Potential, Challenges and Opportunities for Promoting Integrated Agri-Aquaculture among Vegetable Growers and Fish Farmers in Mvomero District of Morogoro Region, Tanzania

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Abstract

Integrated Agri-Aquaculture (IAA) is the integration of fish farming within a broader farming system. Although this system is common in Asia, it is not widely practised in Africa and Tanzania in particular. For many years, lakes, ocean and rivers have been the main source of fish supply in the country. However, the recent upsurge in fish demand coupled with such factors as the use of destructive fishing gears, population growth and poor agricultural practices which lead to pollution and climate change have rendered these sources unsustainable. To increase fish supply, several interventions for promoting fish farming have been implemented. Specifically, IAA is promoted to optimally utilize locally available resources and reduce environmental impacts. However, the main concern is that there has been low yield attained from the IAA contrary to its aim of increasing overall farm yield and income. As a relatively new farming system in the target community, it deemed necessary to explore issues and conditions limiting IAA practice starting with testing its acceptability within the farming communities. The present study analysed the potentials, challenges and opportunities for adopting IAA in Mvomero district of Morogoro region, Tanzania. Both quantitative and qualitative data were collected from vegetable growers and fish farmers. Findings showed that there was a high level of awareness and interest in IAA among vegetable growers and fish farmers. However, only 14% of vegetable growers practised IAA compared to 75% of fish farmers. Lack of knowledge and quality inputs were the main challenges facing the IAA farming system. The study recommends practical training of vegetable farmers on IAA and Integrated Pest Management aspects as a means of promoting IAA. Efforts for IAA promotion should be geared towards facilitating the formation of farmer groups for peer learning and practising IAA.

Keywords: Agri-aquaculture, adoption, potentials, opportunities, Challenges, Mvomero, Tanzania

Introduction

Globally, fish farming is perceived as a Green Economy in a Blue World (UNEP, 2011; FAO, 2013). Cook (2017) found that fish farming has proven to be an innovative strategy for improving economic growth and well-being of communities. In sub-Saharan Africa, fish farming has quickly gained momentum as an innovative and economic mechanism for generating employment, increasing household income, improved nutrition and contributing to food security

(Wetengere, 2010; URT, 2019; Mmanda *et al.,* 2020). In Tanzania, due to abundant land and water resources, fish farming presents great potential in fighting poverty and enhancing food and nutrition security. However, this potential remains untapped (Chenyambuga *et al.,* 2012). This is because aquaculture is largely being operationalized at a subsistence level by small-scale farmers constrained by lack of technology, limited knowledge, low level of investment and scarcity of inputs. Nevertheless, various initiatives are made in Tanzania to improve the performance of the sector as envisaged in different policy documents such as the Fisheries Sector Development Programme of 2010, National Fisheries Policy of 2015, National Five Years Development Plan (2016-2021) and the Fisheries Act of 2003.

The current study explored the potentials, challenges and opportunities for promoting integrated agriculture aquaculture (IAA) in Tanzania from the practitioners' point of view. Specifically, it addressed three main questions: (1) what is the status of IAA adoption? (2) What are the factors constraining or may constrain adoption of IAA? (3) If resources are limited, can farmers collaborate to practice IAA? The point of departure of the study is informed by the fact that although several studies (Lamtane, 2008; Shoko *et al.,* 2019; Limbu *et al.,* 2017) have been conducted in Tanzania on aquaculture and IAA, majority have focused on technical and economic aspects. There is scant evidence (FAO, 2014, Kinkela *et al.,* 2019) on how targeted people and communities perceive the system in terms of opportunities and challenges from a social-cultural perspective. Limbu *et al.* (2017) add that adoption of IAA system in African countries including Tanzania has been slow due to little rigorous empirical participatory research aimed at promoting IAA adoption in small-scale farmers setting.

Aquaculture, food security, climate change and population growth

Studies show an increase in global fish demand during the last several decades due to various reasons (FAO, 2004; Ababouch and Fipi, 2015). At the same time, the world has experienced stagnation of wild fish catches (FAO, 2014). This has created a gap between the supply and demand for fishes. Aquaculture has been an alternative means to bridge the gap between fish supply and demand leading to most of the net growth in fish production during the last decade (Delgado *et al.,* 2003). Hall *et al.* (2011) contend that fish farming ensures food security by producing some easily cultured freshwater species, which stimulate domestic production through integrated farming.

The Conservation International and World Fish Centre (2010) conducted a global study which assessed fish farming in 18 different countries. Findings revealed that although aquaculture is key to feeding the growing urban population, it is prone to climate change that has serious consequences on fish farming communities (Ababouch and Fipi, 2015). The risk of climate change is spreading fast to lowland areas with significant impact to resource-poor farmers, causing loss of livelihoods, human displacement and migration. Further, the World Bank (2013) warns that the effects of climate change can shift the status quo of people in tropical countries, harm agriculture in general and fish farming which is a source of livelihood for people living under vulnerable conditions.

As a remedy, IAA system has been recommended by FAO for its advantages for social relevance and environmental stability as well as to maximization of economic and environmental potentials (Ayoola, 2010; FAO, 2014). Further, studies (Pretty, 2008; IAASTD, 2009: Zajdband, 2011) inform that the introduction of aquaculture into existing agricultural systems is being promoted as a sustainable alternative for the future of food production. This is because the introduction of aquaculture into other existing farming systems enables the generation of synergies between farm components. According to Edwards (1998), synergies occur when "an output from one sub-system in an integrated farming system which may otherwise have been wasted becomes an input to another sub-system resulting in greater efficiency of the output of desired products from the land/water area under the farmer's control"

The concept and types of integrated agri-aquaculture systems

According to Zajdband (2011), IAA is an efficient and environmentally sound farming system. The basic principle of IAA is to grow fish in water bodies that are closely integrated into household farms, and intentionally make use of the resource flows such as animal and plant by-products from the diverse on-farm enterprises. It is practised to achieve various aims including reducing the need for external inputs while offering diversified technologies and enabling efficient use of conventional inputs such as labour, organic fertilizer and capital to increase farm productivity. Also, IAA aims to convert agricultural wastes and manure into high-quality fish protein; to use the nutrients generated in the pond as fertilizers for growing crops to reduce the need for off-farm inputs. This promotes efficient utilization of farm space for multiple productions (Abiona *et al.,* 2012), increases the degree of internal recycling, and decreases dependence on external inputs (Cavalett *et al.,* 2006; Pullin *et al.,* 2007). Bailey (2008) asserts that because of the diverse nature of enterprises in IAAs the system offers lower risks and can contribute to increased farm resilience.

There are different systems of IAA, for example, the interaction between crops, livestock and fish (Zajdband, 2011). Kinkela *et al.* (2017) provide a typology of IAA subsystems in sub-Saharan Africa (SSA). Generally, the IAA system has been named based on their interacting components, i.e. rice -cum fish, pig-cum-fish, poultry-cum fish or multi-component farms with three or more linked elements (Zajdband, 2011; Shoko *et al.,* 2019). In East Africa, IAA husbandry practices involve various methods of stock management (monoculture or polyculture; single or multiple stocking and harvesting strategies), use of different feeds (natural, supplementary or complete feed), management of substrate and water quality, and disease prevention and therapy (Kipkemboi *et al.,* 2007). Of late, the integration of fish in rice fields by some farmers is attracting the attention of other non-practitioners in areas where flooded rice production is dominant (Ogello, 2013). Another form that has been promoted in Tanzania is fish polyculture and vegetable farming (Limbu *et al.,* 2017), vegetable-fish culture integration (Shoko *et al.,* 2011) and fish-poultry integration (Shoko *et al.,* 2019).

Methodology

The present study was conducted in Mvomero district (6° 14' 8.2212" S and 38° 41' 37.4928" E.) of Morogoro region, Tanzania. The district is among the most popular area in vegetable production. The research was conducted in four villages of Mvomero district namely Mkindo in Hembeti ward, Tangeni in Mzumbe ward, Mgeta in Langali ward and Langali in Mlali ward (Fig. 1). Mkindo village has a rice production basin which is popular for production of rice. Data collection was carried out from March to June 2015.

Before the main survey, visits were made, and interviews were held with key informants at the village and district levels. At the district, interviews were held with the district fisheries officer and the District Agricultural Irrigation and Cooperatives Officer (DAICO) whereas, at the village, the village extension officers were interviewed. During the interview emphasize

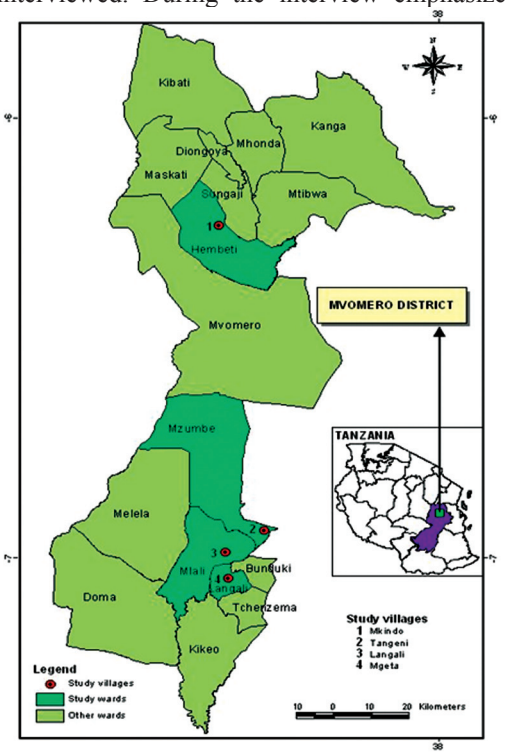

Figure 1: Map showing the study area

was given to identification of farmers involved in vegetable and fish farming whether in stand-alone or in integration. Key informant interviews provided an initial impression of where and how to conduct actual fieldwork. Therefore, information obtained was used as the basis for selecting the villages for undertaking the study.

The villages selected for in-depth study were those with a high chance of getting both vegetable growers and fish farmers who some of them practice IAA as indicated by key informants. However, during the survey, there were no fish farmers in Mgeta. Therefore, only fish farmers from the other three villages were interviewed. Stratified and systematic sampling techniques were used to obtain 69 vegetable growers from four villages as follows: Mkindo (11), Tangeni (29), Mgeta (10) and Langali (19). All 16 fish farmers were sampled from the study area since there were few of them. Purposive and snowballing methods were used in sampling fish farmers (Blernackl and Waldorf, 1981; Patton, 2002).

Interviews, questionnaire and focus group discussions (FGD) checklist were the instruments used for data collection. Both interview schedules consisted of closed and open-ended questions. Due to a small number of fish farmers in the study area, the research team capitalized on open-ended questions. Pre-testing of instruments was done at Langali and Tangeni to check the strengths and weaknesses of the study tools. After pre-testing, checklists and a questionnaire were discussed by the study team before making the necessary modifications to improve further the instruments. In addition to interview schedules, non-participant observation method was used to triangulate the data. The research team was able to visit a total of 16 fishponds and measure dimensions to triangulate information about the size of ponds as reported by fish farmers. Likewise, the research team visited the ponds for vegetable farmers to learn how integration is practised. In total six integrated ponds were visited. Quantitative data were analysed with the SPSS software version 20 using descriptive statistics to generate frequencies and percentages whereas qualitative data were analysed using content analysis techniques (Braun and Clarke, 2006).

Results and discussion

Demographic characteristics of respondents

The results showed that 75% of vegetable growers were men while 25% were females. The same trend was observed among fish farmers which imply that in the study area both vegetable growing and fish farming enterprises are dominated by men. The present finding is in line with those from Mmanda *et al.* (2020) who reported male domination in fish farming. Similarly, FAO (2014) reported a slightly higher (27.3%) percentage of women engaged in aquaculture and fisheries in Nigeria. The male dominancy in aquaculture implies the laborious nature of farming operations which their female counterparts cannot easily undertake. For example, the activities such as fish pond construction and management, vegetable production, chemical spray and watering operations are laborious.

In terms of ages, about 36% and 38% of vegetable growers and fish farmers respectively were in the age category of 41 to 50 years. Furthermore, results showed that about 20% of vegetable growers were in the age category of 31 to 40 years whereas only one (6%) of the fish farmer was in this category. Also, about 19% of both vegetable growers and fish farmers were in the age category of 51 to 60 years. While only 6% of vegetable growers were beyond 60 years, about 38% of fish farmers were beyond 60 years. The findings imply that majority of respondents were energetic and active hence be able to cope with the level of energy (labour) demanded in vegetable and fish farming activities. Usually, the age group of below 50 years is of innovative and motivated individuals who can cope with challenges that may emanate from vegetable and fish farming activities including the adoption of new technologies (Acheampong *et al.,* 2018).

In terms of educational attainment, results showed that the majority of vegetable growers (86%) and all (100%) of fish farmers attended primary education. A few (4%) of vegetable growers had education beyond primary education. This finding indicates that most respondents were somewhat literate enough to follow the training and read extension materials aimed at improving production. The current finding agrees with the findings of Obiero *et*

al. (2019) who reported that educated farmers can access information and knowledge of production processes. Elite farmers can also be able to process and analyse new information. This is important as education is a catalyst for easy adoption of new technological practices as it creates a favourable mental attitude for the acceptance of new ideas and practice (Agbamu, 2006). Furthermore, information on the innovations requires some attainment of at least basic education to learn and practice. Thus, the more educated an individual is, the easier it will be for him/her to perceive, interpret, and respond to new information much faster than their less-educated counterparts.

Livelihood activities

Generally, all respondents from both vegetable growers and fish farmers were involved in crop cultivation as the main source of livelihood. Besides, respondents were engaged in vegetable, fish production or both. The results further showed that 55% of interviewees practised general agriculture as their primary occupation and main source of livelihood whereas vegetable production as a subcomponent is practised by about 36% of farmers. This finding agrees with the finding from the 2016/17 Tanzania Annual Agriculture Sample Survey crop and livestock report (URT, 2017). Other livelihood activities were small businesses, livestock keeping, artisan work and wage employment. Also, results showed that vegetable gardens are located either in the same village (64%) where the farmer/owner stay or away from the village (36%). The reason for the higher percentage of vegetable gardens to be in the village where respondents reside could be attributed to the nature of the crop where horticultural crops require intensive care as compared to other crops. In this regard, it is a challenge to attend the garden if it is located far away from home including reducing the risk of theft. Theft has been reported to affect vegetable growers in several areas such as Ethiopia (Alamerie *et al.,* 2014) and Tanzania (Nombo, 2017). It was also noted from the present study that most vegetable growers would like their gardens to be within the villages where they live. However, land and water scarcity could not allow vegetable growers to have vegetable gardens in their respective villages. Water and land scarcity have been reported to affect vegetable production in other areas (Alamerie *et al.,* 2014).

Experience in vegetable growing and fish farming

The results showed that, about half (51%) of vegetable growers and fish farmers (63%) had an experience ranging from one to 10 years. Likewise, about 45% of vegetable growers and 38% of fish farmers had an experience of over 10 years (Table 1). The present results are supported by those from Barguma and Ndughu (2014) in Nigeria who reported that experience has an impact on fish farming productivity and usage of information and communication technologies. The implication is that when comparing the two enterprises, over 40% of respondents in the study area were not quite experienced in fish farming.

This implies that fish farming was has not picked up quite well in some areas of the study with most farmers lacking experience. Although studies (Balarin, 1985; Bryceson, 2002) demonstrate that fish farming in Tanzania has a long history, most of the activities were concentrated in coastal areas and around Like Victoria (Silas *et al.,* 2020). The activity has only spread in other parts of Tanzania in the 1990s (Shoko *et al.,* 2011). This may imply that most of the fish farmers in those areas lacked proper fish farming skills. Experience is important for the effective undertakings of any farm enterprise (Barguma and Ndaghu, 2014). Usually, as farmers accumulate experience over time, they progressively switch from traditional agricultural technologies to improved technologies based on observed performance and learning by doing (Feder *et al.,* 1985). Thus, there is a need for increased extension services by increasing agent contacts with farmers, establishing demonstration plots and farmer training centres. This will enable farmers to develop relevant skills and knowledge on fish farming and vegetable-fish farming integration system.

Table 1: Experience (in years) involved in vegetable and fish farming production

Vegetable farming	Frequency	%
Less than 1	3	4.3
>1 – 5	17	24.6
5 – 10	18	26.1
Above 10	31	44.9
Total	**69**	**100.0**
Fish farming		
Less than 1	0	0
>1 – 5	7	43.8
5 – 10	3	18.8
Above 10	6	37.5
Total	**16**	**100.0**

Awareness and practices in IAA

The study findings showed that about 73% and 81% of vegetable and fish farmers respectively were aware of IAA (Fig. 2). Awareness leads to interest and makes an individual seek information about the new practice (Rogers, 2003). While studying the influence of awareness on adoption of agricultural technologies among improved sweet potato producers in Ghana, Acheampong *et al.* (2018) found that awareness has a major influence on the adoption of improved sweet potato varieties. Despite a good number of vegetable farmers who were aware of the IAA system, only 14% practised this farming system compared to 75% of fish farmers who practised the system (Fig. 2). Normally during the innovation adoption process, at the awareness stage farmer knows of the existence of the innovation but lacks details (Rogers, 2003). Awareness of innovation usually precedes its adoption and diffusion (Rogers, 2003; Acheampong *et al.,* 2018). It implies that efforts should be made to assist farmers in the present study area to acquire more information and knowledge for final adoption.

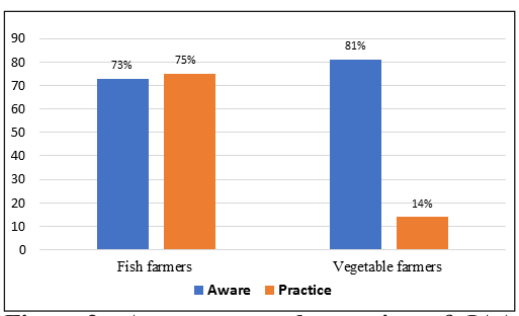

Figure 2: Awareness and practice of IAA between vegetable and fish farmers

Constraints that prevents vegetable growers and fish farmers to practice IAA

The majority of respondents during the present study reported lack of knowledge and skills (63%) limited funds to buy quality seed (31%) and security issues (6%) as the main hindrance to practice IAA system. On the other hand, findings from FGDs revealed that fish farmers also experience limited land, unreliable water including long-distance of water source for fish farming. Lack of knowledge may be linked to inefficient extension services. The present findings are supported by the previous results (Ofuoku *et al.,* 2008) where inadequate extension services were found to be a major problem to fish farming development among small scale farmers in Nigeria.

Similarly, the present findings are supported by previous studies (Ibrahim and Yahaya, 2011; Kinkela *et al.,* 2019). Inadequate capital and technical know-how are among the major constraints facing women in homestead fish farming in Nigeria (Ibrahim and Yahaya, 2011; Kinkela *et al.,* 2019). Similar findings were reported by Kinkela *et al.* (2019) while studying smallholder farmers' practices of IAA system in Peri-urban and Rural Areas in sub-Saharan Africa. Findings from the present study imply that the IAA practice is mainly constrained by lack of financial capital, and inadequate management and technical skills. Thus, better access to financial capital and technical know how of vegetable and fish culture, and integration will contribute to the adoption of the vegetable-fish farming integration system.

The findings also showed that 6% of respondents did not practice IAA because of lack of security of their produce. Given the fact that fish farming has a ready market and are easily harvested, renders the business vulnerable and prone to theft, thus, discourages fish farmers. Lack of security in fish farming has also been reported in Western Kenya by Shitote *et al.* (2013). It was evident that lack of

security was more of a concern to those farmers whose land is located far away from home and sometimes in another village. This finding is akin to that of Mulokozi *et al.* (2020) who reported that ponds being distantly located from residential areas made it easy to be accessed by poachers. When fish or vegetable production unit is closer to homestead, it is convenient for the farmer to provide intensive care and ensure security. As previously pointed out, fish farming and horticulture farming requires great attention when compared to other farmed crops. Comparatively, when doing fish farming using ponds, fencing is feasible and helpful. However, with the vegetable-fish farming system, given the size of production plots involved, fencing is not feasible, especially for small scale farmers. This is because they have a low financial capital base. This, coupled with poor access to financial capital makes it even harder to think of fencing their farms or hiring security services. Working in groups may be a suitable strategy to deal with the challenge of theft as farmers can pool together resources or labour to secure their enterprises.

The perceived interest of respondents to practice IAA if constraints were removed

The present findings showed that about 93% of vegetable growers who were not practicing IAA farming system were interested in practicing the system (Table 2). Likewise, results from FGD showed that all fish farmers including those who did not practice IAA during the survey were interested in practicing this farming system. Almost two-thirds (64%) of vegetable growers were interested in practising IAA for increasing both income and food security, while about 31% and 4% mentioned increasing income and food security respectively only.

The present findings indicate that attaining self-sufficiency in terms of food security and income was the main reasons that drove farmers to become interested in the system. These findings agree with those reported earlier by Hall *et al.* (2011) and Mulokozi *et al.* (2020). Many farmers in rural areas practise aquaculture mainly for income and food security (Mulokozi *et al.,* 2020) or only food security (Hall *et al.,* 2011).

Table 2: Whether vegetable growers are interested in practicing IAA if constraints were removed

Response	Frequency	%
Yes	56	93.3
No	4	6.7
Total	**60**	**100.0**
Reasons for being interested in practicing IAA		
Increase income	13	31.1
Food	2	4.4
Both income and food	29	64.4
Total	**45**	**100.0**
Reasons for not being interested in practicing IAA		
Lack of capital to buy fingerlings	1	25.0
Limited land	2	50.0
Too busy with other activities	1	25.0
Total	**4**	**100.0**

Limited access to land was reported by vegetable growers (50%) who were not interested in practicing IAA as a hindrance for practicing IAA. Other hindrances mentioned by vegetable growers included being busy with other activities (25%) and lack of capital for buying quality fingerlings (25%).

The implication from the present findings is that some farmers still do not understand the potential of IAA in optimizing overall farm yield and income. The potential of IAA was demonstrated in Malawi whereas farmers obtained 11% and 134% higher farm productivity and income per hectare, respectively than non-IAA farmers (Dey *et al.,* 2010). Similarly, Limbu *et al.* (2017) and Shoko *et al.* (2019) found out that IAA has the potential to produce higher pond output which eventually leads to higher income.

Usually, limited understanding of IAA potential in increasing farm output and diversifying income among vegetable growers is caused by the inadequate promotion of this

farming system by responsible government agencies such as extension service providers (Mulokozi *et al.,* 2020). It is therefore important for the government to provide support to extension service providers to promote IAA and improve production and productivity. This is an important initiative in improving people's livelihoods through increased income. IAA seems a relevant starting point for the development of socially, ecologically and financially sustainable agriculture in the context of small-scale farmers (Edwards, 1998).

Interest in Entering a Partnership for Promoting IAA and how to Divide the Proceeds among Themselves

Interest in entering a partnership for promoting IAA

Currently, in the study area, vegetable production and fish farming are run separately and by different enterprises. One of the ways to promote IAA is for the vegetable and fish farmers to enter into a partnership so that they can take advantages of the synergies (Edwards, 1998; Cassman *et al.,* 2005; Pretty, 2008; Ayoola, 2010; FAO, 2014; Obiero *et al.,* 2019).

Results from the present study showed that more than two-thirds (68%) of vegetable growers were not interested in entering into a partnership with a fish farmer while only about 31% were interested (Table 3). On the contrary, the majority (81%) of fish farmers were interested. These findings demonstrate the diverging scenario in interest to work in partnership among fish farmers and vegetable growers. Despite high levels of awareness (73%), lack of interest among vegetable growers could be linked to their lack of experience on the benefits of IAA system. On the other hand, a high level of interest of fish farmers may be attributed to practical experiences on the advantages accrued from the partnership. Such advantages include the issues of feeding and feed costs, security and labour. That is, by entering into partnership, fish farmers can reduce the cost of labour through working together or by sharing the cost or labour with vegetable growers. Also, they can save the cost of feed by utilizing the remnants of vegetables.

Table 3: If vegetable growers are interested in entering a partnership with a fish farmer

Response	Frequency	%
Yes	20	31.3
No	44	68.8
Total	**64**	**100.0**
Reasons for being interested in entering a partnership with a fish farmer		
Exchange of knowledge	12	63.2
Increase income	7	36.8
Total	**19**	**100.0**
Reasons for not being interested in entering a partnership with a fish farmer		
To avoid conflict	26	66.7
The partnership is not reliable/sustainable	13	33.3
Total	**39**	**100.0**

For those who were interested, the main reason given was exchange of knowledge and skills (reported by 63%) and increase income (reported by 37%). It was further reported that partnership could enable fish farmers to work together, learn from and support each other in terms of labour and other social issues. For those who were not interested the reasons were a possibility of conflicts over land and other resources (67%).

Yet, 33% of vegetable farmers perceived partnership as something which cannot be sustained. The result has many implications; one is that there is a clear understanding of the importance of working together. Collaboration allows pulling resources together to enjoy economies of scale and increase bargaining power, thus benefiting from markets of the products. Also, farmer to farmer learning for increased capacity and having a common and strong voice. These aspects are very important in farmer empowerment. On the other hand, reflecting on reasons given by those who were not interested in entering into a partnership, suggests that some farmers have not realized the potential of working together.

This may be embedded in the scores of history of cooperatives in Tanzania where there are spots of discouragement (Sambuo and

Msaki, 2019). However, this may be a signal that extension services have not adequately performed its job of facilitating farmer organization and empowerment.

Thus, it is recommended from the findings of the present study that there is a need for improving extension services especially when promoting a relatively new technology like IAA. The impact of effective extension services is well documented. For example, while investigating the impact of extension services among Egyptian fish farmers Dickson *et al.* (2016) reported a higher profit from farmers who received training compared to those who did not. Similar results were also reported from Malawi by Dey *et al.* (2010).

Ways to share the proceeds from a partnership

Results from the present study showed that about 69% of all vegetable growers who were interested in entering into partnership did not know how they can enter into a partnership with fish farmers (see Table 4). However, 23% suggested that they would like both fish farming and vegetable gardens to be managed by all and share profit equally while about 8% suggested that they would like to exchange goods, i.e. vegetables with fish. On the other hand, discussions with fish farmer confirmed the responses of vegetable growers and added equal profit sharing. On top of the ways to share proceeds, fish farmers commented capacity building as an important means in accruing benefits resulting from IAA. In connection to this, studies have demonstrated that IAA is profitable provided it is well managed and good quality inputs such as fingerlings are available and affordable (Chenyambuga *et al.,* 2012; Dickson *et al.,* 2016).

Perceived Available Opportunities for Promoting IAA

The market for vegetables and fish products

The present results showed that 58% of the respondents are not meeting customers' demands (Fig. 3). Meaning that the current level of vegetable production does not suffice the demand. This was also affirmed by about 91% of respondents who reported that they would sell more vegetable if they could have produced more. On the other hand, results further showed that vegetable growers' failed to meet market demands due to lack of capital to expand or meet the initial costs of vegetable production (50%) and, pest and diseases problems (23%, Table 5). Other constraints mentioned include limited access to land (14%) and an unreliable market (11%). These findings are in line with the position of Tanzania Horticultural Development Strategy (2012-2021). The strategy states that Tanzania's horticultural industry faces several challenges including, low productivity and quality, limited access to finance, land and infrastructure, inadequate market development support and lack of entrepreneurship culture (Horticultural Development Council of Tanzania, HODECT, 2010). The present findings are also supported by previous results which found out that smallholder vegetable farmers face limited access to farm credit among other limitations (Muhanji *et al.,* 2011).

It should be noted, however, that while generally there is a demand for vegetables; some vegetable growers (11%) felt that markets were unreliable. This finding is supported by those from Mutayoba and Ngaruko (2015), who reported that insufficient market information and communication between farmers, traders and consumers pose an important hindrance to market accessibility. Thus, to enable vegetable

Table 4: If interested in entering a partnership, how would you like to divide the proceeds amongst famers? a) Vegetable growers

Reasons for not being interested	Frequency	Percent
Exchange of goods (vegetables with fish)	3	7.7
Both fish pond and garden managed by all and share profit equally Doing jointly and share the profit equally	9	23.1
Don't know how this can be done	27	69.2
Total	**39**	**100.0**

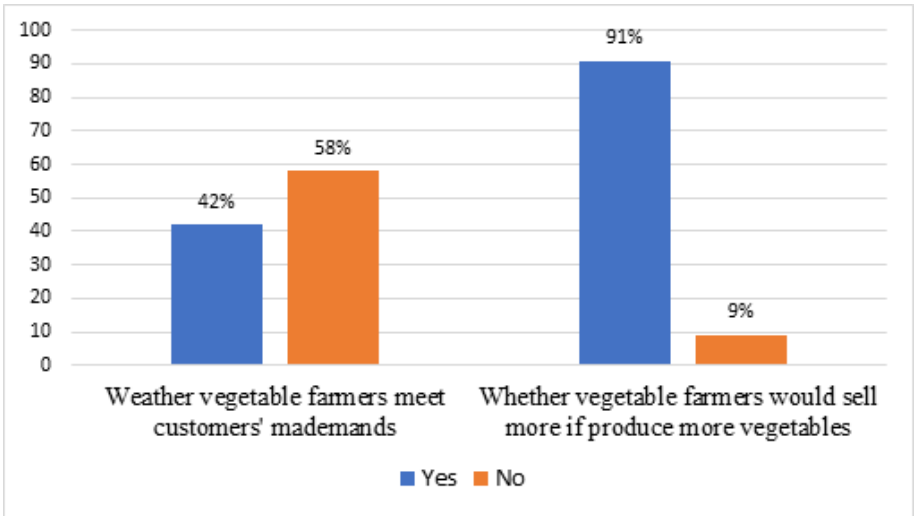

Figure 3: Market for vegetables

growers to participate effectively in and benefit from the enterprise, a combination of all the factors should be addressed.

Table 5: Main constraints that prevent the farmer from producing more vegetables

Constraints	Frequency	%
Lack of capital	30	52.6
Pest and diseases	13	22.8
Limited access to land	8	14.0
Unreliable market	6	10.5
Total	**57**	**100.0**

The current fisheries production in Tanzania ranges from 325,000 to 380,000 tonnes per annum while the demand is over 700,000 tonnes (URT, 2019). About 85% of the production is from inland fisheries, 14% from marine fisheries and just one per cent from aquaculture. This calls for intensification of aquaculture to bridge the gap between fish supply and demand in the country.

Conclusions and recommendations

The study aimed at exploring the potentials, challenges and opportunities for promoting integrated agriculture aquaculture in the study area. Based on the findings of the study, it is concluded that there was a potential for promoting IAA practice as a strategy to improve people's livelihood. However, there were challenges identified that need to be addressed. These included: limited knowledge on IAA practice, lack of capital (financial capital for buying fingerlings) and labour for pond construction. There is also negative perception on forming a partnership among farmers. Besides, the availability of market for both fish and vegetable products, existing government efforts to promote fish farming and the availability of production resources were the identified opportunities.

We recommend that Agricultural extension agents in collaboration with other actors should design and implement training programmes on Best Management Practices (BMPs) in fish farming including integrated Aquaculture Agriculture (IAA). Such training programmes will improve knowledge and skills in fish farming. Also, concerted efforts should be done to improve access to capital to farmers through the promotion of the formation of Savings and Credit Co-operative Society, provision of soft loans and ensure availability of required inputs.

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