

Harnessing the Opportunities and Overcoming the Constraints to Widespread Adoption of Cage Aquaculture in Ghana

Technology Adoption and Policy Development/Study/09TAP04PU

Emmanuel A. Frimpong
Virginia Polytechnic Institute and State University
Blacksburg, Virginia, USA

Kwamena K. Quagraine
Purdue University
West Lafayette, Indiana, USA

Stephen Amisah, Nelson W. Agbo and Gifty Anane-Taabeah
Kwame Nkrumah University of Science and Technology
Kumasi, Ghana

EXECUTIVE SUMMARY

Sub-Saharan Africa has abundant land and water resources, but these have not been tapped to increase aquaculture production significantly in global terms. Recent analyses of Sub-Saharan Africa aquaculture have noted a relative lack of public sector research and development attention to alternative culture systems (e.g., cage culture) in Africa and recommended increased attention to alternative production systems while striving to increase intensity and production from the traditional earthen ponds. Likewise, the analyses identified progress made in Nigeria and Egypt in the production of species other than the tilapias as dictated by local demands for those alternative species, leading to their recommendations for expansion of production of high-demand indigenous species for niche markets. As a business model, diversification of species and systems provides a safety net and access to new markets for investors. This project involved complementary investigations of the opportunities and challenges to the adoption of cage culture as an alternative production system in Ghana, experimental studies of nutritional requirements and a market survey of indigenous, non-traditional aquaculture species with potential for development.

In the study of constraints and opportunities in cage aquaculture in Ghana, lack of capital to initiate a business and buy inputs especially high quality imported floating feeds was the most important constraint identified followed closely by inadequate extension services. On the other hand, prospects of local feed production were reported and some financial institutions indicated willingness to lend money for aquaculture if properly guaranteed. Government and NGO's microfinance options are also emerging opportunities. To make up for some of the deficiencies in extension services and training, a group of farmers who participated in this study and indicated they needed more training were funded to attend a one day workshop on Low Volume-High Density cage culture systems held at Crystal Lake Fish Farms in Ghana.

This investigation has produced valuable insight not previously available to farmers and the private sector of Ghana, the Fisheries Commission of Ghana and other relevant government institutions. We expect these results to contribute to diversification and rapid acceleration of aquaculture development in Ghana and the sub-region. A comprehensive Strength Weaknesses Opportunities and Threats (SWOT) analysis of the aquaculture industry in Ghana is underway utilizing lessons learned from past, the current, and ongoing AquaFish CRSP projects. This analysis is being undertaken with input from the Fisheries Commission of Ghana.

ABSTRACT

This study was conducted to identify why the overall contribution of the aquaculture industry to local fish production in Ghana is low (<1%) although cage aquaculture has a potential to increase production. We administered 134 questionnaires to six respondent groups (current cage fish farmers, potential adopters of cage aquaculture, farmers who have abandoned cage aquaculture, Fisheries Commission, regional and district fisheries officers, and financial institutions) to obtain insight into the constraints in cage aquaculture as well as opportunities that can be exploited to promote cage aquaculture adoption. For the purpose of this study, potential adopters are individuals who have fish-related livelihoods including fishermen, pond-based fish farmers, and fish traders. We also interviewed key informants in relevant government institutions. Preliminary results indicate that lack of capital and lack of government extension services are the main constraints in cage aquaculture in Ghana. Lack of capital manifests in farmers' inability to afford quality floating feed and could explain low production levels of current cage farmers, although most (95%) suggested they could market their fish if they increased production. Lack of capital also accounted for the inability of potential adopters and farmers who have abandoned cage aquaculture to start or continue cage aquaculture respectively. Major opportunities identified include 1) a high interest among potential adopters (79%) to start cage aquaculture and farmers who have abandoned cage aquaculture (100%) to resume if constraints are removed, 2) development of a feed production plant in Ghana by a private enterprise, 3) willingness of some financial institutions to provide loans for cage farmers, and 4) a number of government initiatives to promote cage aquaculture. Our preliminary recommendations are that the Fisheries Commission should work with the financial institutions to help determine farmers' ability to repay loans and guarantee loans made by the financial institutions. Also, there is a need for a more specialized aquaculture extension service accessible to farmers to help with technical issues built on the model of agricultural extension services in Ghana.

INTRODUCTION

Aquaculture in Ghana has been predominantly land-based since its inception in the 1950's. There are currently about 4,500 ponds operated by more than 2,800 fish farmers in Ashanti, Brong Ahafo, Central and Western Regions of Ghana (Lionel Awity, unpublished data). Despite these numbers the contribution of aquaculture to local fish production is still insignificant. Available data suggests that the output from aquaculture in 2006 was estimated to be less than 1% of local fish production (Abban *et al.* 2006). Increasing aquaculture production will be a major step towards food security in Ghana and a further step in achieving 20% of local production, similar to the global mean, which the government seeks (Abban *et al.* 2006). In order to achieve this goal in addition to meeting the estimated annual deficit of 400, 000 mt (Asmah 2008), cage aquaculture must be given serious consideration since land-based aquaculture in Ghana is mostly extensive and the land is finite.

The country offers considerable opportunity for small-holder and commercial scale development of freshwater cage aquaculture, especially in the Volta Lake. Utilizing only 1% of the area of Volta Lake (approximately 8502 km²) (ILEC 1999) corresponds to about 8500 hectares of water. This quantity of water is more than 10 times the area used for land-based aquaculture, about 468 hectares, estimated with 1,300 farms with mean size of 0.36 hectares (Asmah 2008). The culture of other desirable species such as the catfishes can also be expanded through cage aquaculture in addition to Nile tilapia (*Oreochromis niloticus*) which is currently the only species cultured in cages in Ghana (Blow and Leonard 2007). There is no doubt that cage aquaculture has the potential to make significant contribution to total fish production and food security in Ghana. China is a good example of a country where cage aquaculture has played an important role in inland fish yields. During 1978 to 1993, production from cage aquaculture accounted for 67.5% of total fish production of inland water bodies (Baotong and Yeping 1997). Even in Ghana, a single commercial cage farm contributed about 21% (200 tons out of 950 tons) to total aquaculture production in 2004 (Awity 2005). It has been suggested that if cage farmers in Ghana can produce yields

of 50-150 kg/m³/9 months as done elsewhere in Africa, less than 100 hectares of fish cages can produce yields matching the current capture fisheries production of 90,000 mt (Ofori *et al.* 2010).

Evidently cage aquaculture is not without negative environmental impacts. However, most impacts can be avoided if appropriate policies are implemented to limit the area of water allocated for cage aquaculture, which is currently being considered (Lionel Awity, pers. comm.). Existing irrigation reservoirs also have the potential to be used for cage aquaculture since they are less likely to raise major concerns.

Obviously, having significant national water resources for cage aquaculture is an important first step, but national development policy for cage aquaculture should be cognizant of other complex and interacting constraints to cage aquaculture development as have already been documented elsewhere (Hambrey 2006). Cage aquaculture has been developing in Ghana consistently in the last decade but there have been no significant reflection in the overall aquaculture production figures. Major constraints to aquaculture development suggested for Sub-Saharan Africa are feed and seed quality and availability, cost of cage design and construction, and financing (Ridler and Hishamunda 2001; Halwart and Moehl 2006; Moehl *et al.* 2006; Blow and Leonard 2007; Asmah 2008). Other constraints identified include lack of technical know-how (Ridler and Hishamunda 2001; Halwart and Moehl 2006; Blow and Leonard 2007; Asmah 2008), lack of market (Hambrey 2006; Moehl *et al.* 2006), lack of processing (Blow and Leonard 2007), lack of access to information and support (Ridler and Hishamunda 2001; Moehl *et al.* 2006; Asmah 2008), conflict over water use (Halwart and Moehl 2006) among others.

Many of the constraint suggested have been attributed to aquaculture in general and are likely to be constraints facing cage farmers but because they are mostly described for the entire sub-Saharan Africa, it becomes difficult to develop policy strategies and solutions targeting specific constraints. It is imperative that each country identifies its specific set of constraints and prioritize development interventions accordingly.

Our goal was to identify why the overall contribution of the aquaculture industry to local fish production in Ghana is low although cage aquaculture has a potential to increase production, and make necessary recommendation to the Fisheries Commission aimed at developing interventions for expanding cage aquaculture. Our specific objective was to identify the main constraints to cage aquaculture in Ghana. We also sought to identify any opportunities that could be exploited to increase the contribution of cage aquaculture to fish production in Ghana.

Description of the study area

The study was conducted in communities around the Volta Lake where there are present or past cage aquaculture activities. Lake Volta is currently the main inland water body used for cage aquaculture in Ghana. It presents enormous opportunities for aquaculture expansion. Communities around the lake are mainly engaged in fishing and farming employing mostly men with the women focusing on fish processing and trading. Lake Volta and its tributaries drain 70% of the entire area of Ghana (FAO 2005) covering mostly Northern, Volta, Eastern and Brong Ahafo regions. The Eastern and Volta regions were the focus of this study. We selected the respondent groups from several districts in these regions based on the recommendations from the Fisheries Commission.

METHODS

Sample selection and data collection

The surveys were done with three main respondents including current cage fish farmers (Adopters), cage fish farmers who have abandoned the trade (Abandoned), and Potential Adopters represented by people with fish-related livelihoods such as pond aquaculture and trading in fish. The other respondents were the Fisheries Commission, regional and district Fisheries Officers, and representatives of financial

institutions. The group consisted of people already employed in fish activities including fishermen, pond and pen-based fish farmers and fish traders. Regional and district Fisheries Officers of the Fisheries Commission function as extension officers to fish farmers in addition to their prescribed duties. Therefore we included this respondent group to learn about their perspectives of what the constraints in cage aquaculture in Ghana were.

With the exception of Potential Adopters and financial institutions, all respondents identified for this study had small populations which were easily accessed through census. We obtained a list of Adopters and Abandoned from the Fisheries Officers and contacted as many as were available. Where we could not contact farmers directly, we employed opinion leaders to help access them. We also interviewed financial institutions based on their availability and preparedness to voluntarily answer questions.

The field studies were conducted the summer of 2010 and 2011. We employed both surveys and interviews in this study. We administered most of the questionnaires in person to ensure answers provided were directed to exact questions asked. A total of 134 questionnaires were administered. Questionnaires were structured to suit respondent groups but we incorporated similar questions across some questionnaires to aid comparison among groups. We interviewed 45 Adopters, 20 Abandoned (including 10 individuals who had abandoned pen fish farming), and 57 Potential Adopters. We also administered 1 questionnaire to the Fisheries Commission, 5 questionnaires to regional and district Fisheries Officers, and 6 financial institutions identified in the two regions used in this study. We further interviewed key informants in relevant government institutions.

Questionnaire design

Based on the information available in the literature about constraints in aquaculture in general and cage aquaculture in particular we developed nine items representing constraints that could be evaluated by Adopters, Abandoned and Potential Adopters. The nine items were presented and scored on a four-point interval scale ranging from “not important” to “very important” modified from Vagias (2006) level of problem type-scale. Respondents were to rank the constraints according to how important they were in their cage aquaculture operations, their decision to abandon or adopt the business. Additionally we presented the same set of constraints to the Fisheries Commission and the regional and district Fisheries Officers. We also provided an open-ended option for respondents to state other constraints they thought were very important.

Adopters, Abandoned and Potential Adopters were asked to indicate (yes/no) whether they had had specific cage aquaculture training. We followed up with an open ended question of the type of training, where and when they had the training. We used these multiple measures of training as a way of assessing the level of knowledge of respondents in cage aquaculture.

We also wanted to evaluate the market availability for products, the profitability of cage aquaculture from the respondents’ perspective, and interest in the business. To do this we developed a series of binary response questions which were presented to the appropriate respondent groups. We asked Adopters to indicate (yes/no) whether they thought they would be able to sell more fish if they could expand production above their current level. Then we asked them if they would recommend cage aquaculture to potential farmers. To evaluate the level of interest, we asked Potential Adopters to indicate (yes/no) whether they were interested in starting cage aquaculture on the Volta Lake. We further asked both Abandoned and Potential Adopters to indicate (yes/no) if they were interested in resuming or starting cage aquaculture if constraints are removed, and to provide reasons for their responses.

Opportunities available for farmers to access loans from banks and financial institutions were explored through both close-ended and open-ended questions. Financial institutions were asked to indicate (yes/no) if they had given loans to fish farmers in the past. When the response was yes, they were further asked to

indicate the percentages of farmers who paid the loan at the appointed time, sometime after the appointed time or never repaid the loan. Future opportunities for loans were explored by asking financial institutions to indicate (yes/no) whether they had some form of budget for fish farmers currently. For those that responded in the affirmative, we asked them to provide specific requirements that farmers needed to meet in order to access a loan.

Interviews

We used select questions from the questionnaires as an interview guide in conducting the interviews with the key informants in government research institutions. We asked interviewees their opinions about the constraints in cage aquaculture in Ghana and opportunities they knew existed which could improve the industry. We took notes in all interviews but taped none of the interviews to avoid making interviewees uncomfortable.

In this preliminary analysis, the quantitative questions in the surveys were analyzed using descriptive statistics such as arithmetic means, percentages and proportions and the qualitative questions were either coded and analyzed using descriptive statistics or analyzed qualitatively. All interviews were transcribed and stored to await analysis with the surveys.

RESULTS AND DISCUSSION

Constraints in cage fish farming

Overall, the three main respondents groups (Adopters, Abandoned and Potential Adopters), the Fisheries Commission, and regional and district fisheries officers ranked lack of capital high on a 4-point scale. Mean ranking of lack of capital was 3.5 for Adopters (Figure 1). Abandoned and Potential Adopters had mean rankings of 3.3 and 3.2 respectively. Due to the small sample size of the Fisheries Commission, and regional and district fisheries officers (n = 1 and 5 respectively), their means were not included in the comparisons but it is worth mentioning that the Fisheries Commission ranked lack of capital as very important (4) while the regional and district officers had a mean ranking of 4 for the same constraint.

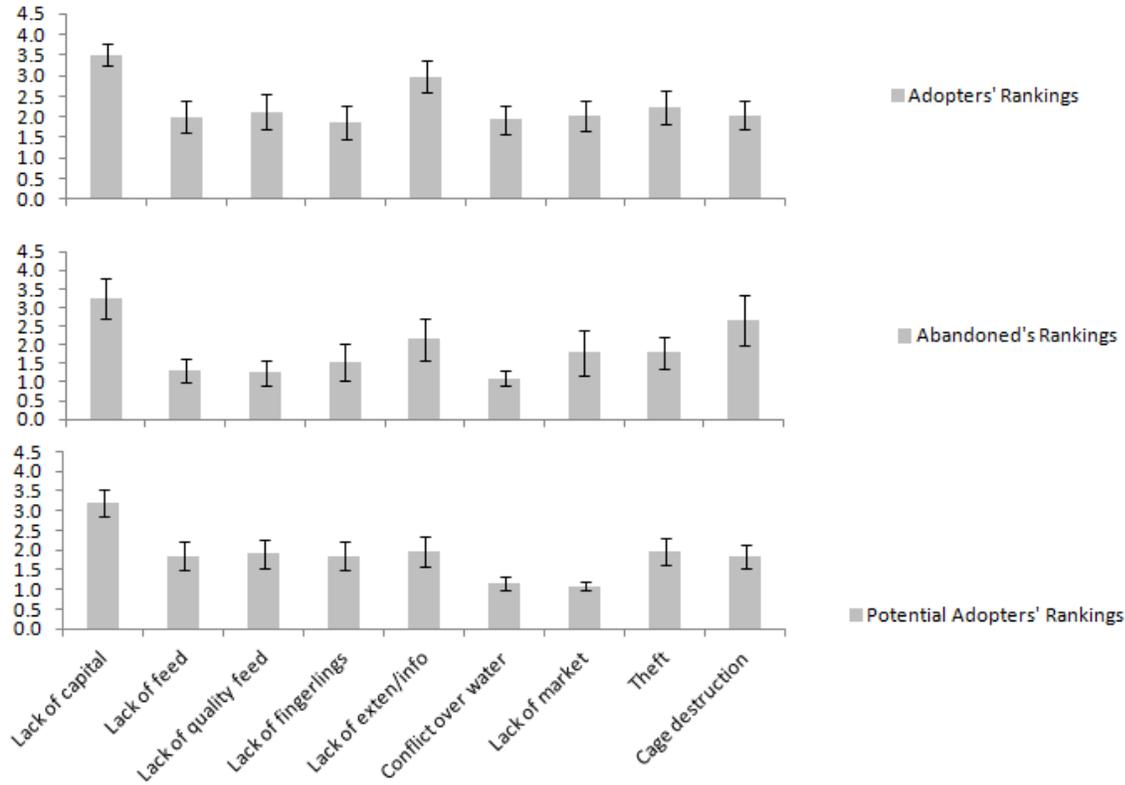


Figure 1.- Mean rankings of nine constraints for Adopters, Abandoned and Potential Adopters. The ranking is based on a 4-point scale from not-important to very-important. Total sample size (n) for Adopters, Abandoned and Potential Adopters are 45, 20 and 57 respectively. Error bars are 95% confidence intervals.

The results from the survey suggest that lack of capital is the main constraint in cage aquaculture in Ghana and not lack of feed and fingerlings as has been suggested for Sub-Saharan Africa (Halwart and Moehl 2006). Rather, the problem appears to be high input cost, specifically, feed cost due to the importance of feed in the relatively intensive system of tilapia cage aquaculture. Lack of good fingerlings may have been a constraint in the past but with the extensive research conducted by the Aquaculture Research and Development Centre of the Water Research Institute (CSIR-WRI) to improve the genetic quality of tilapia broodstock and fingerlings, and the availability of many commercial hatcheries, lack of fingerlings is probably a problem of the past in Ghana. When the respondents were asked to state other constraints they thought were important, high feed cost emerged as the most important constraint. Additionally, extra information provided by some respondents indicated that high feed cost was an important constraint not the lack of feed or lack of good quality feed (Figure 2). It is therefore reasonable to conclude that farmers lack capital to buy feed for their business because quality feed are often imported. This result corroborates the opinion of Blow and Leonard (2007) that the unavailability of high-quality locally produced feeds at competitive prices in sub-Saharan Africa was a constraint in cage aquaculture. High feed cost also translated into high fish price, which some farmers felt affected their profit (Figure 3) even though lack of market was not necessarily a major constraint according to the survey results.

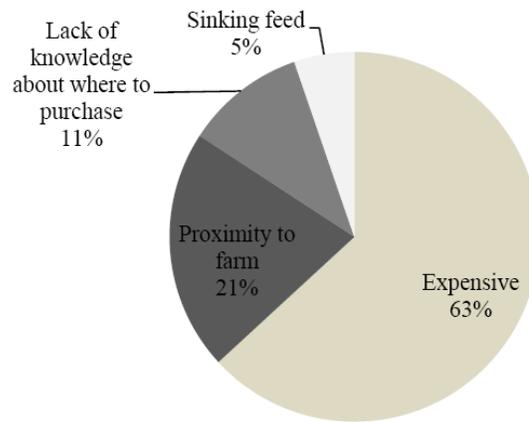


Figure 2.- Proportion of respondents who provided additional information about other factors they considered constraints in relation to lack of feed and good quality feed. Sample size n = 17.

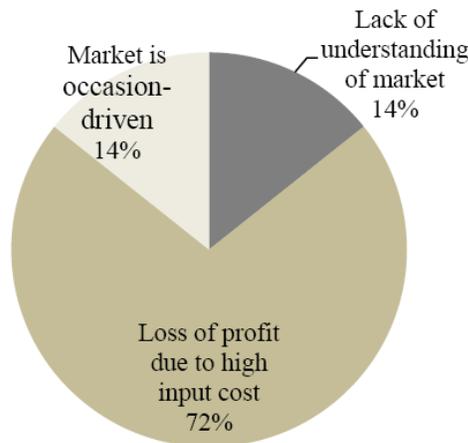


Figure 3. Proportion of respondents (n = 7), who provided additional information about other factors they considered constraints in relation to lack of market.

For the Abandoned and Potential Adopters, lack of capital could explain why they are not currently practicing cage aquaculture. When asked if they were interested in resuming the business, all 20 respondents (100%) in the Abandoned group (including 10 farmers who have abandoned pen fish farming) were interested in resuming cage aquaculture if they had capital. The pen farmers were interested in adopting cage aquaculture but not pen farming because they had received some training in cage aquaculture and found it more desirable than pen aquaculture.

Lack of extension was ranked as the second most important constraint by Adopters with a mean of 3.0 (Figure 1). The Fisheries Commission ranked lack of extension as very important (4), however, both the Abandoned and Potential Adopters rated lack of extension or lack of information (for Potential Adopters) as a slightly unimportant constraint. In contrast, the regional and district fisheries officers ranked lack of extension quite low with a mean of 1.6. This is probably because the regional and district fisheries officers felt they were doing their best doubling as extension officers in addition to their assigned duties.

Apart from lack of capital and lack of extension, respondents ranked all other constraint as slightly unimportant (mean rank of 2.2 or lower). The only exceptions are cage destruction by storms which was ranked higher by Abandoned (mean rank of 2.7) and theft which was ranked 4 and 3.4 by the Fisheries Commission, and regional and district fisheries officers respectively. Cage destruction by storms was ranked as slightly important because 50% of the cage farmers who had quit the business did so because their cages had been destroyed by storms. Theft was probably ranked high by the Fisheries Commission, and the regional and district fisheries officers because of individual reports by some farmers but it appears that once capital is available to hire security personnel on farms, the problem of theft is easily dealt with.

Interview results shared some similarities with survey result in terms of lack of extension being a major constraint in cage fish farming. Whereas all three interviewees mentioned lack of extension specifically, only one mentioned lack of capital as a constraint. Interestingly, all three interviewees stated lack of knowledge in cage aquaculture as the main constraint. However, this did not show in the responses of Adopters and Abandoned considering that 71% and 85% respectively, said they had had cage aquaculture training. On the other hand, lack of knowledge may be a constraint for Potential Adopter evident by a small number (30%) with training in cage aquaculture.

Opportunities that can be exploited

In response to whether they would be able to market their produce if they could expand their production above current level, 95% of Adopters (n = 37) responded yes, suggesting a potential to expand the aquaculture industry through cage aquaculture. Farmers also appear to be making profits judging from the fact that 96% of all Adopters said they would recommend cage aquaculture to potential farmers, with more than half of them (57%, n = 44) recommending cage aquaculture on the basis of its profitability.

Another opportunity that can be exploited to expand production was evident when 79% of Potential Adopters said they were interested in starting cage aquaculture on the Volta Lake. Some fisher folk in the group indicated they could hardly wait to start due to the advantage of getting fish all year round compared to the seasonality of fishing. Additionally, 84% and 100% of Potential Adopters and Abandoned respectively, responded yes when asked whether they were interested to start or resume cage aquaculture if constraints are removed. The prospects of making profit was a strong indication why both Abandoned and Potential Adopters were interested in cage aquaculture but they also indicated that they found management of cages relatively easy.

We also learned through the interviews that a private enterprise has started producing floating feed for fish farmers in Ghana. Hopefully, this should ease the burden of high feed cost on farmers especially if local ingredients are used. We expect locally produced floating feed to be cheaper but the price and quality of locally produced floating feed will need to be verified in future studies before a definite advantage for cage aquaculture development can be ascribed.

In exploring the possibility of cage fish farmers being able to access loans from banks and other financial institution, we learned that some banks have had unpleasant experiences with fish farmers in the past and indeed were skeptical about future loans to fish farmers. Nevertheless, some institutions were willing to provide loans to fish farmers if they had guarantors, property collateral, and the institution had sufficient knowledge about the entire project. There were also opportunities for groups to access micro-finance with relatively less stringent criteria. Our findings are consistent with that of another study by Hishamunda and Manning (2002) who investigated the role of banks in aquaculture development in six countries in Sub-Saharan Africa (Cote d'Ivoire, Madagascar, Malawi, Mozambique, Nigeria, and Zambia) and found that banks were skeptical about giving fish farmers loans because of past failures but there still existed opportunities for acquiring loans if farmers had a convincing proof of success.

Certain government initiatives were also identified as avenues to improve cage aquaculture in Ghana. Results from the survey revealed that some interested individuals had received training in cage aquaculture organized by the government and were awaiting cages from the government to commence business. This is probably a part of a “Youth in Agriculture” proposal by the Ministry of Agriculture which we learned about during the interviews. Finally, our study also revealed that limited government supported microfinance and small loans centers were in operation in Ghana and could be accessed by fish farmers.

TRAINING

Lack of extension (or lack of information) was ranked high as a constraint by all respondents except regional fisheries officers. For adopters reporting lack of training as a constraint, one way to ease this constraint and ensure that they do not eventually abandon cage culture because of lack of knowledge is to provide training. We identified 15 such farmers who would benefit from immediate training. In February 2011, these farmers, along with three project personnel were sponsored by KNUST to attend a one-day workshop on Low Volume-High Density (LVHD) cage systems. Ten of the farmers made it to the workshop taught by Ms. Karen Veverica of Auburn University and held at Crystal Lake Farms at Anum-Boso on the Volta Lake. There were opportunities to learn important basic lessons in fish farming such as feeding and understanding feed conversion ratios, as well as specific hands-on experiences with LVHD cage systems.

CONCLUSION AND RECOMMENDATIONS

Our study suggests that the main constraint in cage aquaculture in Ghana is the lack of capital to purchase input such as feed. While lack of capital prevented farmers who have abandoned cage aquaculture from resuming, the constraint also barred potential adopters from starting cage aquaculture even though they showed a high interest in the business. In addition, farmers appeared to have knowledge in their operations but it seems the knowledge is inadequate and they could use more extension services.

In light of these results, our preliminary recommendations are that the Fisheries Commission should work with the financial institutions to help determine farmers’ ability to repay loans and guarantee loans made by the financial institutions. In the long run, aquaculture could be made more attractive and competitive by subsidizing feed cost for small-holders, especially if quality floating feed is produced locally. It would seem appropriate to provide subsidies for some of the most expensive inputs for aquaculture since farmers in crop production receive similar subsidies on fertilizers and other inputs. Also, there is a need for a more specialized aquaculture extension service accessible to farmers to help with technical issues built on the model of agricultural extension services in Ghana. Farmers who cannot afford private extension services would greatly benefit from such a program especially if this is a cheaper alternative.

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