

Full Length Research Paper

Aquaculture extension service in Kenya: Farmers and extension officers perspectives

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A cross-sectional study was undertaken to examine the aquaculture extension service in Kenya. Primary data was collected using a semi-structured questionnaire administered to 292 randomly selected fish farmers and 56 extension officers in different counties in Kenya. Descriptive statistics mainly mean and frequencies were computed to determine key characteristics of farmers and extension officers. Inferential statistics were done using the Chi-Square test of goodness of fit at a significant level of $P \leq 0.05$. Analyses were done using (Stata 13) and (SPSS version 23). The results demonstrated that youth fish farmers' contribution to the aquaculture sector is relatively low (26%) and extension service is perceived as helpful to fish farmers, though practices and outcomes vary among farmers. The education level of the farmers indicated that farmer literacy level is high and can positively affect adoption of new technologies. The results further showed that the training and visit extension model continues to dominate the sector. In addition, extension officers ranked poorly the possession of appropriate extension and training materials. It can be concluded that the challenges that extension officers face are not new. Thus, changes in government led aquaculture extension service will be ineffective unless they are attached to substantial changes in financing and relevant capacity building initiatives.

Key words: Advisory, productivity, training, financing.

INTRODUCTION

A consensus exists that extension services will improve farmers' agricultural productivity and livelihoods if adequately designed and implemented (Ragasa et al., 2016). Agricultural advisory services are perceived by

many actors involved in rural development as essential elements in improving farm performance and strengthening ties between farmers, research, agricultural education, and other actors of the society (Obwanga et

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al., 2017). Extension and advisory services broadly include: (i) the actors involved in the advisory activity and the relationships they maintain with each other and with other external actors and (ii) the methods that are used by advisory service actors to create knowledge and know-how in individual and/or collective learning processes (Hilkens et al., 2018). The success of a new technology relies strongly on its dissemination from the source of the invention to a wide range of potential end-users (Kumar et al., 2018; Obiero et al., 2019). It is widely recognized that a well-functioning extension system is crucial for disseminating information and promoting adoption of new farming technologies among farmers who otherwise may lack the knowledge of, and avenues to obtain, new technologies on their own (Suvedi et al., 2017). Skilled extension personnel are involved in developing effective extension programs that identify critical problems and then design appropriate combinations of solutions. These provide the necessary information, including results of on-farm trials that demonstrate feasibility, and are essential for the timely transfer of technologies to farmers (Engle, 2017).

Despite decades of research and development, hundreds of millions of dollars of investment, and high biophysical potential, aquaculture has not yet significantly contributed to national food supplies or economic growth in Kenya (Obiero et al., 2019). Specific constraints related to aquaculture development include inadequate supply of quality fish seed and feed, limited access to knowledge, lack of technical and marketing information and increasing competition from cheaper imported farmed fish products such as Chinese tilapia (Aloo et al., 2017; Awuor et al., 2019; KMFRI, 2017; Koge et al., 2018; Nyonje et al., 2018). These constraints, compounded with problems of inadequate government funding of aquaculture research and development (R&D) as well as lack of incentives for investment in the sector to cushion the rural poor households have compelled policy-makers to search for alternative ways of promoting aquaculture production in the continent (Sanyang et al., 2016).

Currently 'national funding for agricultural extension and advisory services remains low and variable (Aloo et al., 2017; Obwanga et al., 2018). None the less, renewed national, regional and global interest and commitments provide a momentous opportunity to deliver services that are farmer-centered, participatory, well-funded, demand-driven and performance-oriented. 'Yet, there are few studies that have assessed the impacts on society of public and privately funded research and extension programs in solving farmers' immediate and pressing problems. Therefore, detailed farm-level data and analyses are needed to determine the impacts of research and extension programs to contribute to aquaculture's growth and development. In addition, lack of skilled and experienced aquaculture extension services and limited access to newer information technologies hamper farmer innovation and uptake of new technologies, innovations

and best management practices (TIMPs). This paper examined the aquaculture extension service in Kenya based on farmers and extension officers' perspectives.

MATERIALS AND METHODS

Research design

The study employed a cross-sectional survey design. The extension officers and fish farmers' data for this study were collected from 17 Counties in Kenya, including Busia, Homabay, Kirinyaga, Kakamega, Kiambu, Kilifi, Kisii, Kisumu, Kwale, Laikipia, Meru, Migori, Muranga, Nyamira, Nyeri, Siaya and Vihiga (Figure 1). The counties were selected based on five criteria, including high concentrations of aquaculture activity, high production potential, existing infrastructure such as processing and research facilities, adequate water resources and marketing potential, amongst other factors (Obiero et al., 2019).

Sample size and sampling technique

A multistage purposive sampling procedure was used in the selection of the survey population. The central sampling units were fish farmers and extension officers. Subsequently, random sampling was employed in the identified counties to select fish farmers and extension officers to be included in the study. An online tool <https://www.random.org/> was used to select a random representative sample size that allowed generalization to a larger population and the use of inferential statistics.

Data collection instruments and procedures

In this study, personal face-to-face interviews using semi-structured questionnaires were the main research instruments used and aided in controlling for non-verbal behaviors. The questionnaire was constructed, taking into account the objectives of the research. A pilot study was undertaken to assess the questionnaires' suitability using ten respondents who were not part of the target groups. The pilot study aided in ensuring the reliability and validity of the questionnaire. A total of 292 fish farmers and 56 extension officers were interviewed in October 2019. Secondary data from published and unpublished records were used to complement primary data. Key informant interviews were also applied to obtain insights through an in-depth exploration of the subject matter and discover information that would otherwise not be revealed in a survey.

Data analysis

Data collected from the field were entered and analyzed using Statistical Product and Service Solutions (SPSS) version 23.0 and Stata version 13 (Corp 2013). Descriptive statistics, mainly mean and frequencies, were computed to determine key characteristics of farmers and extension officers. Inferential statistics were done using the Chi-Square test of goodness of fit. All data analyzed were considered significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

Socio-demographic characteristics of fish farmers

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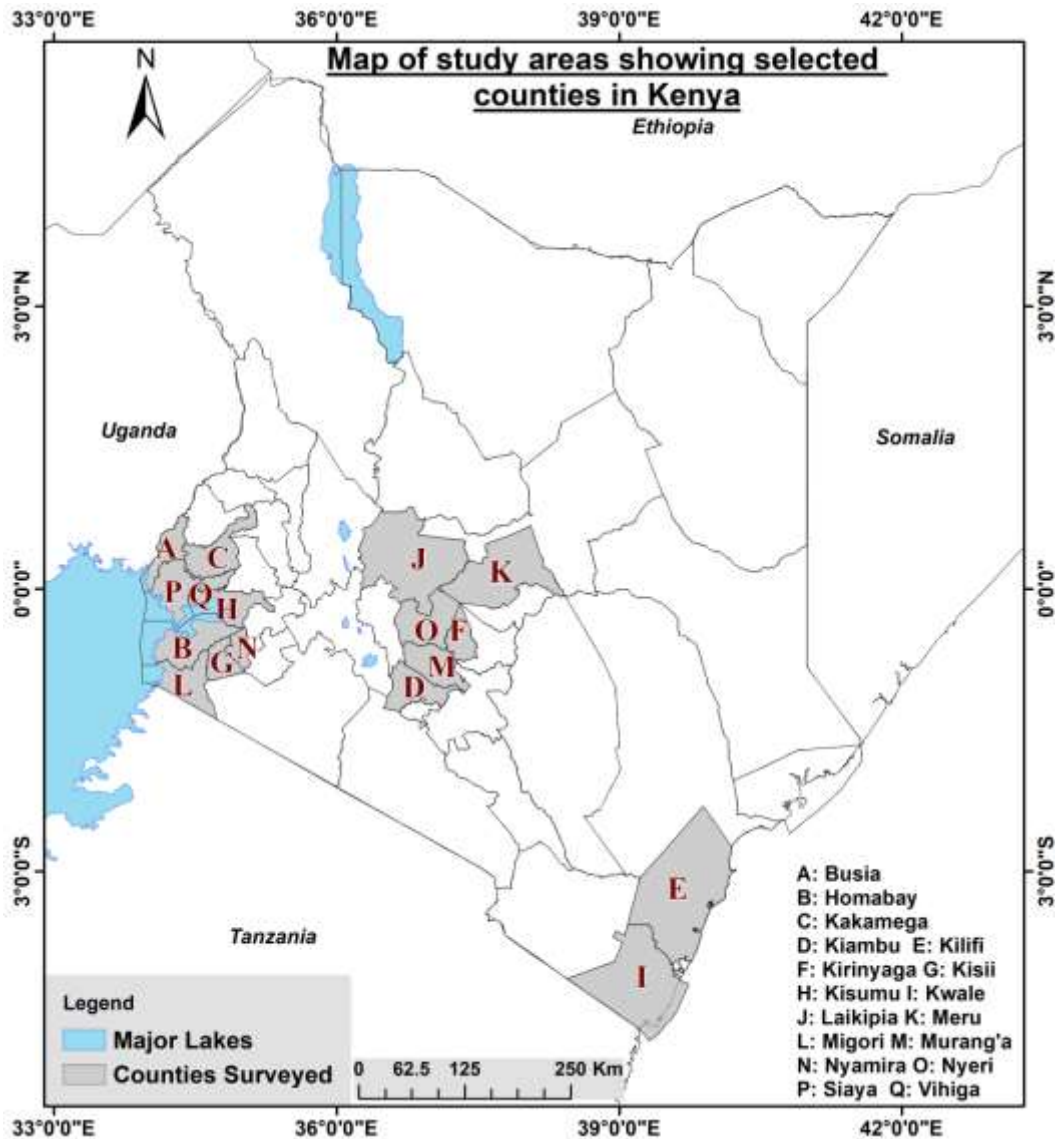


Figure 1. Map of study areas showing selected Counties surveyed in Kenya.
Source: Field Survey (2019).

fish farming households in the current study are summarized in Table 1. As observed, a total of 292 fish farmers were interviewed, of whom 81% were male. On average, few women (19%) engaged in fish farming, suggesting a gender gap between male and female-headed households. The findings confirmed the observations by Githukia et al. (2020) that fish farming in Kenya is mainly male-dominated. However, on a county analysis (Table 2), only Kwale County was having more female fish farmers than their male counterparts. Women and men in the same household are typified by unequal power relations leaving women with inadequate decision-making power. This affects control over aquacultural assets, capacity building opportunities, formal financial services, inputs, and produce, leading to low productivity.

The mean age of fish farmers was 50.6 years (SD = 13.21), with the youngest farmer being 19 years and the oldest 90 years (Table 3). The study showed that youth participation is relatively low. However, their contribution to the aquaculture sector can be improved. A general perception that perpetuates their general reluctance to participate in the subsector is that fish farming is unprofitable and unattractive and less desirable by individuals with higher education levels. To attract more youth that are qualified, capacity building and business financing will be critical for ensuring entrepreneurship to drive the subsector forward, generating rural jobs and increasing income.

The study further found that 76% of the farmers had attained secondary education and post-secondary

Table 1. Socio-demographic characteristics of fish farmers.

Variable		Proportion (%)
Gender	Male	81 (237)
	Female	19 (55)
Age	> 20	1 (3)
	21-30	7 (20)
	31-40	18 (53)
	41-50	26 (76)
	51-60	21 (62)
	>61	26 (76)
Education	No school	3 (10)
	Primary	21 (60)
	Secondary	42 (123)
	Diploma	16 (47)
	University	18 (51)
Extension officer awareness	Yes	91 (266)
	No	9 (26)
Frequency of extension officer farm visit	Once a Week	10.5 (30)
	Every 2 weeks	12.5 (36)
	Monthly	48.1 (138)
	Biannually	14.3 (41)
	Annually	5.9 (17)
	Never	8.7 (25)

*Values in brackets indicate proportion to total sample
Source: Field survey, (2019).

Table 2. County * Gender of fish farmers Cross tabulation.

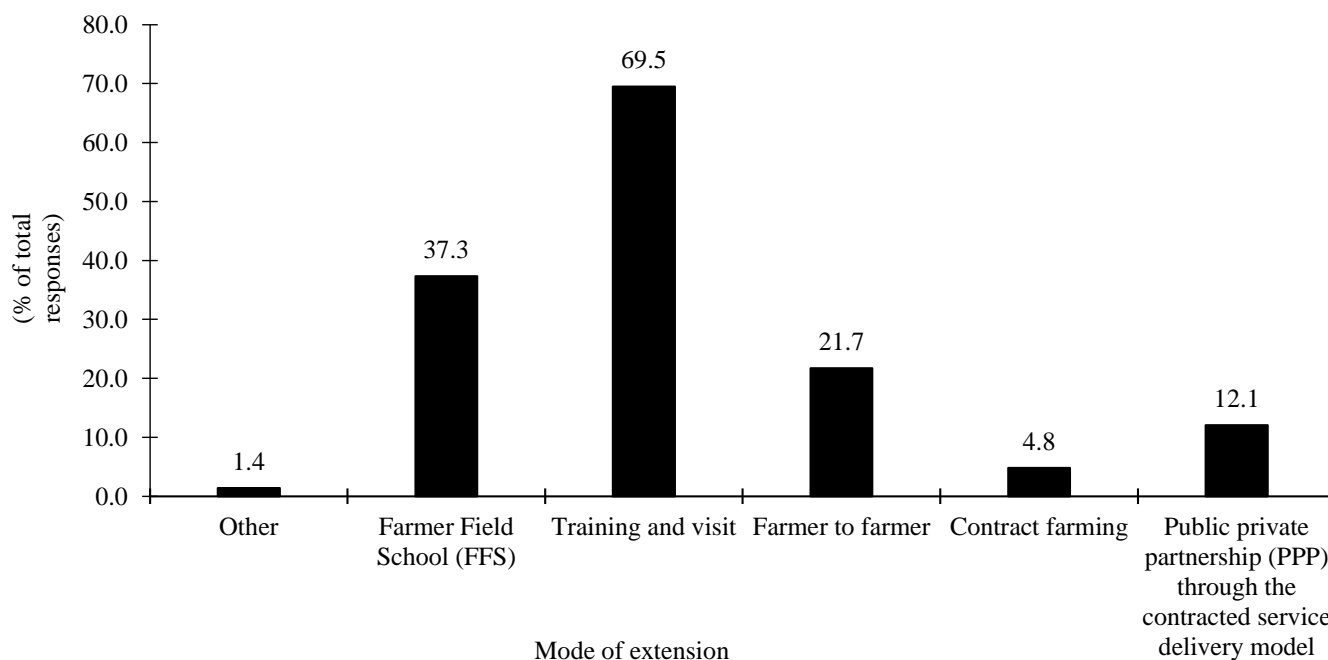
	Gender of respondent		Total
	Male	Female	
Busia	2	0	2
Homabay	13	6	19
Kakamega	11	2	13
Kiambu	12	3	15
Kilifi	17	8	25
Kirinyaga	25	5	30
Kisii	13	5	18
Kisumu	21	1	22
County Kwale	1	3	4
Laikipia	5	0	5
Meru	23	3	26
Migori	15	2	17
Muranga	11	4	15
Nyamira	14	1	15
Nyeri	24	6	30
Siaya	13	1	14
Vihiga	17	5	22
Total	237	55	292

Source: Field survey (2019).

Table 3. Farmers' Age distribution.

	N	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
Age	292	19	90	50.6	13.207	-0.027	-0.563

Source: Field survey (2019).

**Figure 2.** Mode of contact with extension officers surveyed in different counties in Kenya.

Source: Field survey (2019).

education. Only 3% of the respondents did not have any formal training. This implies that the literacy level of fish farmers in Kenya is high, giving a better understanding of the information relayed by the extension service. Educated farmers can better process information and adopt new technologies, innovations, and management practices more rapidly than their less-educated counterparts. Similar to previous findings by Githukia et al. (2020) who posit that education is thought to create a favorable mental attitude for the acceptance of innovations and comprehension of basic extension service information on fish production and marketing. Beyond formal education, fish farmers also need a range of entrepreneurial skills to make well-informed investment choices for increased production and profitability (Koge et al., 2018). In this study, 91% of the farmers reported that they were aware of the extension officer within their area, but the frequency of contact was mainly monthly. The interviewed farmers gave various reasons for perceiving extension officers as being important, key among them were (i) provision of advice on fish farming (46.7%); (ii) transfer of technology (23.3%); and (iii) dissemination of information (21.6%).

There was a statistically significant association between farmers' awareness of extension officers in their areas and frequency of visits by the extension officer ($\chi^2 = 84.37$; $df = 10$; $P = 0.000$). This implies that frequent contact is associated with more awareness of the extension officers. There was also a statistically significant association between frequency of extension officer's visit to the farm and the usefulness of extension services offered ($\chi^2 = 51.59$; $df = 10$; $P = 0.000$). The farming households in the sample reported that the main mode of contact with extension officers is through training and visits (69.5%) (Figure 2). These findings affirm that extension systems based on the training and visit model continue to dominate aquaculture extension in Kenya. Extension officers in Kenya have not fully adopted current and advanced means of accessing and disseminating information. They are still dependent on the traditional dissemination methods that necessitate them to move from place to place.

Farmers' perceptions of extension service

Most fish farmers reported that the quality of the

Table 4. Likert scale indicating attributes of farmer perceptions of extension officers.

Attribute	SD	D	N	A	SA	WAS	Rank
Provides good ideas	10	7	14	153	95	4.13	2
Readily available	10	34	27	129	78	3.83	4
Well prepared	7	22	33	136	80	3.94	3
Has training materials needed	9	70	66	95	38	3.30	5
Has relevant practical skills	5	9	18	134	112	4.22	1

WAS = Weighted Average Score; SD, Strongly Disagree; D, disagree; N, Neutral; A, Agree; SA, Strongly Agree.
Source: Field survey (2019).

extension officer in helping them was either good (50.3%) or excellent (35.6%). Only a few respondents rated the quality of extension officers in helping fish farmers as poor (2.4%) or fair (6.5%). This implies that, while extension is perceived as helpful to farmers, farmers' practices and outcomes vary. The implication is that behaviors, competencies and knowledge of extension workers should be defined and training programs and extension services evaluated over time. In line with these, Obwanga et al. (2017) noted that extension is marred with unscrupulous personnel who have permeated the sector. Implying that extension service should be streamlined by the right quality control measures. From the present study, the main training topics from extension officers include: fish stocking, breeding and harvesting (64%), pond/production system construction and design (63.4%); water quality management (58.2%), pond fertilization and liming (55.8%); record-keeping and financial management (45.2%). However, cooperative group formation and management are less tackled by extension officers during training (27.1%). Upon rating the five attributes indicating farmers' perception of extension officers, extension officers possessing relevant practical skills was rated most highly, with an average weighted score of 4.22 (Table 4). Extension officers possessing the needed training materials ranked the least with an average weighted score of 3.30. Ideally, more illustrations are ideal for farmers, but the emphasis should be on technology rather than memorization.

It was observed that 93.1% of the farmers preferred public-private extension than private extension (6.9%). This corroborates the aquaculture key informants' proposition that a mix of a private and public extension would be ideal in increasing fish production in the country. The study found that fish farmers preferred a mixed method of getting information regarding fish production/fish farming. 71.6% of the farmers reported a preference for individual farm visits, 53.4% for extension farmers' meeting and 28.4% for agricultural shows/trade fairs. Few farmers preferred print media (7.9%), more preferred mass media (13.4%), Information and Communication Technology (ICT) (19.5%) and social media (19.5%). ICT's role in service delivery and its impact is undeniable. In the recent past, Kenya has been

focusing on transitioning into a knowledge-based economy, and the government has equally identified ICT as a key enabler in the achievement of Vision 2030 economic development goals (The Public Sector ICT Report, 2016). In that regard, extension officers will need the latest knowledge and skill in utilizing modern technologies such as the internet, computers, and multimedia. In the present study, 44.8% of the farmers reported the impacts of the new knowledge and skills acquired from extension services resulted in improved productivity/yield. These results imply that at least some contact with extension officers was important for increasing fish production.

Socio-demographic characteristics of extension officers

In general, the extension service sector is male-dominated. There were more males (82.1%) and limited number of female officers in general (17.9%). There are several challenges to recruiting and retaining women mostly attributable to fewer women in agricultural research, reluctance to relocate if married or due to inadequacy of medical and housing allowances, or due to cultural restrictions deterring their mobility. In the study, all extension officers had attained secondary education and post-secondary education. Diploma level dominated and higher college levels were present. Table 5 summarizes the demographic characteristics and other factors of extension officers.

There was a statistically significant association ($P < 0.05$) of adoption of aquaculture technologies and frequency of contact with farmers ($\chi^2 = 4.331$; $df = 1$; $P = 0.037$). Implying that frequency of extension contact is crucial in influencing aquaculture technology adoption. Similarly, there was a statistically significant association ($P < 0.05$) of skills and knowledge enhancement programs and on-job training attendance ($\chi^2 = 19.56$; $df = 1$; $P = 0.000$), implying that attending more on job training results in skills and knowledge enhancement. Well-informed extension agents can discuss novel technologies with farmers and thereby influence farmers' decisions about adoption. Therefore, it is vital to provide training of trainers

Table 5. Socio-demographic characteristics of extension officers in Kenya.

Socioeconomic variables		Proportion (%)
Gender	Male	82 (46)
	Female	18 (10)
Education	Secondary	7 (4)
	Certificate	20 (11)
	Diploma	41 (23)
	University	23 (13)
	Postgraduate	9 (5)
Area of study in College	Livestock/Veterinary Science	7 (4)
	Fisheries and Aquaculture	48 (27)
	Agricultural Education and Extension	5 (3)
	General Agriculture	14 (8)
	General Biology	9 (5)
	Natural Resource Management	4 (2)
Employer	Other specify	13 (7)
	County government	20 (11)
Promotion in the last 6 years	Seconded from National Government	80 (45)
	Yes	54 (30)
Frequency of Extension Officer Farm Visit	No	46 (26)
	Once a Week	54 (30)
	Every 2 weeks	21 (12)
	Monthly	18 (10)
	Biannually	5 (3)
	Never	2 (1)

*Values in brackets indicate proportion to total sample.
Source: Field survey (2019).

(ToT) training opportunities in niche areas such as those offered by development programs like the Kenya Climate Smart Agriculture Project (KCSAP) and International Fund for Agricultural Development (IFAD) to counties as part of efforts to promote increased adoption of new TIMPs by farmers. There was also a statistically significant association ($P < 0.05$) of adopting aquaculture technologies by farmers and extension officers' highest education level ($\chi^2 = 3.988$; df 1; $P = 0.046$) implying that educated extension officers can process and disseminate information better leading to rapid adoption of new Technologies, Innovations, and best Management Practices (TIMPs) than their less-educated counterparts. Besides, Kumar et al. (2018) documents that extension support reduces the complexities associated with aquaculture technology.

Challenges faced by extension officers

Extension officers face several inherent problems that deprive fish farmers of the much-needed technical services, including but not limited to insufficient facilitation

in terms of transport and equipment (52%), inadequate training (14%), and inadequate staff (12%) (Figure 3). Obwanga et al. (2017) noted that the Kenyan aquaculture sector continue to suffer the challenges of acute shortage of human capacity, an area requiring urgent attention. Therefore, changes in government led aquaculture research, and useful extension service will be ineffective in strengthening the capacity of fish farmers unless they are attached to substantial changes in financing and infrastructural investment. While the government may be constrained in handling extension services, it may need to identify innovative pathways to address the issue of adequate financing. Furthermore, leveraging on collaborative public private partnerships could bring novel insights in investment and capacity building.

CONCLUSION AND RECOMMENDATIONS

This paper examined the aquaculture extension service

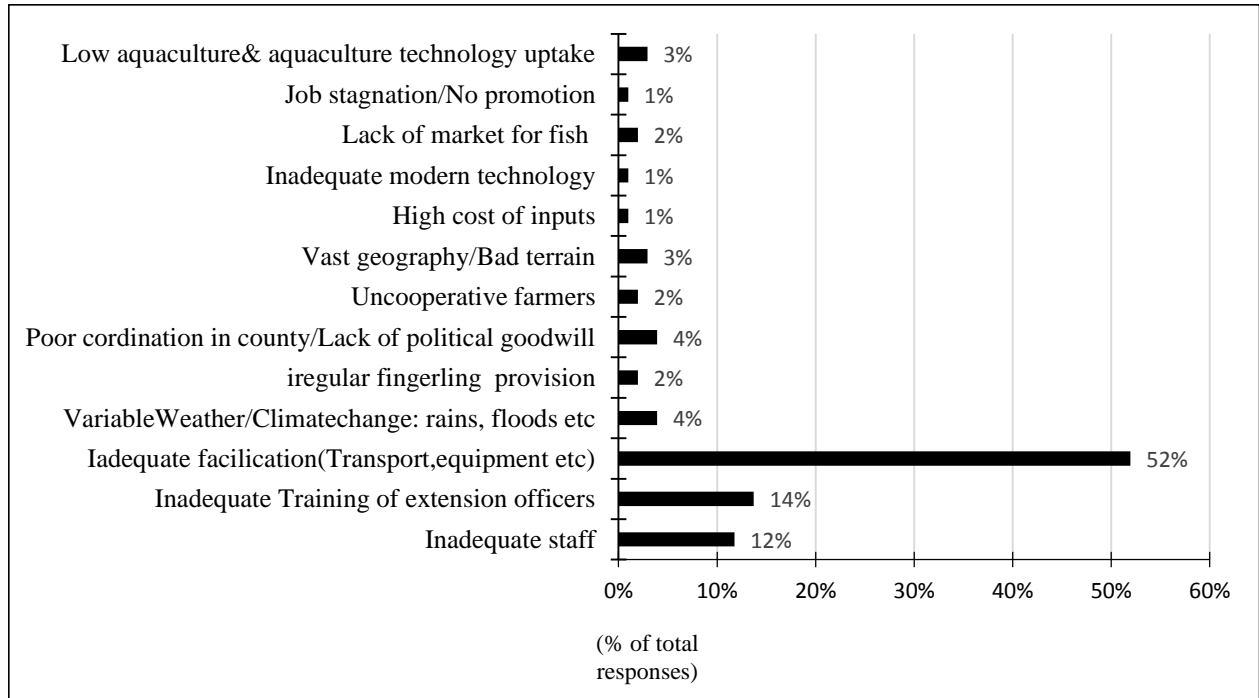


Figure 3. Challenges faced in service delivery by extension officers in Kenya.
Source: Field survey (2019).

in Kenya based on farmers and extension officers' perspectives. It provides some insight and additional empirical evidences into aquaculture extension service provision, particularly in Kenya's rural settings. Results indicated that on average, female participation among fish farming households and extension officers was lower compared to male counterparts in both categories. For aquaculture to significantly impact people's livelihoods, the assurance of male and female participation is inevitable. Therefore, enabling women fish farmers to have more access to factors of production and eliminating discriminatory social norms that hinder optimum participation will increase aquaculture productivity and enhance development outcomes and social well-being of women, their households, communities, and the nation at large. There will be a need for gender-specific incentives, modified recruitment criteria, and leadership training to have more female participation in extension service delivery. No single strategy is likely to produce the desired results instead, a combination and integration of strategies may be needed to attract and retain women to the profession, beginning at the tertiary education levels. Other results indicate that extension is perceived as being helpful to farmers. However, practices and outcomes vary among farmers. This calls for extension officers to ensure the right approach to ensure farmers adopt TIMPs in increasing production outcomes equally. Farmers may be confused by too many trainers. It is, therefore essential to streamline extension and advisory

services to prevent farmers from having varying opinions. It has also been demonstrated that farmer literacy is relatively high. Still, beyond formal education fish, farmers will also need a range of entrepreneurship skills to make well-informed investment choices for increased production and profitability.

The results further show that the training and visit model continues to dominate aquaculture extension. Therefore, there is a need for capacity building in modern fish farming technologies and the adoption of recent technologies in information dissemination. The study reveals that few farmers prefer Mass Media, ICT, and Social Media. However, to make information transfer more effective, greater use of modern information technology and communication among researchers, extension officers and fish farmers will be required. ICT is a significant contributor to extending the reach of extension services into remote locations-where the networks exist-and to diverse populations. Besides, extension officers possessing the needed training materials ranked the least. What farmers need to know, though, is that general extension materials have limited usefulness for extension. More illustrations with an emphasis on adoption of environmentally friendly technology rather than memorization can improve internalization of TIMPs.

The results demonstrate that the challenges that extension officers face are not new. This is evidence that changes in government led aquaculture research and extension service will be ineffective unless they are

attached to substantial changes in financing. A mix of a private and public extension service would also suffice more so due to the inadequate staff facilitation. Staff professional development should also be given the highest priority by on-job trainings and capacity building to enhance their professional knowledge. It is recommended that the Ministry Responsible for Fisheries, Aquaculture and the Blue Economy to facilitate training and internships for extension service providers to enhance practical skills and experience on emerging aquaculture technologies and establish a training programme to support continual professional development of extension service providers by applying gender responsive and affirmative action strategies. The National and County Governments to enhance opportunities for attachment and internships for Certificate, Diploma and Degree holders to acquire practical skills and experience before employment as extension service providers. Finally, higher learning and vocational training institutions to develop partnership arrangements to offer joint programs to employees in the fisheries and aquaculture sector to sharpen their skills through Continuous Professional Development Courses (CPDC).

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Ethical statement

This article does not contain any studies with animals performed by any of the authors.

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