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FISH AND FISH PRODUCTS CONSUMPTION BEHAVIOURS AND ATTITUDES OF FARMERS IN WESTERN KENYA

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ABSTRACT

Fish and fish products contain high-quality protein of animal origin with essential bioavailable micronutrients such as iron, zinc, vitamins and omega-3 fatty acids. Although fish contribute to food and nutrition security, fish consumption per capita in Kenya is lower than Africa's and the world's average annual per capita consumptions. This study assessed fish farmers' attitudes and consumption behaviours for fish and value-added fish products in three Counties in Western Kenya. A cross-sectional study involving a mixed-method approach applying qualitative and quantitative techniques was used to collect data from one hundred and thirty-eight women with children aged 6 to 59 months. Participants were selected from a random sample of registered fish farmer groups representing vulnerable, marginalized and common interest groups within the study areas. Overall, most households consume fish as their main source of protein with the Nile tilapia being the most preferred fish species. A majority (64%) of the farmers had positive attitudes towards fish consumption and were interested in incorporating value-added fish products into their daily diets. In addition, availability of value-added fish products, knowledge of the existence of these products, skills in preparation and cooking, and socio-economic factors influenced consumption. The farmer's age ([Adjusted odds ratio, AOR = 2.83], [95% CI: 1.23-6.52], p = 0.014), marital status ([AOR = 7.31], [95% CI: 1.51-35.4], p = 0.014), monthly income ([AOR = 1.33], [95% CI: 0.13-0.83], p = 0.019) and occupation of the household head ([AOR = 5.06, [95% CI: 2.06-12.4], p<0.001) were positively associated with consumption of value-added fish products. However, education level ([AOR = 1.84, [95% CI: 0.17-20.0], p = 0.617) was not associated with consumption of value-added fish products. Fish consumption patterns such as frequency and portion sizes significantly improved in the fish farmer households after they began fish farming. Furthermore, few farmers consumed value-added fish products due to low availability, lack of awareness and inadequate skills for preparation and cooking. In conclusion, awareness creation campaigns on fish value addition, nutrition education and behaviour change communication aimed at modifying nutrition behaviours are necessary to increase fish consumption, improve knowledge and skills, and ensure the availability of value-added fish products during all seasons.

Key words: Value-added fish products, fish consumption patterns, fish consumption behaviours

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INTRODUCTION

Globally, fish consumption rates are growing faster than the global population because of increased incomes and awareness of the health benefits associated with consuming fish and fish products [1]. Global fish production was about 179 million tonnes in 2018, with aquaculture accounting for 46% of the total production; 52% of the fish production was for direct human consumption [2]. Particularly in developing countries, aquaculture has an important role in providing food, rural livelihoods, and incomes in developing countries [3]. For example, fish, including finfish and shellfish, contribute 17% of animal protein, and 7% of all proteins globally [4]. Fish provides a well-balanced, relatively high amount of essential amino acids, docosahexaenoic and eicosapentaenoic omega-3 fatty acids and essential minerals (especially iron and zinc) and vitamins, often in highly bioavailable forms [5, 6]. As such, fish is regarded as "nature's superfood" by FAO [7]. Additionally, fisheries and aquaculture create economic value through the production, trade and marketing of wild and farmed fish [8, 9].

In most sub-Saharan Africa countries, challenges such as increased populations, food insecurity and malnutrition have justified the urgency to develop the aquaculture sector [10]. The highest proportion of the world's undernourished people (25% or 224 million people) in 2016 were from sub-Saharan Africa [11]. In Kenya, the national level of stunted, underweight and wasted children is at 26, 11 and 4%, respectively [12], whereas 9% of women aged 15 to 49 years are underweight [13]. Consumption of poor-quality diets and lack of access to food diversity are the major predisposing factors for child and maternal malnutrition [14, 15]. However, supplementing diets with protein and micronutrients from fish has the potential to reduce the prevalence of malnutrition [16]. In many developing countries, small-scale aquaculture has been recognised as a pathway to improve households' calorie intake and increase dietary diversity and the quality of diets, thereby improving nutritional status and helping obtain food security at the household level [17]. Thus, the consumption of fish is a good practice as it contributes to dietary diversity [18] in addition to being a low-cost source of protein for low-income and subsistence households [19].

Due to significant growth in fisheries and aquaculture production, the world's annual per capita fish consumption increased from an average of 9.9 kg in the 1960s to 20 kg in 2015 [20]. Nonetheless, this increase has not been uniform across all regions of the world. For example, despite the high dependence on fish as a source of animal protein in developed and developing regions, sub-Saharan African has the lowest levels of per capita fish consumption [11]. Kenya is an

emerging economy with socio-economically important freshwater fisheries and ongoing food security concerns [21]. Despite the efforts of Kenyan government and other development partners such as USAID and the Collaborative Research Support Program (CRSP) to promote fish production and consumption [22], the country's annual per capita fish consumption declined from 6 to 4.5 kg between 2000 and 2011 [20]. This could be attributed to high fish prices, limited preparation and cooking skills, sensory factors like taste and smell, and consumers' attitudes [23, 24]. Yet, the attitude and consumption behaviours of fish and fish products among farmers in Western Kenya have received little research attention, partly because the existing literature on fisheries and aquaculture development in Kenya indicates a strong focus on fish production at the expense of consumption [25]. Due to the food and nutritional security issues and widespread malnutrition and micronutrient deficiencies, understanding fish farmers' behaviour and attitudes might be beneficial for sustaining domestic food security and livelihoods in Kenya.

MATERIALS AND METHODS

Sample size and sampling procedures

A cross-sectional study was designed and carried out to collect data from selected fish farmer groups participating in the Kenya Climate Smart Agriculture Project (KCSAP). KCSAP targets three Counties, namely Kakamega, Siaya and Busia. Within these Counties, this study targeted wards where aquaculture value chain (AVC) technologies, innovations, and management practices (TIMP) are being validated [26]. A mixed-method of qualitative and quantitative approaches was used to collect data from the selected fish farmer groups. The farmers were selected based on the KCSAP criteria of targeting vulnerable and marginalized groups as primary beneficiaries of project interventions [26]. Focus group discussions of 8 to 12 members and key informant interviews among County fisheries officers, farmer group leaders and lead farmers were done to obtain qualitative data. The group members identified for interviews were those who could provide information on the subject matter and could best inform the research questions and enhance understanding of fish consumption behaviours in the target communities. A trained facilitator used an interview guide to direct the interviews and discussions, and the notes were recorded by a trained documenter. The quantitative study was undertaken in July 2020; a structured household questionnaire was used to collect data on household socio-demographic characteristics, household sources of income, the proportion of household income dependent on aquaculture, how incomes emanating from fish farming was utilised, consumption patterns for fish and fish products, fish preparation, and attitudes towards fish consumption. The trained field enumerators interviewed the study

participants using the Open Data Kit (ODK), an open-source application installed on Android phones [27].

Data analysis and ethical considerations

All data were validated for accuracy and entered into the IBM Statistical Package for Social Sciences (SPSS) Statistics, version 20 [28] and analysed using both descriptive and inferential statistics. Data on most of the above-outlined parameters (socio-demographic characteristics, etc.) were expressed in percentages. The chi-square test was used to compare categorical variables, while one-way analysis of variance (ANOVA) was used to compare County differences for the variables of interest. For the attitude section, the respondents were presented with 10 statements to which they could respond with one of five option: strongly agree, agree, neutral, disagree or strongly disagree. These were scored 5, 4, 3, 2 and 1, respectively. Consequently, the maximum total attitude score for the 10 statements was 50 and the minimum score was 10. Farmers with attitude scores of 80% and above were grouped as having a positive attitude, while those with 79% and below were considered as having a negative attitude [29, 30]. Binary logistic regression was used to determine the association between variables of interest and $p<0.05$ was considered statistically significant. The qualitative data were analysed using the thematic content analysis method by identifying similarities, differences and trends between the individuals and group responses [31]. The study also followed ethical criteria outlined for human research surveys [32]. The relevant County government departments, through the Director of Agriculture, Livestock and Fisheries and the Director of Health and Sanitation, authorised the data collection.

RESULTS AND DISCUSSION

Socio-demographic characteristics of the study population

A total of 138 participants were interviewed in the three Counties (Busia 61, Kakamega 36 and Siaya 41). The majority (88.4%) of the households were headed by males most of whom (62.3%) were more than 35 years old. More than three quarters (84.1%) of the respondents were married, a figure that is much higher than the national figure of 60% [12]. The main occupation of heads of households was fish farming (56.5%). Nearly all (98.6%) of the respondents were of the Christian faith and the majority (95.7%) had some formal education (Table 1). In addition, most households relied on small-scale fish production, both as a source of fish for household consumption and market sales. Almost one third (29.5%) of the households from Busia County obtained most of their income from fish farming or capture fisheries in the past year (compared to 22% for Siaya and only 8.3% for

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Kakamega Counties, Figure 1). Less than a third of the farmers confirmed that fish farming was their only source of income, with a significant difference ($\chi^2 = 7.069$, $p = 0.029$) among the three Counties. At 12.4%, Busia County had the highest proportion of households reporting that they relied on fish farming as their only source of income, followed by Siaya (6.5%) and Kakamega (1.4%). Thus, upscaling climate-smart fish culture technologies and modern marketing tools that are relevant for sustainable aquaculture production and marketing are needed in Western Kenya [33, 34].

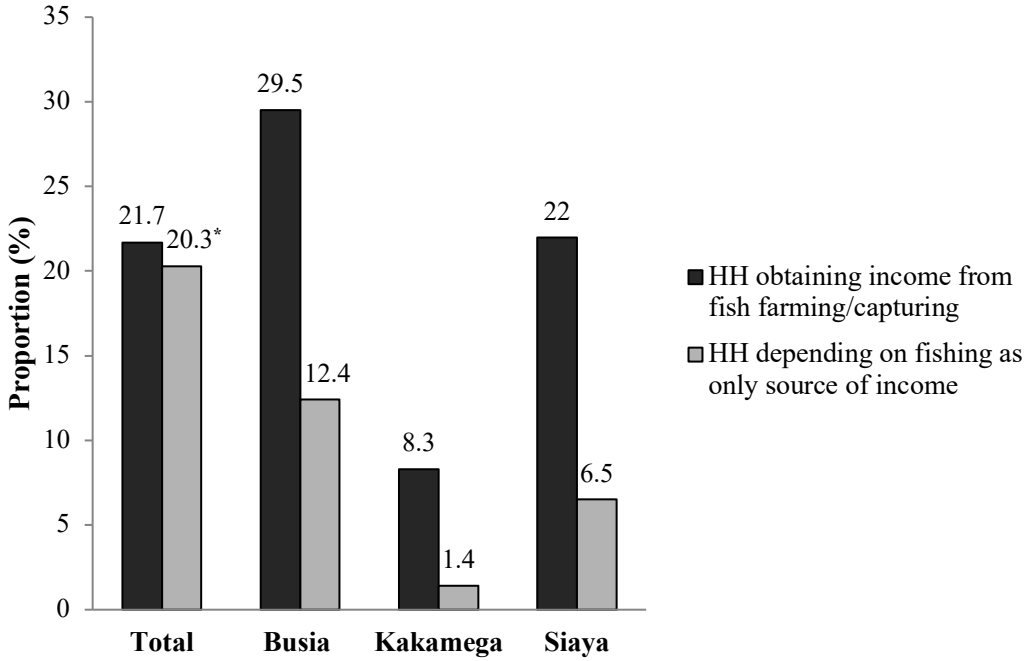

Figure 1: Proportion of households obtaining income from fish farming/capturing and households depending on fishing as their only source of income

P<0.05 significant using the χ^2 test

Household fish production and utilization of income from fish farming

Table 2 shows fish production and how the income from fishing was spent. Out of the 138 households interviewed in the three Counties, 92% reported that they were currently producing fish (n = 128), 62.3% of them were producing fish for both consumption and sale whereas 26.8% were producing for consumption only. The majority of the fish farmers from Busia County (70.5%) produced fish for sale and consumption, followed by Siaya (68.3%) then Kakamega (41.7%). Readily available markets both at the farm gate, where individual farmers sell fish directly to individual consumers, and at the local markets may be a motivating factor for the farmers in Busia to sell most of their fish. Given the positive projections for the contribution of fish to protein intake in Kenya and the potential to improve dietary

quality [35], it is important to educate the farmers on the importance of consuming the fish they produce. Furthermore, a large proportion of households (79%) obtain a monthly income of less than Ksh. 5,000 (about US$50) from fish production. Notably, both partners (husband and wife) jointly make most of the household's decisions on the utilisation of income from fish farming, which include buying food (84.1%) and paying school fees (42%). Most of these households who made joint decisions were from Kakamega (58.3%), followed by Busia (29.5%) and Siaya Counties (17.1%). The results suggested that there was a need to sensitize and train the farmers on how to prioritize the income obtained from fish farming to purchase more nutritious foods to improve nutrition outcomes for women and children.

Fish consumption patterns and preparation methods in fish farming households

As shown in Table 3a, fish consumption patterns in the three Counties were different ($p<0.01$) with most households in Busia County reporting fish as their main source of protein (45.9%) while silver cyprinid (*Rastrineobola argentea*), locally and popularly known as *omena* both in three study Counties and nationally, was the main source of protein in Siaya (53.7%). Fish is the main source of protein in Busia due to it having the largest accessible fish market, one that serves both Kenya and Uganda. Thus, fish and fish products are readily available. In Siaya County, omena is the main source of protein possibly because it is sourced directly from Lake Victoria and is thus readily available and relatively cheap compared with other fish species [36]. This suggests the potential of locally available small fish species helping to alleviate micronutrient deficiencies and under-nutrition in young children [37].

In this study, fish provided animal-source protein to a large proportion of farmers because it is easily accessible and affordable to the farmers at the farm gate or from fish markets. According to Ole-MoiYoi [38], in Kenya, wild-caught fish and farmed fish from ponds make up a large proportion of the total protein that is consumed by people from the 'poor' socio-economic classes. Notably, more than half of farmer households in the current study acquired fish for consumption through market purchases. This was due to the long culture period required for fish to mature in the pond and lack of synchronized stocking, i.e. stocking fish at the same time so as to harvest fingerlings at once and ensure availability in all seasons. This latter point—lack of synchronized stocking—was brought out by some participants during FGDs. In 97.8% of the interviewed households, all their members usually consume fish, with only 2.2% adults and 0.7% children not

consuming fish due to allergies, history of illness after fish consumption and nausea.

Nile tilapia (*Oreochromis niloticus)* was the most consumed fish species across the three Counties, with farmers from Siaya County being the highest consumers. Nile tilapia is also the most preferred of the wild and farmed fish species in Kenya [25]. The higher preference for tilapia could be associated with consumers' perception of its taste and health value as well as its large production, contributing to 70% of the total aquaculture production in Kenya [39]. Additionally, cultural tradition and proximity to fishing areas affect fish consumption patterns in Kenya [40]. For instance, catfish was hardly consumed among the study participants due to cultural factors as pointed out by one of the farmers during a FGD that 'catfish looks like a snake; we can't eat it'. Apart from catfish, none of the farmers had any restriction on consuming other fish species, although it was mentioned that some groups such as the Luhya sub-tribe of the Wanga had restrictions due to cultural beliefs. Elsewhere, catfish were also consumed less in urban centres (Nyeri and Nairobi) due to its low availability in these markets [25]. However, a higher preference for catfish than Nile tilapia was reported in Kirinyaga, possibly because catfish is relatively fleshier, easy to fillet, and less bony compared to tilapia.

Fish freshness is an important determinant influencing its consumption. Most farmers (39.9%) reported utilising fresh and whole fish, with significant ($p<0.001$) variations across Counties. The farmers stated that they consider fish freshness, price and size when purchasing fish, and making curry was the most preferred method of preparation (Table 3b). This could be associated with the habit of many Kenyans of eating fish with ugali, a stiff porridge made by mixing corn meal with boiling water. Frying fish was the second most preferred method of preparation, with most households tending to reuse frying oil more than once. This practice, however, is known to cause the oil to undergo a series of chemical reactions that increase free radicals in the oil, which can increase the risk for cardiovascular and other chronic diseases [41]. Thus, it is important to raise public awareness that consumption of repeatedly heated oils is detrimental to health. Furthermore, excessive reuse of frying oil enhances foaming, colour darkening and off-flavours, all of which reduce the acceptability and consumption of fried fish.

Fish consumption patterns

Fish consumption patterns among fish farming households were not different in the three Counties ($p = 0.116$, $\chi2 = 12.977$, Figure 1). A majority (65.2%) of the households consumed three meals a day with no differences across Counties ($p = 0.376$). Consumption of fish at least twice a week is known to improve the health

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outcomes for consumers [42]. In the present study, farmers lacking individual ponds depended solely on group ponds and were likely to consume fish once a year. However, more than half (58%) of the farmer households consume fish more than once a week. The main reasons for the relatively high fish consumption were fish availability and the knowledge of its nutritional benefits that include it being a good source of protein, iron, and omega-3 fatty acids. During FGDs, some of the farmers cited that fish has medicinal value such as protection against infections like the common cold. One FGD respondent said, *"Fish can be easily chewed and digested by children, it makes people intelligent, and it's safe meat choice because meat from livestock is exposed to a lot of drugs."* It is possible that government campaigns through the Economic Stimulus Programme or 'Eat more fish' campaigns, media advertisements, County nutritionists and family and community members' efforts to promote the nutritional and health benefits of eating fish may have enhanced positive attitude towards fish consumption in these communities. Indeed, subsistence fishers and their families consume substantial quantities of fish, making it the main source of protein in their diet [43].

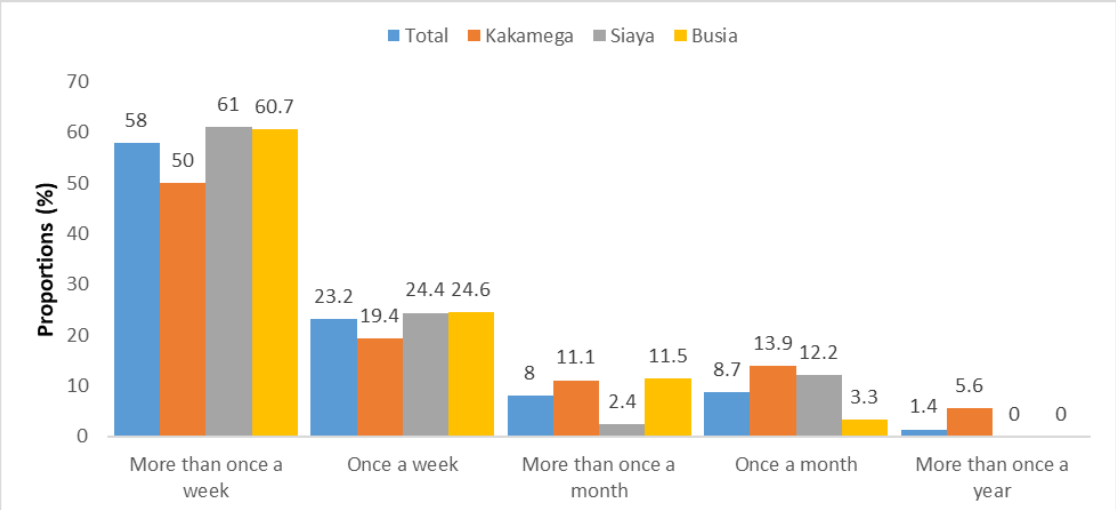

Figure 2: Household fish consumption patterns among fish farming households in Kakamega, Siaya and Busia Counties. *p<0.05 significant using the χ^2 test

Attitudes toward fish consumption

The understanding of consumer perceptions, attitudes and purchasing power is of importance for behavioural change to improve diet quality. Some cultural beliefs, practices and poor knowledge of the health benefits of fish consumption have been associated with no or few households consuming fish twice a week [44]. In the present study, more than half (63.8%) of the farmers had positive attitudes towards fish consumption (Table 4b), suggesting the potential for the success of

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community-based participatory interventions to improve nutrition outcomes for women and children. Almost all (97.7%) respondents from the three Counties reported that their family members thought they should consume fish (Table 4a).

Fish consumption patterns changed significantly in the fish-farmer households since the households began fish farming. Fish farming has increased not only the frequency of fish consumption but also the portion sizes of fish consumed by the household members. For instance, one FGD participant said, *"During the harvest period, consumption of fish in my house increases to 2-3 times a week."* Another one stated, *"Before we started fish farming, I used to eat fish only when I had a visitor, but now I eat fish more frequently."* These results suggested that as fish production increased in these communities, households' fish consumption patterns improved as well. Nguka *et al.* [45] also reported that fish farming had a positive and significant influence on the number of meals eaten per day among fish farmers.

Consumption of value-added fish products

Fish is a very perishable food commodity that requires proper handling and preservation to increase its shelf-life and retain its quality and nutritional attributes. Many small-scale farmers lack access to cold-rooms yet value-addition of fish — for example in the forms of preservation and processing — could provide a better alternative for them to retain fish quality for longer. Value-addition reduces post-harvest losses, increases the shelf-life of the fish product and leads to a sustainable supply even during the off-season [25]. More than two-thirds (68.1%) of farmers in this study do not consume value-added fish products such as samosas, fish fingers, fish balls and fish fillets because these products are not available, farmers lack knowledge about the existence of such products and poor preparation and cooking skills. Kyule *et al.* [46] reported similar results where more than half of their respondents consumed value-added fish products for the first time during market trials in Kirinyaga and Meru Counties. In the present study, few farmers ever prepared or consumed value-added fish products; the majority have not consumed such products due to inadequate skills on how to prepare and cook them. On the other hand, the majority of farmers were interested in incorporating value-added fish products into their daily diets, including feeding their babies on them (Table 5a). It was evident that farmers desired different forms of value-added fish products, but their desires were restricted by the lack of availability of fish products and limited preparation and cooking skills. Consumers who place an importance on the attractiveness of a particular commodity are more likely to choose fish products over the whole fish [47]. In view of this, improving consumers' skills on how to prepare value-added fish products and improving the market

performance of all fish species — through value-addition, for example — will not only improve food security but also the health and nutrition status of consumers. According to Githukia *et al.* [25], women mostly participated in the peripheral parts of the fish value chain such as post-harvest processing, marketing and trading. Therefore, their participation in small-scale fisheries and the production of value-added fish products could lead to their empowerment, with greater control over income resulting in purchasing and consuming nutritious foods and lead to the improvement of the health care for children, and thus improved nutrition outcomes [17].

Furthermore, the availability of value-added fish products, knowledge of the existence of such products, skills to prepare and cook them and socio-economic factors influenced consumption (Table 5b). An important result from the study was that the older farmers (>35 years) were twice as likely to consume value-added fish products as the younger ones ([AOR = 2.83], [95% CI: 1.23- 6.52, p = 0.014). Older farmers could be more cautious about health complications that come with age, and they might be consuming more fish and fish products to delay the onset or reduce the severity of old-age-related health complications. Fish and fish products contain omega-3 fatty acids which help to alleviate some of the symptoms of rheumatoid arthritis, with beneficial effects on swollen and tender joints, grip strength and mobility in older people [47]. Marital status was also found to have a significant positive influence on the consumption of value-added fish products (AOR=7.31, [95% CI: 1.51- 35.4], p = 0.014]. Interestingly, married farmers were seven times more likely to consume value-added fish products than those who are were not married (single or widowed). A plausible explanation is that living together with a spouse might help with pooling resources thus improving household income while unmarried or divorced farmers may have less income, which influences household food choices. These results agree with Bakre *et al.* [48] who reported a reduced odds of fish consumption among the 'never married or divorced' individuals. Moreover, a positive relationship was observed between household monthly income and the consumption of value-added fish products (AOR = 1.33, [95% CI: 0.127-0.834], p = 0.019). Notably, an increase in household income led to an increase in the consumption of fish products. Farmers with a higher monthly income may enjoy meal preparation less and they are more likely to buy the more convenient value-added fish products that require no or less preparation. Value-added fish products are also likely to be relatively expensive because the convenience they deliver comes at an extra cost, thereby limiting the purchasing power of farmers with less monthly income. This study also showed that the participation of the household head in fish farming as the main occupation contributed to more consumption of value-added fish products in their household

than those whose head engaged in other occupations ([AOR = 5.06, [95% CI: 2.06-12.4], p<0.001]). This suggested that fish and fish product consumption was regular in households involved in fish farming, similar to the results reported by Nguka *et al.* [45]. Fish farmers may have the perception that farm-reared fish are free of diseases, pesticides and other harmful toxicants, and are more readily accessible to their households.

CONCLUSION

Fish consumption patterns significantly improved in the fish farming households since the households began fish farming. However, only a few of them consumed value-added fish products due to low availability, lack of awareness and inadequate preparation and cooking skills. Development of value-added products from low-value, small fish species should be promoted. Women's self-help groups could be encouraged to engage in income-generating aquaculture activities such as the preparation of value-added fish products and their marketing. Campaigns to create awareness about fish value addition and participatory cooking training courses should be beneficial in increasing fish consumption, improving knowledge and skills and ensuring a continuous supply of fish products even during off-seasons. Nutrition education and social behaviour change communication are also needed to ensure that the fish produced is consumed at the household level and the income obtained from fish farming is used to purchase other locally available nutritious foods to improve diet quality.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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Table 1: Socio-demographic characteristics of the study population

Socio-demographic factors	Total (n=138)		Kakamega (n=36)		Siaya (n=41)		Busia (n=61)		p-value* χ^2 value
	n	%	n	%	n	%	n	%	
Head of Household (HH)									0.031*
Male	122	88.4	32	88.9	32	78	58	95.1	6.951
Female	16	11.6	4	11.1	9	22	3	4.9	
Marital status									0.037*
Married	116	84.1	34	94.4	30	73.2	52	85.2	6.589
Not Married	22	15.9	2	5.6	11	26.8	9	14.8	
Occupation of HH									
Fish farmer	78	56.5	16	44.4	23	56.1	39	63.9	0.173
Not a fish farmer	60	43.5	20	55.6	18	43.9	22	36.1	3.504
Religion of HH									
Christian	136	98.6	34	94.4	41	100	61	100	0.056
Muslim	2	1.4	2	5.6	0	0	0	0	5.750
Age of HH									
≤35 Years	52	37.7	8	28.2	18	43.9	26	42.6	0.083
>35 Years	86	62.3	28	77.8	23	56.1	35	57.4	4.974
Education									
Educated	132	95.7	34	94.4	40	97.6	58	95.1	0.533
Not educated	6	4.3	2	5.6	1	2.4	3	4.9	0.766

*$p<0.05$ significant using the χ^2 test

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Table 2: Household fish production, income and decisions on how to spend income from fish farming in the three Counties

	Total (n= 138)		Kakamega (n=36)		Siaya (n=41)		Busia (n=61)		P value χ^2 value
	n	%	N	%	n	%	n	%	
Purpose of fish production									
Sale and consumption	86	62.3	15	41.7	28	68.3	43	70.5	0.001*
Consumption only	37	26.8	18	50	7	17.1	12	19.7	25.29
Sale only	5	3.6	0	0	0	0	5	8.2	
Income from fish									
<Ksh. 5,000	109	79	33	91.7	29	70.9	47	77	0.149
Ksh. 5001-10,000	22	15.9	2	5.6	7	17.1	13	21.3	12.06
Ksh. 10,001-20,000	3	2.2	0	0	2	4.9	1	1.6	
Ksh. 20,001-50,000	3	2.2	1	2.8	2	4.9	0	0	
> Ksh. 100,000	1	0.7	0	0	1	2.4	0	0	
How income from fish is spent									
Invest back in aquaculture	22	15.9	4	11.1	10	24.4	8	13.1	0.204 3.175
Pay school fees	58	42	19	52.9	17	41.5	22	36.1	0.272 2.603
Buy foodstuff	116	84.1	28	77.8	37	90.2	51	83.6	0.326 2.240
Payback loans	7	5.1	5	13.9	0	0	2	3.3	0.015* 8.410
Others†	18	13	3	8.3	9	22	6	9.8	0.127 4.126
Decisions on how income from fish farming is spent									
Both my spouse and I	46	33.3	21	58.3	7	17.1	18	29.5	0.001*
Myself	38	27.5	10	27.8	19	46.3	9	14.8	30.40
My spouse	34	24.6	3	8.3	8	19.5	23	37.7	
Other family members	20	14.5	2	5.6	7	17.1	11	18	

*p<0.05 significant using the χ^2 test. †Includes investing in other business, clothing, rent, and medication

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Table 3a: Fish consumption patterns in fish farming households in Kakamega, Siaya and Busia Counties

	Total (n=138)		Kakamega (n=36)		Siaya (n=41)		Busia (n=61)		P value χ^2 value
	n	%	n	%	n	%	n	%	
Main protein source									
Beans	31	22.5	21	58.3	5	12.2	5	8.2	0.001*
Chicken	3	2.2	3	8.3	0	0	0	0	52.36
Fish†	46	33.3	5	13.9	13	31.7	28	45.9	
Meat	5	3.6	0	0	1	2.4	4	6.6	
Omena	53	33.4	7	19.4	22	53.7	24	39.3	
Consuming fish	135	97.8	34	94.4	40	97.6	61	100	0.192
									3.305
Not consuming fish									
Children	1	0.7	1	2.8	0	0	0	0	0.240
									2.854
Adults	3	2.2	2	5.6	1	2.4	0	0	0.192
									3.305
Reasons for not consuming fish									
Allergic	1	0.7	1	2.8	0	0	0	0	2.31
Got sick last time	1	0.7	0	0	1	2.4	0	0	8.104
Causes nausea	1	0.7	1	2.8	0	0	0	0	
Sources of fish									
Farmed	15	10.9	4	11.1	10	24.4	1	1.6	0.001*
Purchase from market	95	68.8	29	80.6	25	61	41	67.2	23.97
Wild caught and farmed	12	8.7	1	2.8	5	12.2	6	9.8	
Wild caught/captured	16	11.6	2	5.6	1	2.4	13	21.3	
Species of fish mostly consumed									
Catfish	5	3.6	3	8.3	0	0	2	3.3	0.013*
Nile perch	30	21.7	5	13.9	7	17.1	18	29.5	16.23
Nile tilapia	100	72.5	25	69.4	34	82.9	41	67.2	
Form of fish mostly consumed									
Fresh and whole	55	39.9	8	22.2	17	41.5	30	49.2	0.001*
Fried	48	34.8	13	36.1	20	48.8	15	24.6	24.72
Smoked	13	9.4	2	5.6	2	4.9	9	14.8	
Sun dried	22	15.9	13	36.1	2	4.9	7	11.5	
How often the household gets enough fish to eat									
Always	8	5.8	1	2.8	1	2.4	6	9.8	0.188
Most of the times	22	15.9	7	19.4	7	17.1	8	13.1	8.748
Sometimes	68	49.3	13	36.1	21	51.2	34	55.7	
Infrequently	40	29	15	41.7	12	29.3	13	21.3	

*p<0.05 significant using the χ2 test; †Nile tilapia, Nile perch

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Table 3b: Fish preparation methods, fish selection criteria and amount of fish consumed by households in Kakamega, Siaya and Busia Counties

	Total (n=138)		Kakamega (n=36)		Siaya (n=41)		Busia (n=61)		P value χ^2 value
	n	%	n	%	n	%	n	%	
Preparation method									
Boiled	23	16.7	3	8.3	7	17.1	13	21.3	0.069
Curry	81	58.7	18	50	26	63.4	37	60.7	18.45
Fried	34	24.6	15	41.7	8	19.5	11	18	
Number of times oil reused for deep frying									
>3 times	1	0.7	0	0	1	2.4	0	0	0.018*
Thrice	2	1.4	0	0	0	0	2	3.3	18.45
Twice	13	9.4	4	11.1	4	9.8	5	8.2	
Once	18	13	11	30.6	3	7.3	4	6.6	
Factors considered when purchasing fish									
Quality (fresh)	56	40.6	9	25	21	51.2	26	42.6	0.059
									5.654
Affordable	61	44.2	12	33.3	18	43.9	31	50.8	0.246
									2.809
Taste	26	18.8	22	61.1	1	2.4	3	4.9	0.001*
									57.01
Easy to prepare	9	6.5	8	22.2	1	2.4	0	0	0.001*
									19.93
Healthy	22	15.9	13	36.1	0	0	9	14.8	0.001*
									18.768
Others†	14	10.1	3	8.3	5	12.2	6	9.8	0.850
									0.325
How to tell if fish is not spoilt									
Colour of skin	29	21	11	30.6	7	17.1	11	18	0.261
									2.685
Gill colour	40	29	0	0	17	41.5	23	37.7	0.001*
									20.048
Smell	56	40.6	27	75	14	34.1	15	24.6	0.001*
									24.86
Eyes	6	4.3	1	2.8	1	2.4	4	6.6	0.525
									1.289
Firmness of flesh	24	17.4	2	5.6	5	12.2	17	27.9	0.011*
									8.942
Don't know	6	43	1	2.8	2	4.9	3	4.9	0.866
									0.289

*p<0.05 significant using the χ^2 test; †Includes cleanliness, readily available, size, species and don't purchase fish

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Table 4a: Attitudes towards fish consumption among fish farming households in Kakamega, Siaya and Busia Counties

	Total (n=138)		Kakamega (n=36)		Siaya (n=41)		Busia (n=61)		P value χ^2 value
	n	%	n	%	n	%	n	%	
My family thinks I should eat fish									
Agree	135	97.1	36	100	38	92.4	61	100	0.014*
Disagree	3	2.2	0	0	3	7.3	0	0	12.52
My friends think I should eat fish									
Agree	118	85.5	32	88.9	33	80.5	53	86.8	0.046*
Disagree	17	12.3	4	11.1	7	17.1	6	9.9	15.77
Neutral	3	2.2	0	0	1	2.4	2	3.3	
The government encourages me to eat more fish									
Agree	99	71.8	31	86.1	24	58.5	44	72.1	0.126
Disagree	33	23.9	5	13.9	15	36.6	13	21.3	9.428
Neutral	6	4.3	0	0	2	4.9	4	6.6	
Doctors advise me to eat fish									
Agree	123	89.2	32	88.9	36	87.8	55	90.2	0.303
Disagree	14	10.2	4	11.1	4	9.8	6	9.9	9.482
Neutral	1	0.7	0	0	1	2.4	0	0	
Advertising stimulates me to eat fish									
Agree	113	81.9	33	91.7	34	82.9	46	75.4	0.273
Disagree	21	15.2	3	8.3	5	12.2	13	21.3	9.887
Neutral	4	2.9	0	0	2	4.9	2	0.07	
My partner thinks I should eat fish									
Agree	123	89.2	33	91.6	33	80.5	57	93.4	0.159
Disagree	10	7.2	2	5.6	5	12.2	3	4.9	11.83
Neutral	5	3.6	1	2.8	3	7.3	1	1.6	
Food industry encourages me to eat more fish									
Agree	97	69.5	31	86.1	24	58.5	42	68.8	0.047*
Disagree	36	26.1	4	11.2	14	34.2	18	29.6	15.67
Neutral	5	3.6	1	2.8	3	7.3	1	1.6	
I buy fish to give my family a healthy meal									
Agree	127	92	35	97.2	36	87.8	56	91.8	0.183
Disagree	8	5.8	0	0	5	12.2	3	4.9	8.842
Neutral	3	2.2	1	2.8	0	0	2	3.3	
I buy fish to give my family a nutritious meal									
Agree	127	92.1	34	94.5	37	90.3	56	91.8	0.219
Disagree	7	5.1	0	0	4	9.8	3	4.9	8.274
Neutral	4	2.9	2	5.6	0	0	2	3.3	
I buy fish to offer my family a varied meal									
Agree	108	77.9	30	83.4	31	75.6	47	77.1	0.308
Disagree	23	16.7	4	11.1	10	24.4	9	16.7	9.423
Neutral	7	5.1	2	5.6	0	0	5	5.1	

*$p<0.05$ significant using the χ^2 test

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Table 4b: Farmers' attitude scores for fish consumption

County	Negative attitude (score ≤39)		Positive attitude (score ≥40)		p-value χ^2 value	Mean ± Standard deviation	P value
	n	%	n	%			
Kakamega	8	22.2	28	77.8	0.126	42 ± 4	0.071
Siaya	17	41.5	24	58.5	4.140	40 ± 6	
Busia	25	41.0	36	59.0		40 ± 5	
Total	50	36.2	88	63.8		40 ± 5	

p >0.05 using analysis of variance (ANOVA)

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Table 5a: Consumption of fish products by fish farming households in Kakamega, Siaya and Busia Counties

	Total (n=138)		Kakamega (n=36)		Siaya (n=41)		Busia (n=61)		P Value χ^2 value
	n	%	n	%	n	%	n	%	
Do you consume fish products?									
Yes	44	31.9	6	16.7	14	34.1	24	39.3	0.064 5.498
Fish snacks consumed									
Fish balls	22	15.9	2	5.6	7	17.1	13	21.3	0.119 4.250
Fish samosas	11	8	3	8.3	2	4.9	6	9.8	0.660 0.830
Fish sausages	3	2.2	0	0	1	2.4	2	3.3	0.559 1.169
Sources of the fish snacks									
Bought	41	29.7	6	16.7	11	26.8	24	39.3	0.012* 12.93
Homemade	4	2.9	0	0	4	9.8	0	0	0.004* 15.66
Would you feed your child:									
Fish sausages?	124	89.9	36	100	37	90.2	51	83.6	0.035* 6.684
Fish samosas?	129	93.5	36	100	39	95.1	54	93.5	0.076 5.149
Fish balls?	123	89.1	34	94.4	37	90.2	52	89.1	0.358 2.052
Fish fillet?	126	91.3	35	97.2	39	95.1	52	91.3	0.076 5.161
Fish fingers?	119	86.2	35	97.2	38	92.7	46	86.2	0.004* 11.12
Reasons for offering fish products to children									
They are boneless	2	1.6	0	0	1	2.9	1	1.9	0.023*
They have fish	44	35.8	8	22.2	16	45.7	20	38.5	34.42
Look appetizing	20	16.3	5	13.9	7	20	8	15.4	
Protein rich	42	34.1	20	55.6	6	17.1	16	30.8	
To offer variety	15	12.2	3	8.3	5	14.3	7	13.5	

*p <0.05 significant using the χ^2 test

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Table 5b: Factors associated with farmers' consumption of value-added fish products

Demographic variables	Fish products consumption		
	AOR	95% CI	P-value
Age group (years)			
20-35 (reference)	1		0.014*
>35	2.83	1.23-6.52	
Education			
No formal education (reference)	1		0.617
Formal education	1.84	0.17-20.0	
Marital status			
Not married (reference)	1		0.014*
Married	7.31	1.51-35.4	
Monthly average income (in Ksh)			
Less than 5,000 (reference)	1		0.019*
More than 5,000	1.33	0.127-0.834	
Main occupation of HH head			
Not a fish farmer	1		<0.001*
Fish farmer	5.06	2.06-12.4	

AOR, adjusted odds ratio; *p <0.05 significant using binary logistic regression

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