganda's population who live in rural areas (CIA, 2011). In the 2005 Poverty Reduction Strategy Paper for Uganda, agriculture is identified as one of the sectors with the greatest potential for decreasing poverty within the country (Uganda Ministry of Finance, 2005). Uganda's

Poverty Eradication Action Plan also prioritizes agriculture as a poverty reduction tool, especially in rural areas (Uganda Ministry of Finance, 2005).

The FAO (2005) recognizes that food-based systems bring together and create a platform to address the cornerstones of sustainable development: learning, nutrition, and income. There is an inherent relationship between agriculture and education in Uganda as a means of reducing poverty and malnutrition. Burchi and De Muro (2007) found that food insecurity has a strong relationship to primary education and as access to primary education increases, food insecurity decreases.

The primary education curriculum in Uganda outlines agriculture among the subjects that are most important for pupils learning (National Curriculum Development Centre, 2000). This agriculture curriculum has two goals: 1) to increase interest in agriculture and improve incomes and 2) to provide the basic knowledge needed to successfully improve farming, leading to greater development and food security (National Curriculum Development Centre, 2000).

Five components have been identified as contributors to improving the quality of primary education. These are improving curriculum, increasing learning materials, increasing instructional time, improved teaching, and improved pupil learning capacity (O'Sullivan, 2006). The quality of education can also be improved through the use of experiential learning techniques (FAO, 2004).

Experiential learning is an integration of experience, perception, cognition, and behavior, which form a learning process based on personal experience (Kolb, 1984). Through personal experience, thoughts and concepts are continually formed and modified (Kolb, 1984). The background knowledge, learning attitude, and prior learning experience

that a student brings to the classroom can influence the development of new knowledge (Eberly Center for Teaching Excellence, 2007). Kolb (1984) provides the definition of learning as, “the process whereby knowledge is created through transformation of experience.” The process of learning is made up of four basic steps: 1) concrete experience, 2) reflective observation, 3) abstract conceptualization, and 4) active experimentation (Kolb, 1984). There is no single order in which to complete the four processes, but the highest quality of learning occurs when the student practices all four steps in the learning cycle (Kolb, 1984). In order to complete all four steps, the student must undergo personal experience (Kolb, 1984). However, experience alone does not necessarily constitute learning because students must establish meaning of an experience through reflective thought (Dewey, 1938; Roberts, 2006).

Experiential learning can improve the quality of education by involving children in the learning process, promoting engagement, and changing the attitude children take towards learning (Acker and Gasperini, 2009). The Food and Agriculture Organization of the United Nations (FAO) promotes the use of school gardens for experiential learning through which education and nutrition can be improved (FAO, 2004; FAO, 2005). School gardens are a tool where pupils can attain life skills that are relevant to the everyday challenges of nutrition, food security, and poverty (FAO, 2005). This form of experiential learning can provide a form of non-formal education that prepares future farmers beyond the classroom (Acker and Gasperini, 2009).

As early as the 18<sup>th</sup> century, school gardens were identified as experiential learning tools that would help children connect with real-life experiences (Desmond et al., 2004). Starting in the 19<sup>th</sup> century school gardens were established in developed countries in

Europe, Australia, and the United States (Desmond et al., 2004). Now school garden programs have become regular occurrences in African countries such as Niger and Sierra Leon through inclusion in national education policies and wide-scale school garden classes (Desmond et al., 2004). Although Uganda has not yet instituted a national school garden policy, several methods of experiential learning are recognized in the formal primary curriculum for Uganda. It is stated in the curriculum that for effective teaching, learning should be practiced through the methods of demonstrations in the classroom and the field, field trips, and hands-on experimentation (National Curriculum Development Centre, 2000). School gardens provide a learning laboratory in which these activities can be practiced, thereby enhancing the quality of primary education in Uganda.

Apart from the use of school gardens to improve education, several factors have been identified that have an effect on the quality of education. Various factors must be considered as defined variables in order to interpret the quantitative and qualitative measurements of learning and to determine the effectiveness of the school garden program (Michaelowa, 2001). These factors include age, gender, parental education, siblings, grade repetition, language, school fees, class size and space availability, and teachers and their teaching methods.

### **Personal/Social Factors**

#### *Age*

Age has been determined as one of the important determinants of educational success in Ethiopia, because a student's age correlates to potential for dropping out, and thus impacts school completion and academic achievement (Woldehanna et al., 2005). Older students are

more likely to be viewed as economic support for their families and are more commonly withdrawn from school to supplement the family income (Woldehanna et al., 2005).

Although students are more likely to drop out as age increases, the age of students who stay in school can have a positive correlation. Studies have indicated that the average age of students in primary school level six, equivalent to sixth grade, is 13 years and 10 months and that students above this age tend to score several points higher than younger students (Smith and Barrett, 2010), indicating that age may have an effect on learning outcomes and exam scores. However, the official age of primary school children according to MoES is six-12 years of age, with six being the age of entry and 12 as the age of departure from primary school (MoES, 2009).

### *Gender*

Although there has been a link between age and academic achievement, gender has not been found to have an impact on academic achievement in sub-Saharan Africa (Michaelowa, 2001). A study found that boys and girls in rural Uganda can expect to achieve the same reading scores on standardized tests (Smith and Barrett, 2011). Despite this equality, differences in gender values are present in Uganda and may have an impact on academic success. Woldehanna et al., (2006) states that males are more likely to stay in school longer than females due to differing social expectations and values of males and females. However, the MoES 2009 Annual School Census report reveals that the percentage of students who took and passed the primary leaving exam (PLE) in the Kamuli District was 75% and 80% for males and females, respectively (MoES, 2009). There were also a higher number of female students (95,094) enrolled in primary school in the Kamuli District in 2009 than male students (91,535) (MoES, 2009).

The gender equality represented by the above statistics from the MoES is important because of the role that women play in the transformation of rural economies and social development (Bertini, 2011). Completion of primary school is important as the precursor to secondary school in Uganda, where less than 10% impoverished rural girl children attend secondary school in comparison to 40% of more economically advantaged urban girl children (Bertini, 2011). The Chicago Council on Rural Affairs also suggests that to empower women, they should be prepared and equipped to be entrepreneurs and workers in the rural economy and beyond (Bertini, 2011). Girls attending school and their future contributions to society are critical since the rural economy of Uganda is predominantly based on the agricultural sector and school gardens are identified as providing life skills in agricultural areas.

#### *Family Relationships*

Family relationships are also found to have a profound influence on the academic success of pupils. The level of parental education has been shown to affect educational outcomes of pupils. Primary level six pupils whose parent(s) has had some degree of formal education have been shown to perform better on literacy exams than pupils with parent(s) having no formal education (Smith and Barrett, 2011). Results vary across the African continent, but both formal education of the mother and/or formal education of the father correspond to higher performance on literacy exams. In some African countries, formal paternal education has a greater influence than formal maternal education, while in other African countries the maternal education has a greater influence (Smith and Barrett, 2011). The dominance of the father's education in the performance of rural children is not consistent in urban environments, where the maternal education was shown to play a more influential

role (Smith and Barrett, 2011). Despite a dissension between maternal and paternal education influences, higher education of either parent is linked to a lower chance of pupil drop out (Woldehanna et al., 2005). A study conducted in rural Uganda showed that children are more likely to enroll in school if their mother has a higher education level (Nishimura, 2008). Another study conducted by Abidoye and Eze (2000) showed a strong correlation between maternal education and higher pupil academic achievement.

Studies have found that pupils' home environment can influence their academic performance. A pupil who resides at home with their parents is more likely to score higher in literacy on an exam than a pupil who is living away from home or independently (Smith and Barrett, 2011). In addition, sibling relations within a family have been linked to academic performance. A negative correlation has been found between the likelihood of pupil drop-out and the number of siblings under the age of 5 or over the age of 15 living in the household (Woldehanna et al., 2005).

### **School Experience**

When assessing the educational outcomes of primary pupils many factors may influence those pupils' learning. The World Bank has produced nine internally recognized indicators of educational quality. These nine factors are: libraries, instructional time, homework, textbooks, teacher subject knowledge, teacher experience, laboratories, teacher salaries, and class size (O'Sullivan 2006). Along with these factors, several others are recognized as being influential, including enrollment data and examination achievement data (O'Sullivan, 2006).

### *Grade Repetition*

The repetition of one or more grades in primary school has been linked to lower performance on literacy exams. Along with repeating one or more grades, the repetition of a single grade one or more times has also shown a relationship to lower performance (Smith and Barrett, 2011). Grade repetition has also been linked to generally poor academic performance (Brophy, 2006). Brophy (2006) also states that grade repetition is often socially unacceptable in developing countries, but it is often recognized by family as the only way to deal with poor performance, leading to negative social stigmas for a pupil, which can lead to further poor performance. Frequently, grade repetition and low academic performance are a result of low attendance due to a multitude of factors (Brophy, 2006).

Although the effect of grade repetition on primary level students has been studied with varying results, a study reported by Smith and Barrett (2011) found that 50-60% of students in Namibia and Swaziland have repeated a grade by the P6 level and that this repetition could have a negative effect on other pupils in the class, or “community effect.” This research also indicated a similar trend in Botswana. However, the same study found negligible results for community influence from pupils who have repeated a grade in other African countries such as Kenya, Tanzania, and Uganda.

### *Class Size*

Heneveld (2007) found that availability of space within the classroom had no impact on performance outcomes between high-income and low-income schools in Uganda. However, number of pupils in a class had a negative impact on test performance in Mozambique and Tanzania where classroom occupation exceeded 80 pupils, indicating a potential threshold for classroom occupation and successful performance (Heneveld, 2007).

Michaelowa (2001) also indicates there is a potential classroom population threshold which could negatively impact student achievement. This threshold has not been determined and therefore, the impact of class size on student achievement is inconclusive.

#### *School facilities and resources*

Henevald (2007) indicated that the availability and use of textbooks are not necessarily an indicator of increased performance; however, a study done in 2001 across five other African nations indicated that the presence of books, not necessarily textbooks, can increase reading practice and have a positive influence on education outcomes (Michaelowa, 2001).

A study conducted by the Ugandan government in 1999 found that only 14% of students performed above the minimum standard in English literacy (O’Sullivan, 2006). The nationally recognized language in post-colonial Uganda is English. Despite this national recognition, a plethora of tribal dialects are spoken, even within the same district of Uganda (Masinde, personal communication). The Kamuli district has many tribal languages that are spoken; however, at Namasagali primary school the primary tribal language is Lusoga (Masinde, personal communication). Students are required to learn English and teachers teach in English unless clarification is needed or the pupils are younger (grade level of four or below). It is important to recognize that not all students have proficient English skills, which may influence their education.

Language is an important aspect of education because it is the primary vehicle for literacy development (Bunyi, 1999). The simple ability to read and write a language is only one component of literacy. The term “critical literacy” refers to the ability of students and teacher to effectively communicate in a given language (Bunyi, 1999). Based on a case study

in Kenya impoverished children are more likely to struggle in school due to their unfamiliarity with English upon entering primary school and at home throughout primary school (Bunyi, 1999). Exposure to the language outside of the classroom has been shown to increase testing scores of pupils in primary grade level six in rural Uganda (Smith and Barrett, 2011). One study estimated that Ugandan students who spoke English frequently at home scored twenty points higher in reading achievement than students who never spoke English at home (Hungu and Thuku, 2010). Additionally, studies show that instruction with indigenous language improves educational success and helps with the learning of English (Bunyi, 1999). A study in Madagascar assessing educational quality identified that test results were higher when local languages were used to instruct (Michaelowa, 2001).

In addition to the potential impacts of language on learning, a study conducted by the World Bank found that teaching quality and school quality have a greater impact in poorer countries than in developed countries, specifically in science achievement (Heynemen and Loxley, 1983). However, preliminary results from studies in sub-Saharan Africa also indicate that teacher-centered and less interactive teaching methods do not have an overly large effect on student outcomes (Heneveld, 2007).

### **School Gardens**

Through the usage of school gardens, students are exposed to an interdisciplinary learning experience that can show students how to grow crops, foster skills applicable in an agricultural economy, and develop entrepreneurial abilities for future livelihoods (FAO, 2010). The FAO (2010) states that it is imperative to “prioritize educational goals for children’s garden activities,” because learning is the key to empowering the community and improving future livelihoods.

School gardens also improve retention by providing a hands-on learning environment (FAO, 2010). The hands-on learning environment creates a bridge between classroom concepts and life application (Mohrmann, 1999; Smith and Motsenbocker, 2005). Pigg et al., (2006) found that school gardens in the United States can enhance existing curricula for some students, although the method of utilization may need to be adjusted to make school gardens a more effective learning tool. Similar results were found by Fleener et al., (2011) regarding the impact of school gardens on life skills such as teamwork and communication in the United States. Utilizing school gardens in the United States has also been shown to increase the science achievement of students (Klemmer et al., 2005).

As discussed above, results from the United States indicate that, when utilized contextually, the school gardens have the potential to increase academic performance. Despite differences between developed and developing countries' education systems, economic infrastructure, and predominant livelihoods, school gardens in developing countries have the potential to increase academic performance because they are strongly correlated with important rural livelihoods (FAO, 2010). The assessment of school gardens as a learning tool in developing countries, such as Uganda, should be completed to improve programs and contribute to the existing body of published research on the topic.

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## CHAPTER 2. THE IMPACT OF A SCHOOL GARDEN PROGRAM ON AGRICULTURE LEARNING BY PRIMARY SCHOOL CHILDREN IN RURAL UGANDA

A paper to be submitted to *HortTechnology*

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*Additional index words:* *experiential learning*, universal primary education

### Abstract

The FAO of the UN recognizes food-based systems as a platform to address the cornerstones of sustainable development: learning, nutrition, and income. Food security has a strong relationship to primary education and as access to primary education increases, food insecurity decreases. This study measured the impact of a school garden program on agriculture learning of pupils living in a food insecure region of rural Uganda and aimed to identify if the pupils acquire agriculture knowledge and skills through a school garden program. Agriculture learning of pupils attending a school with a school garden program or attending a school without a garden was investigated through three methods: 1) analyzing exam scores of pupils completing primary school grade 7 from two schools, 2) evaluating pre- and post-test scores over an agriculture topic taught in the national curriculum, and 3) administering a questionnaire of pupils. PLE scores showed improvement at NPS in the period after implementation of the school garden and decreased in the school without a school garden program. Differences in pre- and post-test achievement were not found between schools; however gender was found to have an impact on achievement. The survey results of 64 children identified themes in gender, age, prior garden experience, and school

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experiences, which play an important role in pupils' learning of agriculture. These investigations enhance our understanding of a school garden program's impact on the learning of agriculture topics at the primary school level in rural Uganda and may be used to identify methods to improve primary education, thereby improving nutrition and promoting food security.

### **Introduction**

In 2000, the United Nations Millennium Summit brought together international cooperation with the goal of eradicating extreme poverty worldwide. This global cooperation created the Millennium Development Goals (MDG's), which address eight areas of development around the globe to end extreme poverty and ensure basic human rights for all by 2015. These basic human rights are categorized into health, education, shelter, and security (UN, 2006).

High rates of food insecurity, low incomes, and malnutrition in sub-Saharan Africa make it one of the most challenging regions to improve, and the region suffers from the greatest shortfall for meeting the MDG's (UN, 2006). Among these countries is Uganda; which strives to meet the MDG's, but has also set goals of reducing countrywide poverty to 10% by 2017 (Uganda Ministry of Health, 2005). The government recognizes that to increase income and encourage economic growth, education is an indispensable component, which has shown to be highly economically beneficial to the country (Uganda Ministry of Finance, 2005).

Economics and livelihoods of Uganda are primarily based on agriculture (CIA, 2011). The agricultural sector makes up over 20% of Uganda's gross domestic product (GDP), provides 80% of the employment countrywide, and is the staple livelihood for the 87% of

Uganda's population who live in rural areas (CIA, 2011). In the 2005 Poverty Reduction Strategy Paper for Uganda, agriculture is identified as one of the most important components for decreasing poverty within the country (Uganda Ministry of Finance, 2005). Uganda's Poverty Eradication Action Plan also prioritizes agriculture as a poverty reduction tool, especially in rural areas (Uganda Ministry of Finance, 2005). The Food and Agriculture Organization of the United Nations (FAO) (2005) recognizes that food-based systems bring together and create a platform to address the cornerstones of sustainable development: learning, nutrition, and income. Burchi and De Muro (2007) found that food insecurity has a strong relationship to primary education and as access to primary education increases, food insecurity decreases. The relationship between agriculture and education in Uganda is important as a means of reducing poverty and malnutrition.

Uganda adopted a Universal Primary Education (UPE) policy in 1997, which strives to fulfill goals set by the Ugandan Ministry of Education and Sports (MoES) (Bategeka and Okurut, 2005; FAO, 2004). Despite increased enrollment and increased government strides towards UPE as a means of poverty eradication, studies by the National Assessment of Primary Education Performance have indicated that pupils' knowledge and skills in science have decreased since the introduction of UPE (Bategeka and Okurut, 2005). There has been a dramatic increase in the number of students in primary school grades as a result of UPE, and the increase in the number of pupils has contributed to a decrease of the quality of primary education in Uganda because of limited resources (Bategeka and Okurut, 2005). The quality of primary education, specifically in rural areas, still needs significant improvement in order to ensure a quality education (Hanson, 2010).

The FAO promotes the use of school gardens for experiential learning through which education and nutrition can be improved (FAO, 2004; FAO, 2005). School gardens can improve the quality of education by adding local relevance to a national curriculum (Acker and Gasperini, 2009). The primary education curriculum in Uganda outlines agriculture among the subjects that are most important for pupils' learning (National Curriculum Development Centre, 2000). The agriculture curriculum, a component of the integrated science curriculum, has two goals: 1) to increase interest in agriculture and improve incomes, and 2) to provide the basic knowledge needed to successfully improve farming, leading to greater development and food security (National Curriculum Development Centre, 2000).

School gardens create an area for hands-on learning where pupils can attain life skills that are relevant to everyday challenges such as nutrition, food security, and poverty, and also improve non-formal education, which prepares future farmers beyond the classroom (Acker and Gasperini, 2009; FAO, 2005). Several methods of experiential learning are recognized in the formal primary curriculum for Uganda; it is stated in the curriculum that for effective teaching, learning should be practiced through the methods of demonstrations in the classroom and the field, field trips, and hands-on experimentation (National Curriculum Development Centre, 2000).

The FAO (2010) states that learning is the key to empowering the community and improving future livelihoods. School garden programs help achieve educational outcomes and FAO recommendations include that educational curricula should support school garden activities. The hands-on learning environment creates a bridge between classroom concepts and life application (Mohrmann, 1999; Smith and Motsenbocker, 2005). In the United States, when utilized contextually for outcomes, school gardens have the potential to increase

academic performance (Fleener et al., 2006; Klemmer et al., 2005; Pigg et al., 2006). School gardens in developing countries have the potential to increase academic performance because they are strongly correlated with rural livelihoods (FAO, 2010). The assessment of school gardens as a learning tool in developing countries is applicable to the promotion of school gardens by international organizations and should be completed to improve existing programs.

The study provides insight into the impact of a school garden program on learning of agriculture by children in primary schools in rural Uganda. Assessing the impact of the school garden program could effectively provide evidence for the use of school garden programs to increase the agricultural focus in education, which provides knowledge for children's future rural livelihoods and food security. If a school garden program increases the focus on agriculture but shows little evidence of improvement in learning of agriculture, assessment findings help administrators identify areas of the program that require adjustment or improvement.

The study had the overall objective of evaluating the influence of a school garden program on the learning of agriculture by children attending primary school in the Kamuli District of Uganda. Three sub-objectives included research with primary school pupils in schools either with a school garden program or without a school garden program to 1) determine pupils' scores on the national exam section for integrated science and agriculture, 2) determine the impact of the school garden program on the learning of an agriculture topic, and 3) identify themes from survey results of the pupils' personal home life, home gardens, school gardens, and school experiences that may influence learning of agriculture topics.

This study evaluated the program on a localized scale; however, the study has the potential to be applicable on a larger scale.

The three data collection methods included obtaining Ugandan Primary Leaving Examination (PLE) scores, results of a pre- and post-test over an agriculture topic, and answers to pupil surveys. These methods provide data that are reliable and standard in modern education studies, and one of the primary measures of learning outcomes used in education studies in developing countries is the use of exam scores as a measurement for success (O'Sullivan, 2006). O'Sullivan (2006) also states that supplementary methods, such as student surveys, should be used to attain a comprehensive assessment of learning. Studies done by the World Bank have used data from the Ugandan PLE as well as individual questionnaires and surveys (Heyneman and Loxley, 1983). Previous studies using standardized test scores and surveys about socioeconomic background and school factors show statistically reliable evidence that the methods would reproduce similar data for different locations (Michaelowa, 2001).

### **Materials and Methods**

Two public primary schools were selected for this study located in the Kamuli District, Uganda; Namasagali Primary School (NPS) (latitude 1°33'49" N, longitude 32°56'08" E) and Namasagali College Staffs' Children Primary School (NCS) (latitude 1°56'75"N, longitude 32°57'37"E). NPS and NCS are located in the same district and each contributes either the presence or absence of a school garden program. NPS had a school garden program from 2006-2011 and NCS did not have a school garden program.

Before commencement of the study, approval was obtained from both Iowa State University (ISU) Institutional Review Board (IRB) and the Uganda National Council for Science and Technology (UNCST). Signed consent and assent documents were obtained for both schools, including school administration, all parents of pupils participating in the study, and all pupils participating in the study. Pupil participation was limited to children enrolled in primary school, grade level seven (P7) at both schools. School consent was obtained through the headmaster of each school. Parental consent and child assent forms were distributed and explained during informational meetings at each school for parents and pupils. If consent and assent were not obtained from both the child and parent, the child did not participate in any aspects of the study.

All pupils in P7 at NPS were selected for potential participation and pupils were selected randomly from the NCS P7 class. The NPS P7 class consisted of 30 students, and the NCS P7 class consisted of over 80 pupils. A random sample of 35 NCS pupils was selected to maintain similarity in sample size between NPS and NCS.

The assessment to determine the impact of a school garden program on pupils' learning was obtained through PLE scores for the overall and integrated science section, which includes agriculture, of pupils during the years 2003-2010 from both NPS and NCS, and administration of a pre-test, instructional unit, and post-test on the topic of beekeeping, which is included in the national integrated science, agriculture curriculum, as a potential topic on the PLE. Beekeeping was introduced to the NPS school garden program in 2009 and continued in 2010.

The Ugandan PLE scores used were obtained from NPS and NCS school records by direction from the District office for the Ministry of Education (MOE) in the Kamuli District,

Uganda. Scores of all children completing the PLE exam were included. The year and number of PLE scores used to calculate means and analyses are presented in Table 1. The year 2003 was chosen as the starting year because it was prior to the development of a school garden program at NPS that occurred in 2006.

Test score data were compared from pupils attending NPS before and after the establishment of the school garden program. A second comparison of scores was completed between NPS and NCS for all individual years, 2003-2010. PLE scores included individual subject scores and an aggregate score for each student. For this study, the individual score for science, which includes agriculture, and the aggregate score were used for analysis. Analysis of the PLE scores consisted of independent and paired t-tests using SAS software (SAS, 2009).

To determine levels of learning of the same agriculture material, NPS and NCS both participated in an instructional unit on beekeeping and both pre- and post tests. The beekeeping subject was selected because a component of the school garden program consisted of a beekeeping project, and in Uganda's national curriculum beekeeping is taught in P7 during school term 2, the term during our study (National Curriculum Development Center, 2000). Term 2 is from approximately mid-May to early August. The pre-test and post-test questions were designed to mimic the structure found on the national PLE and local school exams by reviewing previous exams provided by the teachers. The exam format is one in which pupils write their short answers on paper to questions that are grouped into categories. NPS and NCS agriculture teachers reviewed the test questions prior to the pre-test and start of the beekeeping lessons.

The pre-test and post-test included the same eighteen questions, grouped into three categories of benefits of beehives, beehive site selection, and beehive management. Questions were listed in different orders within each category for the pre- and post-test, but were exactly the same for both schools. The pre-test was administered at NCS and NPS the week before the instructional beekeeping unit was scheduled to start. The primary investigator and the translator administered the pre-test. Directions were given in English and translated into Lusoga. Each student was given an exam and a pencil. Exams were printed in English, the standard language for classroom testing and the PLE in Uganda. All students had up to 60 minutes to complete the exam, leaving early if complete.

In both schools the instructional unit on beekeeping was taught by the schools' P7 agriculture teacher to normalize the environment of learning for the primary school pupils. At each school beekeeping was taught for six, 80-minute periods. Teaching material first reviewed beekeeping information from the P5 curriculum, and ended with P7-level content that was applicable to the pre- and post-test. Pupils' attendance in the classes when teachers taught the beekeeping unit were recorded.

A post-test was administered to all participating P7 pupils at NPS and NCS after the teacher completed the beekeeping lessons. The procedure for the post-test was the same as the pre-test. The questions asked were the same as on the pre-test but re-ordered under the same categorical headings. Examples of the beekeeping pre- and post-test can be found in Appendix 2.

Evaluation and marking guides were created by the P7 agriculture teachers at NPS and NCS independently after the completion of the post-test and combined by the primary investigator to create a comprehensive answer key, which was used to assign points to

student answers on their exam. Each question was graded and correctness or partial correctness resulted in a 1 and nothing correct resulted in 0. The number of questions answered correctly or partially correct were recorded out of 18 questions. This procedure was also used to grade the post-test. Only answers that were written in English were considered correct.

The third sub-objective of this study was to identify themes from survey results about pupils' personal home experience, home gardens used as food plots, school gardens, and school experiences that may influence learning of agriculture topics. A survey was administered to all participating pupils at NPS and NCS that gathered participant information, school garden, home garden, and school environment information. The survey for NPS pupils contained 34 questions. The survey for NCS pupils contained 27 questions, which was the same as NPS except that it did not include questions about the school garden program since one was not present. The survey of each pupil was done individually in private by the investigator and with a Lusoga translator present. Questions were asked in English and translated into Lusoga as needed for clarity. Survey answers were recorded onto questionnaire forms in notebooks by the investigator. Examples of the surveys for both schools can be found in Appendix 2.

Pre- and post-test score data were analyzed using SPSS software (SPSS, 2010). Within the SPSS software, t-tests were performed to determine differences between scores on the pre-test and post-test between both schools. Survey data were compared and analyzed against pre-and post-test scores using independent t-tests, paired t-tests, and regression analysis of variance (ANOVA) in SPSS version 19.0 (SPSS, 2010).

## Results and Discussion

PLE scores for all P7 students who took the PLE in the years 2003-2010, across all years were not different between NPS and NCS (Appendix Figure 1). PLE scores for science and exam aggregate showed better achievement at NPS after the school garden program was implemented (2006-2010), compared to before the school garden program (2003-2005), (Table 2). The results of the improvement in academic achievement at NPS, with a school garden program were expected because of curricula enhancement and pupil engagement with skills relevant to daily life (FAO; 2005; Pigg et al., 2006). While other studies have shown that school gardens can improve academic achievement in developed countries, our data support the FAO statements that these benefits of a school garden program apply to developing countries. PLE scores at NCS without a school garden program showed lower achievement for the science and aggregate PLE scores for the years 2006-2010 than for the years 2003-2005 (Table 3). Variables that may affect PLE score changes over time include school qualities, teaching qualities, and teaching methods (Heneveld, 2007; Heynemen and Loxley, 1983). An analysis of these factors was not completed in this study.

There were 21 and 29 pupils who completed the pre-test, post-test, and questionnaire at NPS and NCS, respectively. Pupil scores were shown to improve from the pre-test to the post-test (score gain) at both NPS ( $t=3.892$ ,  $df=28$ ,  $p=.001$ ) and NCS ( $t=2.648$ ,  $df=20$ ,  $p=.015$ ); however, no difference was found to indicate pupils from one school improved more than the other ( $t=.607$ ,  $df=48$ ,  $p=.547$ ) (Table 4). Improvement from pre-test to post-test could indicate knowledge was gained or test-taking ability was improved. The scores of students on the pre- and post-test was well below 50% at both schools, a score low by standards of developed countries, but a passing score in the context of rural Uganda. The

achievement rate could be due to student grade repetition. Brophy (2006) indicates that grade repetition is linked with low academic performance. Percentages of pupils' who stated they had repeated a grade were similar at NCS and NPS, 60.6% and 64.5%, respectively.

Another potential explanation for achievement below 50% on the pre- and post-test could be difficulty with English comprehension. It was observed during the oral questionnaire that pupil comprehension of English was low, requiring all questions to be translated into Lusoga to receive an answer. A study conducted by the Ugandan government in 1999 found that only 14% of students performed above the minimum standard in English literacy (O'Sullivan, 2006). Although the nationally recognized language in Uganda is English, the English language used on the pre- and post-test may have led to lower scores due to pupils' poor understanding of the questions. A study in Madagascar assessing educational quality identified that math scores on tests written in the national language were higher when local languages were used to instruct before switching to instruction in the national language (Michaelowa, 2001).

Despite low achievement, student questionnaires indicated that 87.9% of students at NCS and 93.5% of students at NPS plan to continue on to secondary school. Students who did not plan to continue on in school stated that their plans were to work. The education goals to continue past primary may indicate pupils place high value on education at NPS and NCS. The perception of education is important because it has been associated with pupil dropout rates (Ssewamala et al., 2011). Experiential learning tools such as the school garden program can be utilized to improve pupil attitudes about learning (Acker and Gasperini, 2009; Desmond et al., 2004).

Children's attendance for the six, two-hour beekeeping lessons varied between the two schools with a mean attendance of 33.9% at NPS and a mean attendance of 87.9% at NCS. The highest level of pupil attendance at NPS was on 17 July with 54.8% attendance. The highest level of pupil attendance at NCS was 100% and occurred on 28 June. At NCS 100% of participating students attended at least half of the two-hour lessons, while at NPS only 35.5% of participating students attended at least half of the two-hour lessons. Combined lesson attendance and pre- and post-test scores can be found in Appendix Table 1. In addition to lesson attendance, questionnaire data identified the number of times P7 children missed school per week and why they missed school. Results can be found in Table 5. Although NPS pupils attended fewer lessons, they performed as well as students who attended more lessons at the school without the school garden program. Studies done in the United States indicate that school gardens enhance course of study and increase retention and science achievement (Fleener et al., 2011; Klemmer et al., 2005). Experiential learning of beekeeping in the NPS school garden program may have provided concrete experiences to learn the concepts of beekeeping and compensated for less classroom instruction. Another consideration is that on days the pupils attended the lessons, the agriculture teacher at NPS may have provided missed instruction to keep children who missed the lessons on par with classmates who attended.

Survey data including age, gender, family structure, and home garden experience were similar for pupils at both NPS and NCS. Age (15 and younger or 16 and older) ( $t=1.146$ ,  $p=.258$ ), presence of a personal home garden (yes or no) ( $t=.178$ ,  $p=.859$ ), household family structure (traditional mother and father or other) ( $t=.351$ ,  $p=.727$ ), and lesson attendance (more than three or three and less) ( $t=-.622$ ,  $p=.537$ ) were not found to

have an effect on score gain between the pre- and post-test (Adjusted RSquare -.013). No interaction effects between schools were found and therefore school data were combined for the analysis of variance (ANOVA) (Appendix Table 2).

P7 pupil age at NPS varied from 13 to 19 years and pupil age at NCS varied between 12 and 17 years. The mean age at both NPS and NCS was 15 years (Appendix Figure 2). Beekeeping pre- and post-test achievement was similar across all ages (Appendix Table 3). The average age of students participating in the study was higher than 12 years, which is identified by the Uganda MoES (2009) as the P7 leaving age. Although age was not found to have an impact on score gain, the overall low achievement of less than 50% score gain could be related to higher age of P7 pupils, which may lead to lower attendance and delay progress through primary school (Woldehanna et al., 2005).

Although presence of a personal home garden did not impact beekeeping score gain, 54% of participating pupils at both schools stated having personal home gardens. Crops grown by students showed lower diversity than those grown in the school garden and included primarily maize (*Zea mays* L.), (Appendix Table 4). One-hundred percent of students at both NPS and NCS with personal home gardens grew at least one crop also grown in the school garden at NPS (Appendix Figure 3). Data from questionnaires found that 100% of children at NPS stated they had eaten food from the school garden and 55% of children at NPS stated they had received planting materials to take home from the school garden. The school garden program at Namasagali Primary School provided the resources necessary to fulfill teaching methods recommended by the National Curriculum Development Centre (2000) by providing an area for field demonstrations and hands-on experimentation. The high percentage of pupils reporting consumption and receipt of garden materials indicate the

school garden is benefitting the children in ways discussed by the FAO (2010), such as providing nutrition and planting material for the household.

Of the 21 students who took the pre- and post- test at NPS, 100% lived with siblings. At NCS 93% (27 out of 29) of the students who took the pre- and post-test lived with siblings. Fifty percent of students stated that they lived in a traditional family structure (mother and father) while the other 50% of students live with other relatives or a non-traditional structure (Appendix Table 5). Pupils from NCS and NPS stated similar percentages of household family members with different occupations (Appendix Table 6). Fifty-seven percent of children who stated living with either or both mother and father, in a traditional or non-traditional structure, and knew their parents education level, declared their parents completed levels above primary seven. Although the students declared their parents education exceeded primary, the children who knew their parents education level and lived with one or more parents was less than 50%. The MoES (2011) states that the highest level of education completed by the dominant portion of the population in Uganda is primary school. The most common parental occupation was “farmer,” and evidences the high dependency of rural Ugandans on agriculture (CIA, 2011).

The pupils of both schools have similar age, home garden experience, and family structure. Similar background experiences of pupils may impact knowledge gained outside of a school garden program and may influence their learning of a beekeeping unit. The background knowledge, learning attitude, and prior learning experience that a student brings to the classroom can influence the development of new knowledge (Eberly Center for Teaching Excellence, 2007).

Gender was found to have an impact on score gain (Table 6). The data indicated males scores increased more between pre-and post-test than females ( $t=-1.692$ ,  $p=.098$ ). Pre- and post-test participants at NPS and NCS were composed of 12 females and 9 males, and 6 females and 23 males respectively. Males and females showed similar lesson attendance, family structure, and presence of a personal home garden; however, male pupils were, on average, older than female pupils (Appendix Table 7). Our study indicates that male students, who were older than female students, showed higher achievement, which supports findings that have indicated students above 13 years of age in primary level six tend to score several points higher than younger students (Smith and Barrett, 2011). However, as age increases, attendance can decrease, leading to lower achievement (Woldehanna et al., 2005). The gender of the teacher also may have an influence on children's achievement. Female students score higher when taught by a female teacher and male students score higher when instructed by a male (Michaelowa, 2001). The difference is believed to be related to the role of teachers as role models (Michaelowa, 2001). The primary agriculture teachers at both NPS and NCS are male.

Classroom observation and the data collected from the survey allowed a profile of a typical child attending NPS in primary level seven to be developed. An average child would be a 15-year-old male with a small home garden where maize is grown. The pupil would miss school one day per week on average due to illness, and would live at home with siblings in either a traditional or non-traditional family structure. One or more of the child's parents would farm for their livelihood and subsistence. The child would have repeated a primary grade and would have consumed something from the school garden in the school lunch.

The school environment that a typical P7 child would experience would be a class size of 35 pupils. Classroom instruction would be primarily in English, with translations into Lusoga as needed. The child would have lessons in integrated science, which includes agriculture, mathematics, English and language, and social studies. The student would attend school Monday through Friday and would be at school from approximately 7:45am to 4:30pm.

The classroom environment consists of cement or dirt floors with one-piece wooden benches and desks, and typical seating includes three to five pupils per bench. Classrooms have metal roofs and open windows, and can reach over 80 degrees inside on a sunny day. Classrooms contain a chalkboard for instruction at the front of the room. The pupils do not have textbooks but have individual paper notebooks for their note taking, which remain at the school over night.

### **Study Limitations**

The objectives of this study were focused on assessing the impact of a school garden program on agriculture learning. There are many factors which can influence pupil learning that were not addressed in the study, such as pupil health and cognitive ability to learn. Therefore this study is a component nested within the multi-dimensional factors that have the potential to impact pupil learning. In addition the study is limited to determining the impact of a school garden program on agriculture learning by primary school children. The study is also limited to the situational context of two specific schools within a district in rural Uganda.

## **Conclusions**

School garden programs can benefit children by providing food for a school lunch and plant materials for their home gardens. Achievement below 50% on the beekeeping pre- and post-test could be a result of student characteristics such as age, comprehension of English, and grade repetition. Gender may impact test score achievement and further research should elucidate the influences of gender in primary school children's progress in rural Uganda. Future research should include an in-depth assessment of the uses of a school garden in the teaching methods, integration in the curriculum, teacher training, and teacher preparation in rural Uganda. Due to decreased attendance at NPS due to sickness and poor health, and the evidence of garden material supplementation to the school lunch, it is recommended that an analysis be conducted about the health and nutrition status of the pupils and any effect on their learning.

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**Table 1. Number of children's Primary Leaving Exam scores used for analyses from two primary schools, Uganda.**

	2003 (No.)	2004 (No.)	2005 (No.)	2006 (No.)	2007 (No.)	2008 (No.)	2009 (No.)	2010 (No.)
NPS <sup>y</sup>	67	40	71	73	53	39	88	122
NCS	36	48	62	77	71	85	No Data	149

<sup>y</sup> NPS = Namasagali Primary School, NCS = Namasagali College Staffs' Children Primary school.

**Table 2. Primary Leaving Exam scores of children in grade 7 at Namasagali Primary School, Uganda, before and after implementation of a school garden program.**

Year	No. of Pupils	Science Score	Aggregate Score
2003-2005 <sup>z</sup>	166	7.2 <sup>y</sup>	29
2006-2010	357	6.3	26.8
Paired T-test (P≤0.05)		<sup>x*</sup>	<sup>x*</sup>

<sup>z</sup> 2003-2005 are years before implementation of a school garden program; 2006-2010 are years after implementation of a school garden program.

<sup>y</sup> Standardized scoring of national exams for science is 1-9 and for the aggregate of all subjects 4-36. Passing scores are 8 and below in science and 32 and below in aggregate.

<sup>x\*</sup> Indicates a difference between year groups. Lower scores indicate higher achievement.

**Table 3. Primary Leaving Exam scores of children in grade 7 at Namasagali College Staffs' Children School, Uganda, for year groups before and after implementation of a school garden program at Namasagali Primary School.**

Year	No. of Pupils	Science Score	Aggregate Score
2003-2005 <sup>z</sup>	138	5.6	24.8
2006-2010	357	6.5	27.7
Paired T-test (P≤0.05)		<sup>x*</sup>	<sup>x*</sup>

<sup>z</sup> 2003-2005 are years before implementation of a school garden program; 2006-2010 are years after implementation of a school garden program at NPS.

<sup>y</sup> Standardized scoring of national exams for science is 1-9 and for the aggregate of all subjects 4-36. Passing scores are 8 and below in science and 32 and below in aggregate.

<sup>x\*</sup> Indicates a difference between year groups. Lower scores indicate higher achievement.

**Table 4. Pre-test score, post-test score, and percent score increase for P7 pupils at Namasagali Primary School and Namasagali College Staffs' Primary School, Uganda.**

<b>School</b>	<b>No. exams completed</b>	<b>Pre-test %</b>	<b>Post-test %</b>	<b>Score Increase %</b>	<b>Paired t-test <math>P \leq 0.05</math></b>
NPS <sup>z</sup>	21 <sup>y</sup>	26.7 <sup>x</sup>	33.3	6.6	* <sup>x</sup>
NCS	29	31.1	39.4	8.3	* <sup>x</sup>
Independent t-test ( $P \leq 0.05$ )	NS	NS	NS	NS	

<sup>z</sup> Namasagali Primary School = NPS; Namasagali College Staffs Primary School = NCS.

<sup>y</sup> Number of exams completed corresponds to the number of pupils in grade 7 at each school who took the pre- and post-test.

<sup>x</sup> Data presented are percentage correct out of 18 points, which represents 18 questions with each worth one point for the tests given over the beekeeping module at both schools.

<sup>x</sup> \* indicates a difference between pre-test and post-test scores with  $P \leq 0.05$  significance.

**Table 5. Percent of students reporting different numbers of absences per week and reasons for absence of P7 children at Namasagali Primary School and Namasagali College Staffs' Children Primary School.**

<b>Absent</b>	<b>NPS %</b>	<b>NCS %</b>
0 Days/Week	26 <sup>z</sup>	33
1 Day/Week	58	46
2+ Day/Week	16	21

<b>Reason for Absence</b>	<b>NPS* %</b>	<b>NCS %</b>
Sickness/Health	87	18
Work/Family Issues	13	50
Financial/School Fees	4	14
Other	0	18

<sup>z</sup> Data for % absent is calculated out of the total number of primary grade 7 pupils surveyed. Reason for Absence is calculated out of the number of students who missed one or more days of school per week.

\* Data at NPS results in greater than 100% of students due to multiple answers from a single participant.

**Table 6. Pre-test, post-test, and score gain for female and male P7 pupils from Namasagali Primary School and Namasagali College Staffs' Children Primary School, Uganda.**

<b>Gender</b>	<b>Number</b>	<b>Mean Pre-test %</b>	<b>Mean Post-test %</b>	<b>Mean score gain %</b>
Female	18	22.7 <sup>z</sup>	26.4	3.7
Male	32	31.1	39.9	8.5
Paired t-test ( $P \leq 0.10$ )		NS <sup>y</sup>	*	*

<sup>z</sup> Mean pre- and post-test scores are shown as a percentage correct out of 18 for children in grade primary 7. Mean score gain is the percentage increase in number correct out of 18 between the pre- and post-test score.

<sup>y</sup> \*indicates a difference in scores with  $p \leq 0.10$  between genders, NS indicates means are not different.

### CHAPTER 3. GENERAL CONCLUSIONS

School gardens are promoted for their ability to be utilized as experiential learning tools to improve the quality of education for children in developing countries (FAO, 2004). The results of this study identify trends in children's PLE exam scores, pre- and post-test scores as measures of learning of an agricultural unit within a term, and themes from children's home lives that influence their academic performance in rural Uganda.

Secondary data from the P7 PLE exam scores for science and exam aggregate showed better achievement at NPS in the years after the school garden program was implemented compared to before the school garden program. PLE scores at NCS, without a school garden program in the same community, showed lower achievement for the years after the school garden program was implemented at NPS. The results of the improvement in academic achievement at NPS are expected because of benefits from increased retention, improved attitudes about agriculture, and engagement in the learning process (Acker and Gasperini, 2009; FAO, 2010). The benefits to education and learning are increased when the school garden program is integrated in the curriculum (FAO, 2010). Decreases in NCS achievement cannot be explained within the parameters of this study. Possible changes in school facilities and resources, teaching methods, teacher variation over time, and lack of curricular integration with field experience could impact the PLE scores (Heneveld, 2007; Heynemen and Loxley, 1983).

Overall test achievement on the pre- and post-test exams on beekeeping topics were below 50%, which could be due to grade repetition, low English comprehension, low attendance, or above-average age of pupils (Brophy, 2006; O'Sullivan, 2006; Woldehanna et

al., 2005). Pre- and post-test scores improved at both schools, but did not improve more at one school, and age, presence of a home garden, family structure, and attendance were not found to have an impact on score gain from the pre- to post-test. Gender was found to have an impact and results showed male students scored higher on the post-test and showed higher score gain than female students.

Similar performance on the pre- and post-test between NPS and NCS despite less attendance at NPS indicates that the school garden program may have supplemented classroom instruction at NPS by providing an opportunity for pupils to learn the concepts of beekeeping experientially. In addition, the pupils of both schools have similar age, home garden experience, and family structure. Similar background experiences of pupils may impact knowledge gained outside of a school garden program and may influence their learning of a beekeeping unit (Eberly Center for Teaching Excellence, 2007).

This study identified themes from the questionnaire that were not originally included within the objectives. The study found that the school garden is providing food for the school lunch and planting materials for the children's home gardens. The school garden program at Namasagali Primary School provided the resources necessary to fulfill teaching methods recommended by the National Curriculum Development Centre (2000) by providing an area for field demonstrations and hands-on experimentation and showed evidence of benefitting the students by providing materials for planting and consumption.

The survey data collected information that allowed a profile of a typical child attending NPS in primary level seven to be developed. An average child would be a 15-year-old male with a small home garden where maize is grown. The pupil would miss school one day per week on average due to illness, and would live at home with siblings in either a

traditional or non-traditional family structure. One or more of the child's parents would farm for their livelihood and subsistence. The child would have repeated a primary grade and would have consumed something from the school garden in the school lunch.

The school environment that a typical P7 child would experience would be a class size of 35 pupils. Classroom instruction would be primarily in English, with translations into Lusoga as needed. The child would have lessons in integrated science, which includes agriculture, mathematics, English and language, and social studies. The student would attend school Monday through Friday and would be at school from approximately 7:45am to 4:30pm.

The classroom environment consists of cement or dirt floors with one-piece wooden benches and desks and typical seating includes three to five pupils per bench. Classrooms have metal roofs and open windows, and can reach over 80 degrees inside on a sunny day. Classrooms contain a chalkboard for instruction at the front of the room. The pupils do not have textbooks but have individual paper notebooks for their note taking, which remain at the school over night.

### **Future Research**

Future research should focus on the influences of gender in primary school children's progress in rural Uganda. It is also recommended that future studies include an in-depth assessment of the uses of a school garden in relation to the teaching methods and integration in the curriculum, as well as teacher preparation and training. More detailed study into the impact of language on student achievement in the Kamuli District is recommended. As an additional variable, test construction and its impact on how students achieve in science should be evaluated. Due to decreased attendance at NPS due to sickness and poor health,

and the evidence of garden material supplementation to the school lunch, it is recommended that an analysis be conducted about the health and nutrition status of the pupils and any effect on their learning.

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# APPENDIX 1. ADDITIONAL TABLES AND FIGURES

**Appendix Table 1. Beekeeping pre- and post-test achievement by lesson attendance combined for Namasagali Primary School and Namasagali College Staffs' Children Primary School.**

<b>Lessons Attended</b>	<b>Number of Pupils</b>	<b>Pre-test %</b>	<b>Post-test %</b>	<b>Score Gain %</b>
0 <sup>z</sup>	2 <sup>y</sup>	27.8 <sup>x</sup>	30.6	2.8
1	5	13.3	21.1	7.8
2	5	27.8	30.0	2.2
3	11	28.3	40.6	12.2
4	13	28.3	40.0	11.7
5	14	36.7	41.7	5.0

<sup>z</sup> Lessons attended is the number of lessons out of 6 for NPS and 5 for NCS in which attendance was recorded.

<sup>y</sup> The number of pupils is the combined number of pupils who attended the correlating number of lessons.

<sup>x</sup> Pre-test % and Post-test % are a percentage correct out of 18 questions. The score gain is the percentage increase in score between the pre-test and the post-test.

**Appendix Table 2. Analysis of Variance (ANOVA) regression table for pre-test, age, home garden, family structure, gender, and lesson attendance as correlation factors for score gain between the pre- and post-test for pupils at Namasagali Primary School and Namasagali College Staffs' Children Primary School.**

<b>Model</b>	<b>Unstandardized B</b>	<b>Coefficients Std. Error</b>	<b>Standardized Coefficients Beta</b>	<b>t</b>	<b>Sig.</b>
Constant	1.057	0.922		1.146	0.258
Age	1.105	0.813	0.211	1.359	0.181
Gender <sup>z</sup>	-1.81	0.697	-0.262	-1.692	0.098*
Garden	0.128	0.716	0.026	0.178	0.859
Family	0.227	0.645	0.052	0.351	0.727
LessonsAttended	-0.419	0.673	-0.096	-0.622	0.537

<sup>z</sup>\* indicates a difference of  $P \leq 0.10$ , with negative t indicating males had a higher score gain than females from the beekeeping pre- to post-test.

**Appendix Table 3. Scores of pre- and post-tests from children of different ages in P7 grade level at Namasagali Primary School (NPS) and Namasagali College Staffs' Children Primary School (NCS).**

<b>School</b>	<b>Age<sup>z</sup></b>	<b>No. Students</b>	<b>Mean Pre-Test<sup>y</sup> %</b>	<b>Mean Post-test<sup>y</sup> %</b>	<b>Score Gain<sup>x</sup> %</b>
NCS	12	1	11.1	16.7	5.6
NCS	13	2	22.2	36.1	13.9
NCS	14	9	38.9	48.9	10.0
NCS	15	11	35.6	43.3	8.3
NCS	16	3	16.7	22.2	5.6
NCS	17	3	18.3	29.4	11.1
NPS	13	1	55.6	55.6	0.0
NPS	14	3	42.8	46.1	3.9
NPS	15	11	21.1	31.7	10.6
NPS	16	4	18.1	22.2	4.2
NPS	17	1	16.7	22.2	5.6
NPS	18	1	50.0	44.4	-5.6

<sup>z</sup> Age is in years.

<sup>y</sup> Mean Pre-test and mean Post-test are the percentage correct out of 18 questions averaged for all pupils in each age group at each school.

<sup>x</sup> Mean score gain represents the percentage change in score between the pre-test and post-test for all students in each age group.

**Appendix Table 4. Number of pupils from Namasagali Primary School and Namasagali College Staffs' Children Primary School who grow each crop in their personal home garden.**

<b>Crop</b>	<b>Number of Students who grow each crop</b>
Maize ( <i>Zea mays</i> )	15
Beans ( <i>Pheosis vulgaris</i> )	6
Matoke ( <i>Musa spp.</i> )	7
Eggplant ( <i>Solanum melongena</i> )	5
Cassava ( <i>Manihot esculenta</i> )	7
Tomato ( <i>Solanum lycopersicum</i> )	2
Regular Sweet Potato ( <i>Ipomoea batatas</i> )	2
Millet ( <i>Eleusine coracana</i> )	1
Ground Nuts ( <i>Arachis hypogaea</i> )	1
Soybeans ( <i>Glycine max</i> )	1
Grain Amaranth ( <i>Amaranthus spp.</i> )	1
Cabbage ( <i>Brassica oleracea</i> )	1

The above table shows the number of students at NPS and NCS who grow each crop in their personal home garden.

**Appendix Table 5. Beekeeping pre-and post-test achievement of all pupils from Namasagali Primary School and Namasagali College Staffs' Children Primary School living in households with different family structures.**

<b>Family Members</b>	<b>Number of students who responded with each family combination</b>	<b>Mean Pre-Test Score</b>	<b>Mean Post-Test Score</b>	<b>Mean Difference</b>
Aunt	1	4.0	6.0	2.0
Aunt, Grandmother	3	4.7	5.7	1.0
Aunt, Uncle	1	2.0	2.0	0.0
Aunt, Uncle, Grandmother	1	5.0	7.0	2.0
Father	1	9.0	11.0	2.0
Father, Mother	24	5.7	7.4	1.7
Father, Mother, Aunt	1	3.0	4.0	1.0
Father, Mother, Grandmother	3	4.0	5.3	1.3
Father, Mother, Grandmother, Uncle	1	2.0	5.0	3.0
Father, Mother, Uncle	1	0.0	0.0	0.0
Grandmother, Cousins	1	8.0	10.0	2.0
Grandmother, Grandfather, Cousins	1	2.0	3.0	1.0
Mother	6	5.2	7.5	2.3
Mother, Grandmother, Aunt,	1	11.0	7.0	-4.0
Only Siblings	4	5.5	6.0	0.5

Family members represent all combinations listed by pupils during the oral questionnaire. Pupils reside in the same household as the family members listed. Mean pre-test and mean post-test are means for the number of questions answered correctly out of 18. Mean difference is the mean change in number correct out of 18 questions between the pre-test and the post-test. No differences were found with a  $p \leq 0.05$  between family members living in the household and achievement on the pre-and post-test. Data represent all students from NPS and NCS.

**Appendix Table 6. Percent of pupils' household members from Namasagali College Staffs' Children Primary School (NCS) and Namasagali Primary School (NPS) who participate in various occupations.**

<b>School</b>	<b>Occupation</b>	<b>Percent of Pupils</b>
<b>NCS</b>	Farmer	84.8%
	Teacher	6.1%
	Business	21.2%
<b>NPS</b>	Farmer	71.0%
	Teacher	12.9%
	Business	29.0%

Percent of Pupils is calculated out of the number of students, who took the oral questionnaire, who stated at least one household member worked in each occupation area. Students stated occupations for all household members living with them, resulting in single households with multiple occupations.

**Appendix Table 7. Themes in attendance, family structure, age, and presence of a home garden between male and female students at Namasagali Primary School and Namasagali College Staffs' Children Primary School.**

<b>Gender</b>	<b>Number of Pupils</b>	<b>Attendance</b>	<b>Traditional Family</b>	<b>Mean Age</b>	<b>Home Garden</b>
<b>Male</b>	32	3.6 <sup>z</sup>	50% <sup>y</sup>	15.2	72% <sup>x</sup>
<b>Female</b>	18	3.1	44.0%	14.4	72%
<b>Paired t-test (p≤0.05)</b>	NS <sup>w*</sup>	NS	NS	*	NS

<sup>z</sup> Mean number of beekeeping lessons attended out of 6 for all males or females who took the beekeeping pre- and post-test.

<sup>y</sup> Percent of males and females who took the beekeeping pre- and post-test living in a traditional family system with mother, father, and siblings.

<sup>x</sup> Percent of males and females, who took the beekeeping pre- and post-test who stated having a personal home garden.

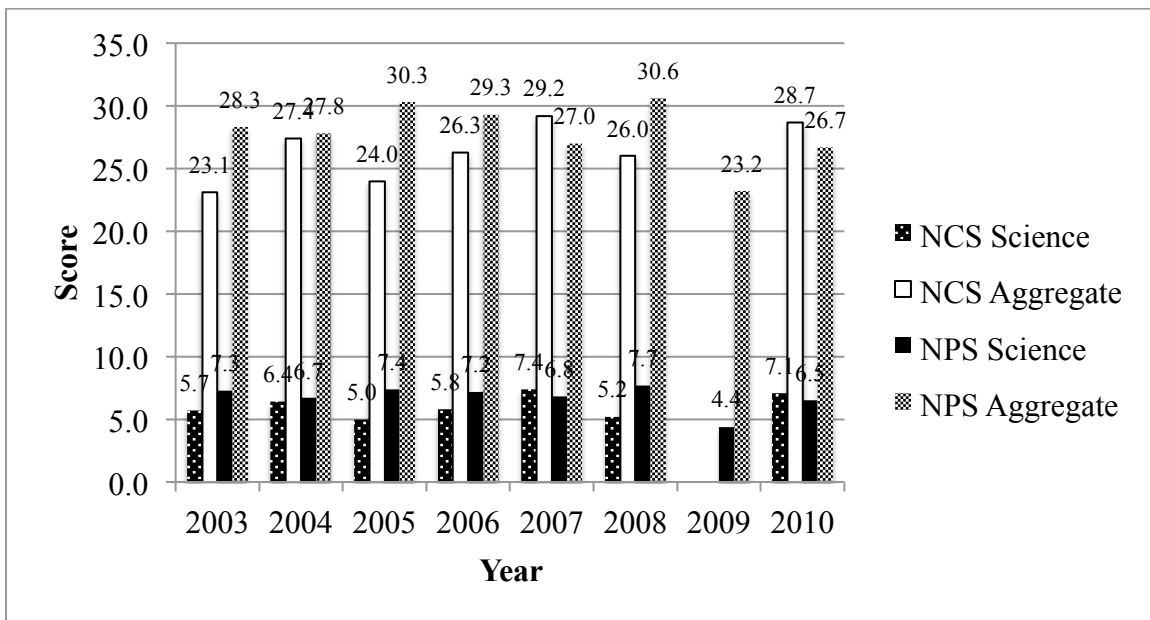
<sup>w\*</sup> Indicates a difference between age for males and females of  $p \leq .05$ . NS indicates not significant.

## APPENDIX FIGURE CAPTIONS

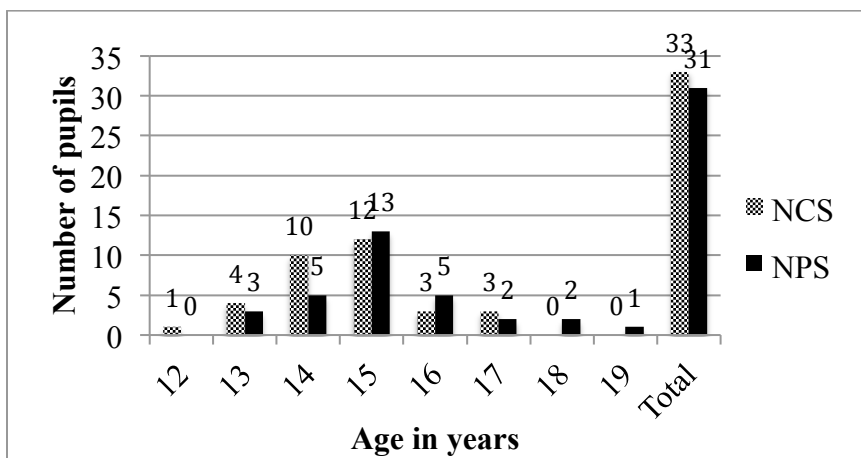
Appendix Figure 1. Science and aggregate Primary Leaving Exam scores for children in P7 attending Namasagali Primary School and Namasagali College Staffs' Children Primary School by year. Bars represent mean scores for all students across all years at both NPS and NCS. Score means were not significantly different between NPS and NCS. Lower scores represent higher achievement. Aggregate scoring is 4-36 and science scoring is 1-9. A score of 8 and below in science and 32 and below in aggregate is passing. PLE scores are standardized.

Appendix Figure 2. Age of pupils who participated in the oral questionnaire from Namasagali Primary School and Namasagali College Staffs' Children Primary School.

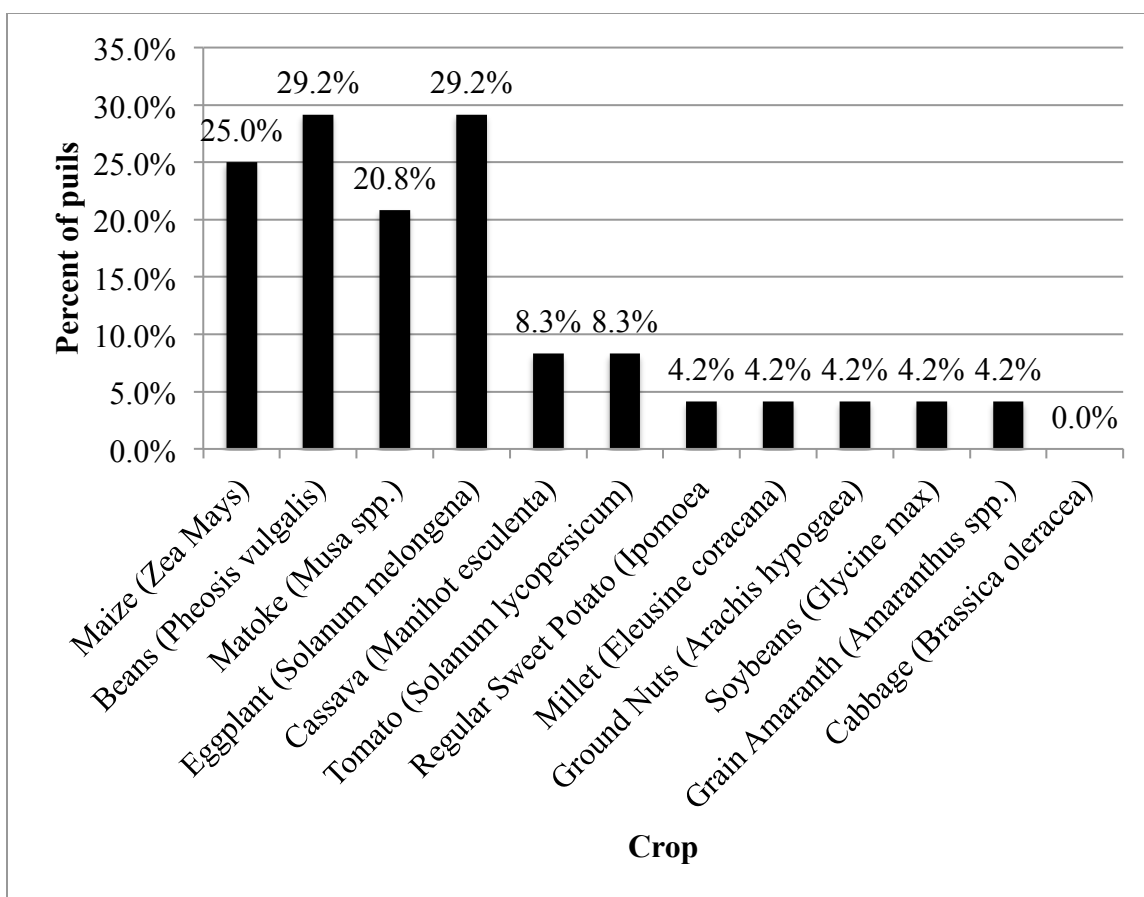
Appendix Figure 3. Percentage of pupils from Namasagali Primary School and Namasagali College Staffs' Children Primary School combined who grow crops found in the school garden in their personal home gardens.



(Fig. 1)



(Fig. 2)



(Fig. 3)

**APPENDIX 2. EXAMPLES OF DATA COLLECTION FORMS**

### **Beekeeping Pre-Test**

State the benefits of beekeeping:

1. Why do people keep bees?

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2. Why does the bee visit flowers?

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3. How do plants benefit from these bees?

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4. How can beekeeping help you earn money?

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5. Name the products of beekeeping.

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6. What food value do we get from bees?

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Choose an appropriate site for a beehive:

7. What is a hive?

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8. What conditions must a beekeeper consider when setting up a hive?

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9. Give two flowering plants that can be used by bees to make honey.

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10. Why do beehives need to be located near a water source?

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Manage a beehive:

11. What does the term 'stocking the hive' mean?

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12. Write down three ways in which we can stock the hive.

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13. What should a beekeeper feed bees on?

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14. How do you attract bees to your hive?

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15. Name a pest of bees.

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Explain the methods of harvesting good quality honey:

16. Mention the equipment a beekeeper should have when handling bees.

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17. What is the best time for harvesting honey?

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18. What is the main use of a smoker when handling bees?

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### **Beekeeping Post-Test**

State the benefits of beekeeping:

1. How do plants benefit from these bees?

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2. Why does the bee visit flowers?

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3. Why do people keep bees?

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4. Name the products of beekeeping.

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5. What food value do we get from bees?

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6. How can beekeeping help you earn money?

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Choose an appropriate site for a beehive:

7. What conditions must a beekeeper consider when setting up a hive?

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8. What is a hive?

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9. Why do beehives need to be located near a water source?

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10. Give two flowering plants that can be used by bees to make honey.

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Manage a beehive:

11. How do you attract bees to your hive?

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12. What should a beekeeper feed bees on?

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13. What does the term 'stocking the hive' mean?

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14. Write down three ways in which we can stock the hive.

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15. Name a pest of bees.

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Explain the methods of harvesting good quality honey:

16. What is the best time for harvesting honey?

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17. Mention the equipment a beekeeper should have when handling bees.

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18. What is the main use of a smoker when handling bees?

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## Questionnaire for students attending Namasagali Primary School with a school garden

### Participant Information

1. What is your name?
  
2. Are you:  
☐ Male                      ☐ Female
  
3. How old are you?
  
4. What tribe do you come from?
  
5. How long have you lived in Namasagali?
  
6. Who do you live with and what is their highest level of education? (**check all that apply**)
 

<u>Who</u>	<u>Highest Level of Education and Level</u>		
<input type="checkbox"/> Aunt	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Cousins	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Father	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Friends	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Grandfather	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Grandmother	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Mother	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Siblings	Primary_____	Secondary _____	Post-Secondary _____
<input type="checkbox"/> Uncle	Primary_____	Secondary _____	Post-Secondary _____
  
7. What does who you live with do for work?
 

<input type="checkbox"/> Business	<input type="checkbox"/> Carpenter	<input type="checkbox"/> Craftsman	<input type="checkbox"/> Farmer
<input type="checkbox"/> Fishing			
<input type="checkbox"/> Teacher	<input type="checkbox"/> Other		
  
8. What are your plans after you finish Primary school?
 

<input type="checkbox"/> Go on in school	<input type="checkbox"/> Work	<input type="checkbox"/> Other _____
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9. What do you do before or after school? (**check all that apply**)
 

<input type="checkbox"/> Cattle	<input type="checkbox"/> Cook	<input type="checkbox"/> Firewood	<input type="checkbox"/> Garden	<input type="checkbox"/> Play
<input type="checkbox"/> Read/Do homework	<input type="checkbox"/> Other	<input type="checkbox"/> Watch Siblings	<input type="checkbox"/> Water	

### Home Garden

10. Do you have a personal home garden separate from your parents? **If No, skip to question 14.**

☐ Yes

☐ No

11. How big is it? (feet x feet)

12. How long have you had a home garden?

☐ Less than 1 year

☐ \_\_\_\_\_ years

13. What do you grow?

☐ Beans

☐ Cassava

☐ Collards

☐ Eggplant

☐ Grain Amaranth

☐ Ground nuts

☐ Maize

☐ Matoke (Banana)

☐ Orange Flesh Sweet Potato

☐ Paw Paw

☐ Regular Sweet Potatoes

☐ Soybeans

☐ Tomato

☐ Other

### **School/ School Garden**

14. Who does your school work with?

☐ ISU ☐ MAK

☐ VEDCO

☐ None

15. How long have you been at this school (Namasagali)?

☐ 1 Year

☐ 2 Years

☐ 3 Years

☐ 4 Years

☐ 5 Years

☐ 6 Years

☐ 7 Years

☐ 8 Years

☐ 9 Years

☐ 10 Years

16. What levels have you attended (Namasagali) school for?

☐ P1

☐ P2

☐ P3

☐ P4

☐ P5

☐ P6

☐ P7

17. If not all levels, what other school did you go to?

18. Did that school have a school garden?

☐ Yes

☐ No

19. Do you work in the school garden at Namasagali Primary School during:

Term 1 ☐ Yes, \_\_\_\_\_ times per week

☐ No

Term 2 ☐ Yes, \_\_\_\_\_ times per week

☐ No

Term 3 ☐ Yes, \_\_\_\_\_ times per week

☐ No

Holidays ☐ Yes, \_\_\_\_\_ times per week

☐ No

20. Do you work in the garden when the ISU/MAK students are not here?

☐ Yes

☐ No

21. What do you grow in the school garden at Namasagali?

☐ Beans

☐ Cabbages

☐ Cassava

☐ Collards

☐ Eggplant

☐ Grain Amaranth

☐ Ground nuts

☐ Maize

<input type="checkbox"/> Matoke (Banana)	<input type="checkbox"/> Orange Flesh Sweet Potato	<input type="checkbox"/>
Papaya <input type="checkbox"/> Regular sweet potatoes	<input type="checkbox"/> Soybeans	<input type="checkbox"/> Spinach <input type="checkbox"/>
Spring Onions <input type="checkbox"/> Tomato	<input type="checkbox"/> Other	

22. Were there planting materials given from your school garden?

☐ Yes ☐ No

23. Did you receive any?

☐ Yes ☐ No

24. If no, why not?

25. Did you eat anything out of the school garden?

☐ Yes ☐ No

26. If no, why not?

27. Do your teachers give you homework?

☐ Yes ☐ No

28. If yes, do you do it?

☐ Yes ☐ No

29. If yes, do you do it before you go home?

☐ Yes ☐ No

30. If so, do you do your homework alone or with others?

☐ Alone ☐ With Others

31. How do you obtain your school supplies?

- ☐ I borrow them from a friend
- ☐ I buy them with my own money
- ☐ I don't have any school supplies
- ☐ I get them at school
- ☐ My guardian buys them for me

32. Do you attend school during each term?

☐ Yes ☐ No

33. About how many days a week do you miss school?

34. Why do you not attend school?

## Questionnaire for students attending Namasagali College Staffs' Children Primary School without a school garden

### Participant Information

1. What is your name?
  
2. Are you:
 

☐ Male
☐ Female
  
3. How old are you?
  
4. What tribe do you come from?
  
5. How long have you lived in Namasagali?
  
6. Who do you live with and what is their highest level of education? **(check all that apply)**

<u>Who</u>	<u>Highest Level of Education</u>
<input type="checkbox"/> Aunt	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Cousins	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Father	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Friends	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Grandfather	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Grandmother	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Mother	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Siblings	Primary_____ Secondary _____ Post-Secondary _____
<input type="checkbox"/> Uncle	Primary_____ Secondary _____ Post-Secondary _____
  
7. What does who you live with do for work?
 

☐ Business
☐ Carpenter
☐ Craftsman
☐ Farmer

☐ Fishing
☐ Teacher
☐ Other
  
8. What are your plans after you finish Primary school?
 

☐ Go on in school
☐ Work
☐ Other

---
  
9. What do you do before or after school? **(check all that apply)**

☐ Cattle
☐ Cook
☐ Firewood
☐ Garden
☐ Play

☐ Read/Do homework
☐ Other
☐ Watch Siblings
☐ Water

**Home Garden**

10. Do you have a personal home garden separate from your parents? **If No, skip to question 14.**

☐ Yes ☐ No

11. How big is it? (feet x feet)

12. How long have you had a home garden?

☐ Less than 1 year ☐ \_\_\_\_\_ years

13. What do you grow?

<input type="checkbox"/> Beans	<input type="checkbox"/> Cassava	<input type="checkbox"/> Collards	<input type="checkbox"/> Eggplant
<input type="checkbox"/> Grain Amaranth	<input type="checkbox"/> Ground nuts	<input type="checkbox"/> Maize	<input type="checkbox"/> Matoke (Banana)
<input type="checkbox"/> Orange Flesh Sweet Potato	<input type="checkbox"/> Paw Paw	<input type="checkbox"/> Regular Sweet Potatoes	
<input type="checkbox"/> Soybeans	<input type="checkbox"/> Tomato	<input type="checkbox"/> Other	

**School/ School Garden**

14. Who does your school work with?

☐ ISU ☐ MAK ☐ VEDCO ☐ None

15. How long have you been at this school (Namasagali College Staffs' Children)?

☐ 1 Year ☐ 2 Years ☐ 3 Years ☐ 4 Years ☐ 5 Years  
☐ 6 Years ☐ 7 Years ☐ 8 Years ☐ 9 Years ☐ 10 Years

16. What levels have you attended (Namasagali College Staffs' Children) school for?

☐ P1 ☐ P2 ☐ P3 ☐ P4 ☐ P5  
☐ P6 ☐ P7

17. If not all levels, what other school did you go to?

18. Did that school have a school garden?

☐ Yes ☐ No

19. Do your teachers give you homework?

☐ Yes ☐ No

20. If yes, do you do it?

☐ Yes ☐ No

21. If yes, do you do it before you go home?

☐ Yes ☐ No

22. If so, do you do your homework alone or with others?

☐ Alone      ☐ With Others

23. How do you obtain your school supplies?

☐ I borrow them from a friend

☐ I buy them with my own money

☐ I don't have any school supplies

☐ I get them at school

☐ My guardian buys them for me

24. Do you attend school during each term?

☐ Yes ☐ No

25. About how many days a week do you miss school?

26. Why do you not attend school?

## **INFORMED CONSENT DOCUMENT**

**Title of Study:** Assessing impacts of school garden programs on agriculture learning in Kamuli District, Uganda

**Investigators:** Ms. Amanda Snodgrass and Dr. Gail Nonnecke

This is a research study. Please take your time in deciding if you and your child would like to participate. Please feel free to ask questions at any time.

### **INTRODUCTION**

The purpose of this study is to investigate the learning of agriculture topics of Primary 7 pupils with and without the influence of a school garden program. You are being invited to participate in this study because you or your child is a Primary 7 pupil at Namasagali Primary School or Namasagali College Staffs' Children Primary School.

### **DESCRIPTION OF PROCEDURES**

If you agree to let your child participate, your child will be asked to take a short pre- and post- examination on beekeeping material that is covered in the Uganda Primary School Curriculum and taught by your child's regular teachers. These two examinations will not be used to evaluate your child's classroom performance by the teachers and is only for use in identifying learning trends by the investigator. Your child will also be asked to complete a survey about their school experience, garden experience and participant information.

Your child's participation will last for one week before and one week after the normal beekeeping unit during period 2. The pre-examination will be given the week before the unit begins and the post-examination the week after the unit is completed. After completing the pre-examination your child will be asked the survey questions, which will take an estimated time of 2 hours. Your child will also be asked to take a post-examination one week after the completion of the beekeeping unit. The total estimated time your child will participate in this study is 6 hours.

### **RISKS**

There are no foreseeable risks at this time for participating in this study.

### **BENEFITS**

If you allow your child to participate in this study, there may be no direct benefit to you or your child. It is hoped that the information gained from this study will provide valuable information about the service-learning/school garden program and its effectiveness.

### **COSTS AND COMPENSATION**

You will not have any costs from allowing your child participate in this study. You will not be compensated for participating in this study.

### **PARTICIPANT RIGHTS**

You and your child's participation in this study is completely voluntary. You and your child may refuse to participate or leave the study at any time. If you decide not to allow your child to participate in the study or decide to end your child's participation early, it will not result in any penalty or loss of benefits to which you and your child are otherwise entitled.

### **CONFIDENTIALITY**

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government agencies and the Institutional Review Board (a committee that reviews and

approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: Data will be summarized and all names will be removed and withheld during data analysis and from other parties. All original data will be kept in a locked facility under the investigator. If the results are published, your identity will remain confidential.

### **QUESTIONS OR PROBLEMS**

You are encouraged to ask questions at any time in the study. A Lusoga-speaking translator will be available to answer questions and help facilitate communication.

For further information about the study contact Amanda Snodgrass or Dr. Gail Nonnecke at Namasagali Primary School.

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, [IRB@iastate.edu](mailto:IRB@iastate.edu), or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

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### **PARTICIPANT or PARENT SIGNATURE**

Your signature indicates that you voluntarily agree to allow your child to participate in this study, and that the study has been explained to you orally and that you have been given the time to read the document, and that your questions have been satisfactorily answered.

\_\_\_\_\_  
(Signature of Parent/Guardian or  
Legally Authorized Representative)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Signature Investigator)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Signature of Witness)

\_\_\_\_\_  
(Date)

## **EKIWANDIIKO EKYOKUKIRIZA N'OKUNYONYOLA**

**Omutwe: Okulondoola emigaso gyenimiro zamasomero kunjiga ya amasomo aga agebyobulimi mu Kamuli district, Uganda**

**Abanonyereza: Mukyala Amanda Snodgrass ne Dr. Gail Nonnecke**

Ensonga yokka eyomulimu guno kunonyerereza. Tukasaba otwale akadde osalewo oba ggwe n'omwana wo mwagala okwetabamu. Era tukusaba obuuze ekibuuzo kyonna kyolina, ekiseera kyonna wokifunira.

### **ENYANJULA**

Ekigendelerwa ekyokunonyereza kuno kye engeri abana abomukibiina ekyomusanvu yebasoma esomo erye byobulimi nga tugerageranya abo abayina enimiro nabatayina. Tukasaba okwenyigira mukunonyereza kuno kubanga omwana wo ali mukibiina ekyo musanvu musomero erya Namasagali primary school oba esomero elya Namasagali College Staff's primary.

### **OKUNYONYOLA ENGERI OKUNONYEREZA GYEKUGENDA OKUKOLEBWA**

Bwonaba nga okirizza omwana wo okwenyigira mukunonyereza kuno, omwana wo ajja kubuzibwa ajja kubuzibwa ebibuuzo byamirundi ebiri, mukusooka nga tanasoma kukulunda enjuki oluvanyuma nga amaze okusomesebwa kubikwatagana nokulunda enjuki. Ebibuuzo bino bija kuba kumutindo gwe emisomo nga bwe gisengekeddwa mu curriculum yamasoma aga primary and nga biva mwago amasoma agosemesebwa abasomesa. Ebibuuzo bino tebijja kukozezebwa nga engeri yokupima omwana byayizze mu taamu, wabula ebinabuzibwa bijja kutuyamba okuteegera engeri abaana gyebasoma mu. Omwana wo ajjakubuzibwa kubiki byayizze musomero, ku nimiro ezokumasomero, nengeri gyayenyigidde mukulima okwo kumasomero.

Omwana wo ajja kwenyigira mukunonyereza kuno okumala ekiseera kya wiki emu nga tebanasomesebwa kubyokulunda enjuki, oluvanyuma ngabamazze okusoma kubyokulunda enjuki bajja kudamu babuzibwe. Ebibuuzo bino bijja kubuzibwa mu taamu eyokubiri. Ebibuuzo ebisooka bijja kubuzibwa nga wakyaliyo wiki emu nga omwana tanasomesebwa kubye njuki. Oluvanyuma lwe ebibuzo bibuuzo ebisooka omwana wo ajja kubizibwa ebibuuzo kunimiro zawaka, amanya ge ne nimiro awaka. Oluvanyuma lwa wiki emu nga omwana wo amaze okusomesebwa kubyokulunda enjuki ajja kubuzibwa ebibuuzo ebye kitundu ekyo kubiri. Ekiseera omwana kyagenda okumala mukunonyereza kuno kya saawa mukaaga zokka.

### **AKABI**

Tewali kabi konna ketusuubira olwomuntu okwetaba mu kunonyereza kuno.

### **OKUGANYULWA**

Bwonooba okkirizza omwana wo okwetaba mukunonyereza kuno, ayinza obutaganyulwa mangu ye nga ye. Wabula tusubira nti byetunafuna mukunonyereza kuno bijja kuyamba okutumbula entambula yemirimu gino eyokukuyiga ngatukola wamu nennimira z'amasomero.

### **EBISALE N'ENSAKO**

Tewali bisale byojja kusasula olwokukkiriza omwana wo okwetaba mukuninyerereza kuno. Era tewali nsako ejja kukuweebwa olwokwetaba mukunonyereza kuno.

### **EDDEMBE LYOYO AYETABYE MU KUNONYEREZA**

Okwetaba kwo nomwana wo mukunonyereza kuno kwa kyeyagalire. Ggwe n'omwana wo muli ba ddembe okugaana oba okulekera awo okwetaba mu kunonyereza kuno ekiseera kyonna. Bwonooba osazeewo obutakkiriza mwana wo kwetabamu, oba okumuziyiza okwongera okwetaba mu nga twakatandika, tewali kizibu kyonna kijja kubatusibwaako.

### **OKUKUUMA EBYAMA**

Ebiwanddiko byonna ebikwata ku betabye mukunonyereza kuno bijja kukumibwa nga bya kyaama, okusinzira kumateeka galiwo, era tebijja kufulibwa byabuliwo eri buli ayagala. Wabula, amateeka ga gavumenti oba akakiiko akafuga ebyokunonyereza (akaiiko kano kekabera nokukakaso okunonyereza okuwatagana nabantu) kayinza okukebera oba okwokyesaamu mu biwandiiko bino olwokwagala okwekenneenya oba okutumbula omutindo gwokunonyereza. Ebiwandiiko bino biyinda okubaamu amawulire agekyaama.

### **EBIBUZO OBA EBIZIBU**

Osabibwa okubuuza ekibuuzo kyonna kyonooba nakyo, ekissera kyonna kyetunaamala ngatukola okunonyereza kuno. Tujja kubeera n'omuntu amanyi olusoga asobole okuddamu ebibuuzo bino obulungi, nokwanguya okwogereganya.

Bwoba olina amawulire gona gewandyetaaze okumanya kukunonyereza kuno, tukirila Amanda Snodgrass oba Gail Nonnecke ku ssomero lya Namasagali Primary School.

Bwoba olina ebibuuzo ebikwatagana neddembe lyabetaba mu kunonyereza, oba obukozefu bwonna obuyinza okubatukako laba omukulu wekakiiko akakola ku nsonga eno (IRB administrator) mu Iowa State University ku ssimu +1(515) 294-4566, [IRB@iastate.edu](mailto:IRB@iastate.edu), oba omukulu akola kukukakasa ebyokunonyereza (Director, Office of Responsible Research) ku ssimu, +1(515) 294-3115, Iowa State University, Ames, IA, 50010.

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### **OMUKONO GWO OMWAANA OBA OMUZADDE**

Okusaako omukono gwo kitegeeza nti okirizza omwana wo okwenyigira mukunonyereza kuno, ate nokunyereza kuno bakukunyonyodde bulungi mukiseera ekimala, bakusomedde ekiwandiiko kino, nebibuuzo byo bididwaamu bulungi.

## **INFORMED ASSENT DOCUMENT**

**Title of Study:**        **Assessing impacts of school garden programs on agriculture learning in Kamuli District, Uganda**

**Investigators:**        Ms. Amanda Snodgrass and Dr. Gail Nonnecke

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

The purpose of this study is to investigate the level of learning of agriculture topics of Primary 7 pupils with and without a school garden program.

If you agree to participate, you will be asked to take a short pre- and post- examination on beekeeping material that is covered in the Uganda Primary School Curriculum and taught by your regular teachers. These two examinations will not be used by your teachers and are not for a grade. You will also be asked to complete a survey about your school experience, garden experience and participant information. Your participation should not require more than 6 hours.

There are no foreseeable risks to you from participating in this study.

If you decide to participate in this study there may be no direct benefit to you. It is hoped that the information gained in this study will benefit society by enhancing our understanding of the role that school gardens play in increasing learning of agriculture topics.

### **PARTICIPANT RIGHTS**

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty.

### **QUESTIONS OR PROBLEMS**

You are encouraged to ask questions at any time during this study. A Lusoga-speaking translator will be present and available to help facilitate communication and answer questions.

For further information about the study contact Amanda Snodgrass or Dr. Gail Nonnecke at Namasagali Primary School.

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, [IRB@iastate.edu](mailto:IRB@iastate.edu), or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

\_\_\_\_\_  
(Signature of Participant/Pupil)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Signature of Investigator)

\_\_\_\_\_  
(Date)

**EKIWANDIIKO EKYOKUKIRIZISA NO KUNYONYOLA**

**Omutwe: Okulondoola emigaso gyenimiro zamasomero kunjiga ya amasomo aga agebyobulimi mu Kamuli district, Uganda**

**Abanonyereza:** Mukyala Amanda Snodgrass ne Dr. Gail Nonnecke

Kuno kunonyereza era tukusaba otale akeera olokke osalewo oba ogenda kwenyigira mu kunonyereza kuno.

Ekingenderwa kyokunonyereza kuno kya kulaba engeri abaana abali mukibiina ekyo musanvu gyebasoma mu amasomo agakwaata kubyobulimi nga tutunulira abo abyayina pulogulaamu eyenimiro naabvo abatayina.

Bwonaba nga okirizza okwenyigira mumusomo guno ojja kubuzibwa ebibuuzo emirundi ebiri; okusooka nga tonasomesebwa kungeri eyo kulundamu enjuki, oluvanyuma obuzibwa nga omazze okusomesebwa okulunda enjuki. Ebibuuzo bijja kulondebwa mu mucuuricula yamasomo agasomesebwa muddaala lya puraimale. Era nga omaze okuddamu ebibuuzo ebisooka, ojjakusabibwa okudamu ebibuuzo ebikwata kunimiro ekka, amanyago nemyaka gyo. Ebibuuzo bino tebijja kukozezebwa nga ekyokusalawo engeri gyonaba okozze mu taamu. Ojja kudamu ebibuuzo kungeri gyewenyide munimiro zokumasomero, nokulima awaka. Okunonyereza kuno kujja kukutwalira esaawa mukaaga zooka.

Tewali bulabe bwoona bwetusebira nti oyinza okufuna nga buva mukwenyigila mukunonyereza kuno.

Bwona salawo okwenyigira mukunonyereza kuno tewali byakufunamu ebyabuliwo. Wabula tusubira nti ebinaava mukunonyereza kuno bijja kuyamba abatuuze bomu kitundu nga tutegeera engeri enimiro ezo ku amasomero bweziyamba mukusoma amasomo agakwata kubyo bulimi.

**EDDEMBE LYO GWE AGENDA OKUBUZIBWA**

Okwenyigira kwo mukunonyereza kuno ddembe nga weyagalidde, era osobola okugaana okwenyigira mukunonyereza kuno oba okukuvaamu akaseera koona. Tewali kibonerezo kyona kyojja okufuna bwonasalwo okugaana okwenyigira mukunonyereza kuno oba okuvaamu mba okunonyereza kukya genda mumaaso.

**EBIBUZO OBA OBUKALUBIRIVU**

Tukusaba okubuuza ebibuuzo byoona byonwulira nga oyina mukunonyereza kuno. Omuntu amanyi olusoga ajja kubeerawo era ajja kuyamba mukuvunula byetunaaba twogerako nokuddamu ebibuuzo.

Bonaabo nga oyina ebibuuzo byoona buzza mukyala Amanda Snodgrass oba Dr Gail Nonnecke.

Bwonaba nga oyina ebibuuzo kuddembe lya abo abenyigira mukunonyerezza oba obuvune nga buvva mukunonyerezza kuno, tuukirira the IRB Administrator, (515) 294-4566, [IRB@iastate.edu](mailto:IRB@iastate.edu), oba Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

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Omukono gwo muyizi

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Enaku zo omwezi

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Omukono gwooyo anonyerezza

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Enaku zo omwezi

## **ACKNOWLEDGMENTS**

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