International Journal of Agriculture Extension and Rural Development ISSN 2756-3642 Vol. 11(1), pp. 001-007. June, 2023. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Research Article

The methodology and development of a market assessment survey for lake restoration of Lake Bosmtwe and increased livelihoods for small-holder farmers

Grace L. Baldwin Kan-uge[1], Robert M. Stwalley III[1]*

[1]Department of Agriculture and Biological Engineering, Purdue University, West Lafayette, United States.

Received: 03-Apr-2023, Manuscript No IJAERDOA-23-94140; Editor assigned: 04-Apr-2023, PreQC No IJAERDOA-23-94140 (PQ); Reviewed: 18-Apr-2023 QC No. IJAERDOA-23-94140; Revised: 25-Apr-2023, Manuscript No. IJAERDOA-23-94140 (R); Published: 02-May-2023.

A market assessment survey was created to conduct a comprehensive baseline survey of agricultural and fishing practices within the Lake Bosomtwe area in Ghana, providing small holder-farmers the opportunity to share their needs, insight, and input into a potential demonstration farm design. This survey was developed with two overall goals and six research questions. The primary goals were to understand the general population and to prioritize the components for inclusion in an agricultural demonstration farm, which would then serve as an example of improved agricultural methods. From the six research questions, 147 specific questions were developed, which included GPS locations for community households, pit latrines, and water well boreholes. The study sought to interview 10-15 farmers per village. The survey contained five sections: demographics; land use; farming practices; water, sanitation, and hygiene; and fishing. In-person interviews were conducted in 12 villages, and 118 total farmers participated in the survey. Of the participants, 66% were qualified to answer all questions, and 100% of them completed the survey. This paper specifically highlights the initial results of the demographic data from this survey, which currently serves as the most recent comprehensive assessment for this area. Analysis of collected market assessment data is essential in determining the correct elements for inclusion in the proposed extension demonstration farm.

Key words: Demonstration farm, Ghana, international extension, market survey, Lake Bosomtwe.

INTRODUCTION

The communities that live within the Lake Bosomtwe region of Ghana are facing dramatic change in their lives as their lake has grown more noxious, converting a previous fishing subsidence culture into inexperienced farmers with no generational knowledge to draw upon. Any specialized agricultural extension effort for the region would need to understand the baseline knowledge of their clientele, as well as their crop mix and current management practices. This overall market survey project, with the protocols and demographic data presented here, was designed to help focus development efforts in this unique area of West Africa.

The Lake Bosomtwe impact crater is located in the Ashanti region of Ghana, West Africa. The rim-to-rim impact crater diameter is approximately 10.5 km, with the lake located at the center. Three different districts touch the lake shore and contain roughly 155,000 ha of land. There are approximately 7,500 people in 24 villages within the local area, and of these, 12 villages reside within walking distance of the lake shore. A map of the local region showing the lake villages is presented in Figure 1. Over the last ten years, the lake has been subjected to overfishing and environmental degradation. The loss of fish has forced residents of the area to transition from fishing to subsidence farming as their main vocation. These people have little to no experience with agricultural processes such as crop rotation, fertilizer use, or erosion control. Unfortunately, this shift has resulted in more problems within the lake and the continued loss of fish. People living within the impact crater currently cultivate crops in clay soils, with shallow soil profiles, often on the sides of hills with 20% slope or greater. The purpose of this project is to collect information needed to design an extension demonstration farm that will promote improved conservation agricultural practices to local farmers, and through the demonstration of these techniques, help restore and better manage Lake Bosomtwe. Through the adoption of modern agriculture methods, it is likely that both the health of Lake Bosomtwe can eventually be restored and the livelihoods of smallholder farmers in the area can be increased (Baldwin and Stwalley, 2018; Baldwin and Stwalley, 2019; Baldwin,

*Corresponding author. Robert M. Stwalley III, E-mail: rms3@purdue.edu.

2019; Baldwin and Stwalley, 2020).

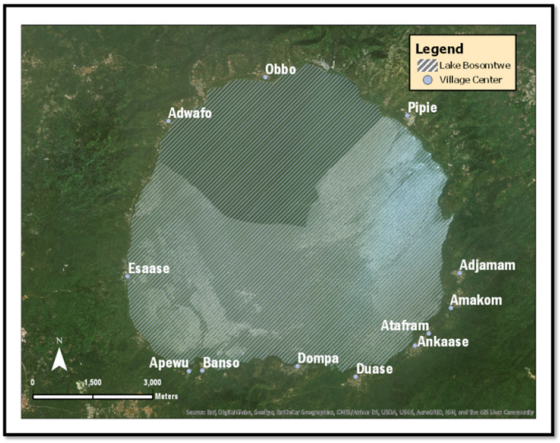

Figure 1: Lake Bosomtwe (Baldwin, 2019).

MATERIALS AND METHODS

This study developed a comprehensive Institutional Research Board (IRB) approved survey that allowed farmers from the 12 villages to share their needs, insights, and ideas, so that these could be incorporated into the design of a demonstration farm and help focus extension outreach activities (Baldwin, 2019). Farmers participated in one-on-one interviews answering 147 questions, which allowed for the following types of data to be collected: demographic, land use, farming practices, water sanitation, hygiene, and fishing. Going forward for the next several years, this survey will likely serve as the most recent comprehensive data assessment for this specific area. Analysis of the collected market assessment data is essential to the design of an extension demonstration farm. Restoration and promotion of small-holder farmer effectiveness is key to economic development, and this study will help establish an initial census of agricultural practices within the region, which are known to have a significant effect on the lake health (Baldwin and Stwalley, 2018; Baldwin, 2019; Baldwin and Stwalley, 2020). The balance of this paper will provide a review of the geographic area, the specific objectives of the survey, the design of the survey and its administrative protocols, the demographic results of the survey, and the conclusions about the alignment of the survey with previous data collections.

Market survey's operational area

The area surrounding Lake Bosomtwe is very mountainous, and this location falls within the tropical forest zone of Ghana. People living within the impact crater cultivate crops in primarily clay soils; with shallow soil profiles, often on the sides of hills with 20% slope or greater. A single perennial stream feeds into the lake from the southwest. The lake is primarily dependent on rainfall within the impact crater for replenishing its water level. Shrinkage of the lake has been a concern, particularly with the large amount of silt deposits that are carried downstream by excess runoff (Baldwin, 2019).

Over the last ten years, the lake has been subjected to overfishing and environmental degradation. The health of the lake has declined substantially due to overfishing and algae blooms caused by over-fertilization of crop plots. Because of these factors, the fish population has declined, and the residents of the area have been forced to transition to subsidence farming as their main vocation. Local experiences in common agricultural practices such as crop rotation, fertilizer use, and erosion control are extremely limited (Baldwin and Stwalley, 2019; Baldwin, 2019). According to a Ghana government group, 97.6% of the population participates in some form of rural crop farming, and the average annual household income in this area is about $100 USD (Ghana Statistical Service, 2010). There are certain activities within the Lake Bosomtwe impact crater that are done very close to the lake shore (Wireko, 2015). These activities include the use of toilet facilities, swine operations, and crop farming. The lake has not been recommended for recreational use since 2016, due to the runoff contaminated with agrochemicals, silt, and organic waste (Nkeyia KA, 2016).

Purpose and objectives of this market assessment survey

The focus of this study was the development of a comprehensive market assessment survey of farmers living within the Lake Bosomtwe area, in order to provide direction for the development of an extension-type agricultural demonstration farm. An IRB approved survey was developed in response to six overarching research questions (Baldwin and Stwalley, 2019; Baldwin, 2019; Baldwin and Stwalley, 2020). This survey was administered using an in-person question / response process.

The following goals for the overall project were set as:

- The determination of the current state of the management knowledge and utilization of natural resources for economic activities within the target population; and
- The determination and prioritization of the components highlighted within the survey as part of the local potential demonstration farm.

The formal research questions that the market assessment survey sought to address were aimed at framing the curriculum of the potential agricultural extension effort. These questions were:

1. What are the household demographics of the residents within the villages of the Lake Bosomtwe area?
2. What are the views of residents within the villages of the Lake Bosomtwe area regarding the current land use and how that has changed over the last thirty years?
3. What are the current agronomic farming practices of the residents within the villages of the Lake Bosomtwe area?
4. What are the current livestock farming practices of the residents within the villages of the Lake Bosomtwe area?
5. What are the water use and sanitation practices of the residents within the villages of the Lake Bosomtwe area?
6. What are the current fishing practices of the residents within the villages of the Lake Bosomtwe area?

From these six research questions, 147 specific questions were developed for use in the survey. Data for Global Positioning System (GPS) location of community households, pit latrines, and water wells or boreholes, were part of the survey questions. This study sought to interview 10-15 farmers

per village for each of the 12 villages located along the shore of Lake Bosomtwe. Their perspectives on land use and ground cover in the Lake Bosomtwe area, current farming practices, current water sanitation and hygiene practices, and current fishing practices were of interest. Demographic data on the participants were also recorded. Information was collected in the form of an oral response and was transcribed onto the survey form by the interviewer (Baldwin, 2019; Baldwin and Stwalley, 2020).

The development of the survey question set was intended to aid the development of specific agricultural curricula for the local area. Therefore, the survey contained a demographic section, plus four primary sections centered on the following topics: land use changes, farming practices, water, sanitation, and hygiene (WASH), and fishing (Baldwin and Stwalley, 2019; Baldwin, 2019; Baldwin and Stwalley, 2020). Each section contained multiple choice and short answer formatted questions (Baldwin, 2019). The demographic section, included questions regarding participant gender, age, level of education, occupation/livelihood, household size, children per household, ages, and annual household income (Baldwin, 2019; Baldwin and Stwalley, 2020).

The change in land use section focused on questions pertaining to an individual's belief in whether the local topography was changing, what human activities that they had observed around the lake, and if they believed that these activities affected the quality of lake water (Baldwin, 2019; Baldwin and Stwalley, 2020). The farming practices section included questions to determine the respondents' farm sizes, the distances of their farms from the lake, their participation in farming cooperatives, their average crop yields and losses by growing season, the major causes for their crop losses, the crops grown on their plots, and their access to agricultural material inputs. Soil fertility practices, field preparation, agrochemical usage, crop irrigation, livestock rearing, egg production, purchase prices for their produce, and other related questions were also developed. The WASH section focused on understanding the current needs and practices of participants for domestic and drinking water usage, along with toilet facilities. Specific information on the state of WASH facilities will aid in improving this critical infrastructure element (Baldwin, 2019).

Since many farmers in the area previously only participated in fishing as their primary form of livelihood, the fishing questions section focused on trying to understand the individual's current fishing skillsets, which might potentially be re-adjusted to above-ground aquaculture. The fishing section included fishing frequency and duration, whether they sold their products and their prices, the trends in catch size, and how a change in fishing catch has affected their income (Baldwin, 2019).

The qualifications to participate in the market assessment survey were limiting as to who could provide input in a deliberate fashion to tailor the results to the most targeted individuals in the community. The participants included in this study were people that practiced farming and lived within the Lake Bosomtwe impact crater. Adults engaged in a family practice of farming were considered 'farmers'. There was no gender specific requirement for participants, but subjects had to be older than 18 years. Only one farmer per household was interviewed. There are 12 different villages directly located along the Lake Bosomtwe shoreline. The maximum number of subjects that could be enrolled in the study was no more than 250 participants, or roughly 22 farmers each from the 12 villages within the impact crater. Farmers were interviewed from each village, so that a thorough understanding of the current agricultural practices throughout the Lake Bosomtwe area could be determined. These data were needed so that farmers' input from each of these communities could be used in the design of a comprehensive demonstration farm to specifically address the local agricultural, commercial, and social needs. Participants did not qualify for this study if they did not participate in some form of farming or fishing within the Lake Bosomtwe impact crater, or if they were younger than 18 years old (Baldwin, 2019).

The protocols for the recruitment of participants and the obtaining of informed consent for this survey were strictly controlled by the IRB policies of the authors' institution. The effort was approved and authorized through Purdue University IRB #1809020994. Participants were recruited by going from house-to-house within each of the 12 villages. Potential subjects were asked if they participated in any form of farming. If the potential subject was involved in any form of farming activity, they were asked if he or she would be willing to provide 60 minutes of their time to take part in this study. The potential subject could have chosen to be interviewed at that moment, a later time, or not at all. Following IRB procedures, the waiver of consent form was read orally to the potential subject, and the individual could again decide whether or not to participate at that time.

Ghana is a relatively peaceful country, and the graduate student researcher has spent multiple years working within the Lake Bosomtwe area and was known to multiple local residents. There were no safety concerns, and the graduate student was the only individual present with the interviewee during the survey data collection. Participation in this study was purely voluntary, and subjects were not compensated in any way. In order to protect participant's confidentiality, the subject's names were not asked for, nor were they recorded. The collected survey data utilized a code identifier to label the obtained data. Subjects' personal names, and household income, remained confidential throughout the entire project. The risks to participants were minimal, no greater than everyday activities. The local language is English, and therefore the survey was conducted in English. Subjects choosing to participate in the study were asked to orally respond to questions, and the subject's responses were recorded by the researcher (Baldwin, 2019).

RESULTS

Demographic results from the lake bosomtwe region market assessment survey

The following results are from the demographic section of the survey shown in Table 1, and they provide an initial classification of participants in the market assessment survey (Baldwin and Stwalley, 2019; Baldwin, 2019). One-hundred and eighteen small-holder farmers took part in this study, or roughly 10 farmers per village.

Table 1. Demographic Information Collected within the Agricultural Market Survey of the Lake Bosomtwe district of Ghana [3].

Section A. Demographic Information				
1. Village Name:				
2. Farmer Number:				
3. Gender				
a) Male	b) Female			
4. Age Group				
a) 18-20	b) 21-40	c) 41-60	d) Over 60	
5. Marital Status				
a) Unmarried	b) Married			
6. What is your level of education?				
a) Primary	b) Middle School/ Junior High	c) High School	d) A & O Level	e) University
f) College				
7. Number of people per household				
a) 1-3	b) 4-6	c) 7-10	d) Over 10	
8. Number of children per household				
a) 0	b) 1-3	c) 4-6	d) 7-10	e) Over 10
9. Number of children per household under the age of 5 years old				
a) 0	b) 1-3	c) 4-6	d) 7-10	e) Over 10
10. Number of children per household ages 6-10 years old				
a) 0	b) 1-3	c) 4-6	d) 7-10	e) Over 10
11. Number of children per household ages 11-15 years old				
a) 0	b) 1-3	c) 4-6	d) 7-10	e) Over 10
12. Number of children per household ages 15-18 years old				
a) 0	b) 1-3	c) 4-6	d) 7-10	e) Over 10
13. What do you do for a living?				
a) Fishing	b) Farming	c) Fishing & Farming	d) Tourism Industry	
e) Medical	f) Education	g) Other	(Specify):	
14. What is your annual household income?				
a) Less than 100 GHD	b) 100-200 GHD	c) 200-300 GHD	d) 300-400 GHD	e) 400 & Above
15. Are you a native of this village?				
a) Yes				b) No
15.1 If yes, how long have you lived in this village?				
a) Less than 10 Years	b) 10- 20 Years	c) 20 - 30 Years	d) More than 30 Years	

Figure 2 provides the relative size of the participation by village. Of the participants surveyed, 66% were qualified to answer all questions, and 100% of those participants completed the survey.

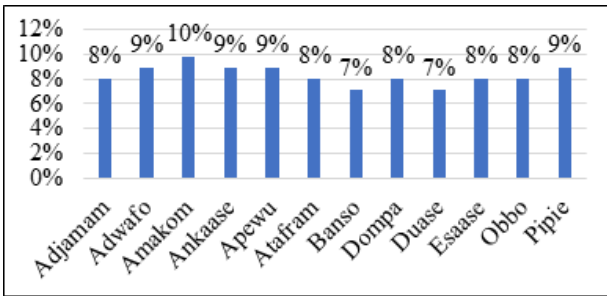

Figure 2: Sample Size by Village – (N=118).

Figure 3 portrays the participants by age and gender that took part in the survey. Sixty-six percent of the participants were male, and 44% were female.

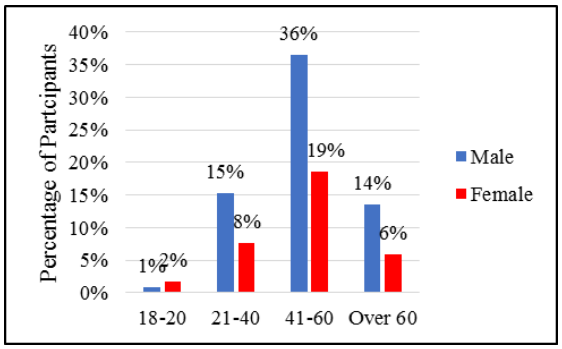

Figure 3: Survey Participants by Age and Gender. **Note:** ( ) Male, ( ) Female

Seventy-five percent of participants were over age 41. The most commonly reported age range was between 41-60 years old. Within which, 65% of the participants were male, and 35% were female. In terms of the education level of the participants, 88% of participants had attained a Middle School Level Class (MSLC) or Junior High School (JHS) level of education, regardless of gender. This is considered equivalent to a U.S. 6th-8th grade level. These data are shown in Figure 4.

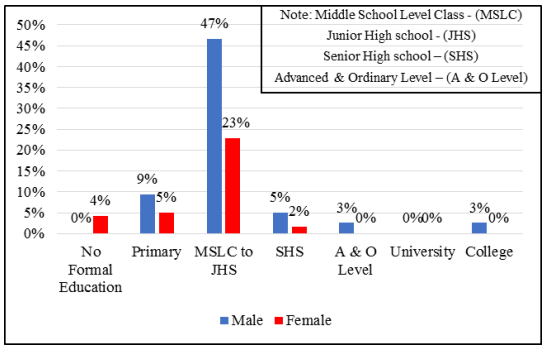

Figure 4: Participants by Education & Gender – (N=118).
Note: ( ) Male, ( ) Female

Household size was of interest. Of the participants interviewed, 34% reported that there were 4 to 6 people residing per household. The percent number of people per household across the ranges was nearly the same, with 34% having 4 to 6 people per household, 31% having 7-10 people per household, and 25% having 1 to 3 people per household. Ten percent of the participants interviewed said that they had over 10 people living within their household. These data are displayed in Figure 5. It is important to note that families around Lake Bosomtwe tend to count multiple generations of their relatives within their household number (Baldwin, 2019). As an example, a father interviewed may be accounting for two sets of parents, his biological parents and his in-laws, then his spouse, and their children. This compression of family units can lead to a higher number of people per household than might otherwise be expected.

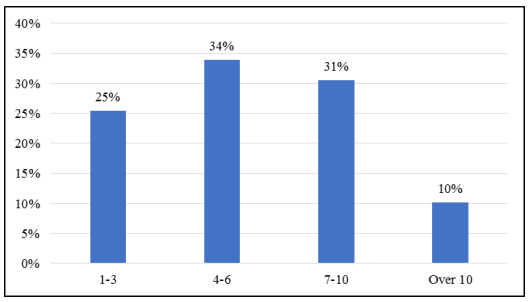

Figure 5: Number of People per Household.

Figure 6 shows the average number of children per household. Twenty-three percent of participants said that over 10 children lived within their household. It is important to note the cultural context when interpreting this figure. Children were noted as those under age 18. In Ghana, especially in more rural settings, it is not uncommon that a father has multiple wives or relations with multiple women. In addition, birth contraceptives are less commonly used in rural settings. Ghanaian women from rural areas on average desire 4.7 children versus a desired 3.9 in urban areas (Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF Macro, 2009). The data collected showed that 31% of the participants had 4 to 6 children living within their household, which was in-line with the 2008 reported survey conducted by Ghana Demographic and Health Survey (GSS, GHS and ICF Macro, 2009).

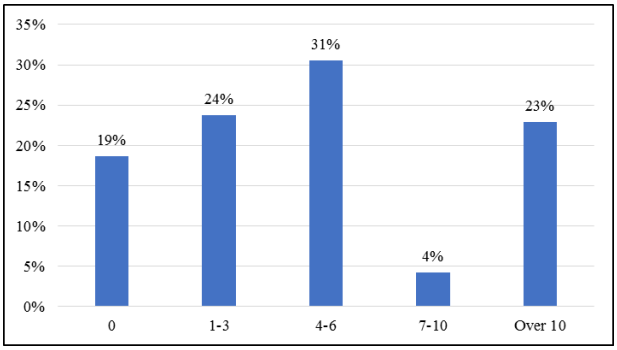

Figure 6: Children per Household.

Figure 7 demonstrates that 98% of participants engaged in some form of farming (Baldwin, 2019). Those that did not report farming as their primary vocation, generally practiced it as a side hobby, acted as an agricultural trader, or participated in teaching through a local school. The reported annual income within the area averages USD $100 (GSS, 2015). However, as shown in Figure 8, on a per capita annual income basis, all participants interviewed report making not more than USD $31. Of those interviewed, 74% make less than $11 on a per capita annual income basis (Baldwin, 2019). Figure 9 illustrates how long the participants have lived in their respective village. Of those interviewed, 96% were native to their village. The remaining 4% were not born in their current village of residency, but now

live in one of the villages where the survey was conducted. Of the interviewees, an incredible 91% have lived within their village more than 10 years. These initial results provide insight into demographics of the participants within the Lake Bosomtwe area, where an agricultural extension demonstration farm has been proposed (Baldwin and Stwalley, 2019; Baldwin, 2019; Baldwin and Stwalley, 2020). This knowledge will aid in steering the delivery level and tone of the curricular materials.

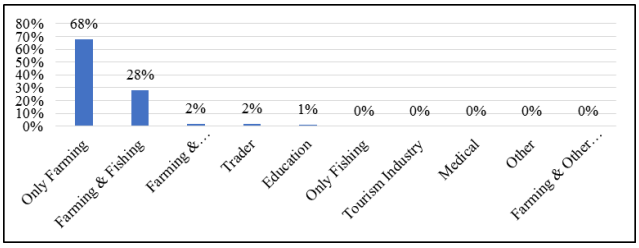

Figure 7: Livelihood of Participants – (N=118).

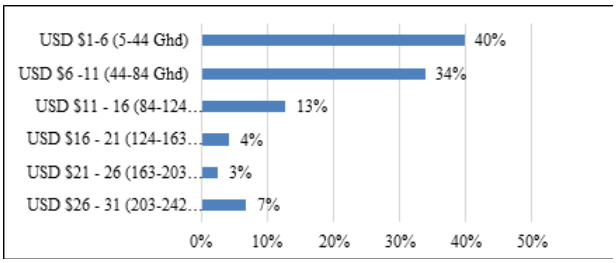

Figure 8: Annual Income Per Capita – (N=118).

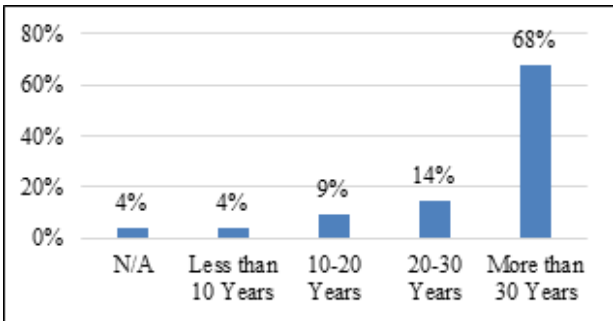

Figure 9: How long have you lived in this village?

DISCUSSION

An important 'sanity check' for the work was felt to be the alignment of the results from the survey with the most recent government census of the region. The 2010 Population and Housing Census of the country found that the district population was 93,910 individuals (GSS, 2015). The participants that took part in the survey are located within this district. The number of individuals that took part in our survey is significantly smaller than that of the district population. However, some similarities can be observed from looking at the obtained survey results and that of the Government's census. The district population is reported to be 47.7% male and 52.3% female (GSS, 2015). Our survey found that we interviewed slightly more males than females, but were within a similar range of values. The average number of people per household was five, which is slightly larger, but falls in-line with the Ghana Health Survey Study (GSS, GHS and ICF Macro, 2009; GSS, 2015). Children constitute the larger portions of the household generally accounting for 42.6% of the household reported value in this study, and the Ghana Health Survey results support this valve (GSS, 2015).

At the district level, almost half of the population has been engaged in agriculture at 48% (GSS, 2015). Though this survey was specifically tailored to focus on interviewing farmers, these results support the perception that those engaging in farming as their primary vocation are increasing. The majority level of education attained at a district level was 64.2% that had attended at least basic school, with only 13.4% moving beyond this level (GSS, 2015). The basic school level in rural Ghana would be considered that of a 6th-8th grade level within a U.S. context. According to the census data, more than half of the district has had at minimum, a middle school level of education (GSS, 2015). The census data falls in-line with the results presented here. The level of education attained by 88% of those interviewed was reported as a minimum of 6th-8th grade. These findings showed that within the sampled population, an even more encouraging percentage of individuals attained at least this 6th-8th grade level of education than was reported in the census. The average annual income within the district was reported to be $100 USD, or $25 USD annual income per capita (GSS, 2015). The reported values from this survey were lower, with 74% making less than $11 on a per capita annual income basis (Baldwin, 2019).

Despite the surveyed number of individuals being much smaller than that of the district population census, our results were close, or slightly more favorable than the overall district population census. Since the purpose of the survey was to gauge and qualify the activity level of the farmers within the villages located along Lake Bosomtwe, and the values collected seem to represent the local population fairly well, the information obtained in this market analysis will be used for the design of the proposed extension demonstration farm (Baldwin and Stwalley, 2019; Baldwin, 2019; Baldwin and Stwalley, 2020).

CONCLUSIONS AND FUTURE EFFORTS

A comprehensive IRB-approved survey was developed in response to two primary goals and six research questions for this project. This survey was conducted within the 12 villages located along the Lake Bosomtwe shore. It contained 147 specific questions. As part of the institutional IRB requirements, qualifications were determined for the participants to take part in the study, and a recruitment protocol was developed. Upon carrying out the survey, data from 118 farmers or roughly 10 farmers per each of the 12 villages were collected. Of the participants surveyed, 66% were qualified to answer all questions, and 100% of participants completed the in-person question / response survey. Sixty-six percent of the participants were male, and 44% were female. Participants over age 41 accounted for 75% of the study group. The percent number of people across the household size ranges was roughly the same, with 34% having 4 to 6 people per household, 31% having 7-10 people per household, 25% having 1 to 3 people per household, and 10% having over 10 people living within their household. The most common response, for the number of children per household was 4 to 6 children, which was in line with the 2008 survey conducted by Ghana Demographic and Health Survey (GSS, HHS, and ICF Macro, 2009). The participants' primary source of livelihood was farming, and all of those interviewed reported making not more than an USD $31 on an annual income per capita basis. The majority of participants interviewed had

attended up to a Middle School Level Class (MSLC) or Junior High School (JHS) level of education.

In general, results from this survey were aligned with the most recent government census (GSS, 2015). This market survey was developed and carried-out during the summer of 2018. It provided sufficient information required to support the design of an agricultural extension demonstration farm. The use of the data collected here will be to promote improved conservation agricultural practices to local farmers, and through the demonstration of these conservation practices, help restore and better manage Lake Bosomtwe. The remaining information and analysis from this comprehensive agricultural market assessment survey of the region will be published in follow-on papers.

ACKNOWLEDGEMENTS

The authors are grateful to the community partners Global Resource Connections Inc. and the Methodist Church Ghana for inviting this study to be conducted. This work would not have been possible without the generous financial support from the Purdue University Hydrologists Helping Others Grant (H2O). The authors would like to thank Ms. Deb Baldwin and Dr. Carol S. Stwalley for their assistance in editing this work. Mr. Elvis Kan-uge for providing cultural insight and revisions regarding the initial survey development work. The assistance of the Purdue University Agricultural and Biological Engineering department is gratefully acknowledged for its support over the years with graduate teaching assistanceships and faculty salaries.

REFERENCES

1. Baldwin GL, Stwalley RM (2018). An agricultural extension demonstration farm template & community development project. ASABE 2018 AIM - Detroit. St. Joseph: ASABE.
2. Baldwin GL, Stwalley RM (2019). Analysis of market assessment survey to help promote lake restoration of Lake Bosomtwe and increased livelihoods for small-holder farmers. ASABE 2019 AIM - Boston. St. Joseph: ASABE.
3. Baldwin GL (2019). Development of design criteria and options for promoting lake restoration of Lake Bosomtwe and improved livelihoods for small-holder farmers near Lake Bosomtwe-Ghana, West Africa. Agricultural & Biological Engineering Masters Thesis. West Lafayette: Purdue University.
4. Baldwin GL, Stwalley RM (2020). Promoting restoration of Lake Bosomtwe through spatial analysis of existing water, sanitation, and hygiene (WASH) sources in Ghana, West Africa. ASABE 2020 AIM - Pasadena. St. Joseph, MI: ASABE.
5. Ghana Statistical Service (GSS), Ghana Health Service (GHS), ICF Marco (2009). Demographic and Health Survey 2008: Key Findings. Calverton, Maryland: GSS, GHS, ICF.
6. Ghana Statistical Service. (2010). Population & Housing Census District Analytical Report for Bosomtwe District. Retrieved.
7. Ghana Statistical Services. (2015). Population and housing census: summary of final results.
8. Nkeyia KA, Asamoah E, Sadick A, Asenso-Gyambibi D, Forkuo EK (2016). Assessment of water quality of Lake Bosomtwe for recreational purposes. Int. J. Agric. Food. Sci. 1:180-114.
9. Wireko A (2015). Impacts of land use/cover change on water quality in Lake Bosomtwe basin of Ghana.