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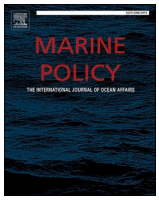

Fish preference at different value chain levels and implications for management of mariculture

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ABSTRACT

In this paper we assess the perceptions on fish consumption behaviour at different value chains using survey data from 3 coastal counties (Kilifi, Mombasa, Kwale) in Kenya. Study profiled the different sectors; fishers, fish traders, fish shops, fish mongers, fish farmers and consumers. Qualitative and quantitative data was captured to evaluate availability of target species, market trends, pricing and fish consumption. A 1–5 Likert scale was adopted to analyse consumption behaviour. The Likert scale data was subjected to ANOVA analysis in SPSS to assess significance. Rabbit fish showed a higher preference compared to milkfish, Nile tilapia grown in sea water "marine tilapia" and silver pompano. High value fish attracted higher prices per kg in all seasons. The market prices of milkfish and Nile tilapia grown in sea water were 25 – 35 % lower than rabbit fish and silver pompano. There were variations in landings during North East Moonson and South East Moonson and more fish landings from open water as compared to near shore areas. Species preference was influenced by palatability, price, demand and quality meat where more than 30 % of the fisher's preferred rabbit fish based on the attributes. Farming skills, seed availability and management informed species farmed. The study demonstrated significance of demographic characteristics: family, age, culture, gender and education on fish preference. The paper reveals a need for high returns and value for money in the preference of fish species thus guiding mariculture management. Findings recommend rabbitfish as a suitable species for mariculture based on reference from both high income level and low income level consumers.

1. Introduction

Globally, aquatic products provide nearly 3.2 billion people with at least 20 % of their animal protein intake. Fish constitute the dominant source of animal protein in many coastal sub Saharan African countries [17,18]. The current fish demand for human consumption is more than what is produced from capture fisheries in East Africa i.e. 470,000 MT, Tanzania (consumption of 8 kg/person) and 150,000 MT, Kenya (consumption of 5.5 kg/person) thus leading to fish deficits [18]. The higher demand than supply possess a great danger in management of the coastal systems from potential degradation.

According to Karuga and Abila [25], the domestic fish market consumes 88 % of the total marine fish produced in Kenya of which 90 % is consumed at the household market segment. It's therefore evident that as fish consumption worldwide continues to increase, there is a likelihood of the effects of trade on social dynamics and health of communities becoming more visible and thus the need of managing alternative interventions like mariculture [10].

Without significant remedies, food and nutritional security may be compromised in East Africa thus the need for a multi-faceted approach rather than dependency on capture fisheries and freshwater systems alone [38]. Therefore, the essence of managing mariculture to utilize the expansive ocean space and diversification of culture species is essential in enhancing societal benefits in rural coastal villages (Mirera et al., 2020).

Previous finfish mariculture ventures in East Africa have focused on the use of earthen ponds constructed nearshore in intertidal mangrove areas to farm milkfish and in the recent past Nile tilapia grown in sea water "marine tilapia" ([34–36,38] in press). Milkfish (*Chanos chanos*) is caught in the coastal waters of Tanzania and Kenya and it's farmed in captivity by collecting fingerlings seasonally from mangrove pools [12, 34]. It's a low value fish and a pioneer finfish grown in Kenya and East

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Africa [35]. The species is herbivorous feeding mainly on lab-lab (a complex mat of blue green algae, diatoms and associated invertebrates) and lumut (mainly filamentous green algae) and associated micro-and meio-fauna [4,6]. The suitability of the species for mariculture is associated to the tolerance to extremes of water quality like dissolved oxygen and salinity (Mmochi & Mwandya, 2003; [50]) which is a common characteristic in intertidal earthen ponds where water exchange is dictated by the tidal regime.

Also, tilapia are tropical freshwater fish native to Africa but introduced to different global destinations for commercial production [28,45]. Currently, tilapia is farmed in 124 countries and ranked the fifth highly farmed species, with an annual production of 6.1 million tonnes [19]. Farming of tilapia has been successful because of its fast growth, higher reproduction, feeding on low trophic levels, euryhaline characteristics and tolerance to adverse environmental conditions [8,24,27,39,47]. Farming of Nile tilapia (Oreochromis niloticus) in marine waters will maximise the use of currently underutilised ocean space for increased fish production and ensure food sufficiency to the more than 690 million people going without food daily [13].

The choice of farmed finfish species has previously been influenced by ability to withstand harsh environmental conditions in the intertidal areas, availability of seed from the wild and simplicity in feeding i.e. benthic algae or lab thus compromising market preference and value [33,35]. This has for a long time provided a biased approach to the management of mariculture limiting farming of high value marine fish species for food security and livelihood improvement. This implies that mariculture has never been considered to be an economic powerhouse that is able to provide livelihoods and a driver of positive social development in the rural coastal communities as argued by Slater et al., [48].

Species like rabbit fish, *Siganus sutor* are important artisanal food fish in the Western Indian Ocean (WIO) region and is highly targeted by fishers [31,40]. The fish is herbivorous and has been observed elsewhere to adapt well to formulated feeds in addition to feeding on algae and has good growth and survival in controlled conditions [2,3]. Globally, the species is farmed in different countries including Iran, India and several other Asian countries. Farming of *Siganus sutor* in East Africa can be traced back to 1980 s in Tanzania in earthen ponds and cages and 2018 in fish cages in Kenya ([32,37]; Mirera et al., 2019).

Similarly, silver pompano is recognized as a premium fish with good quality meat that is popular in high-end restaurants and has been successfully established for aquaculture (brackish and marine waters) in some Asia –Pacific countries like Taiwan, China, Philippines, Malaysia, Indonesia and India. The species is also established in South America including Brazil and North America [18]. Research has established that its ideal for mariculture due to its fast growth, easy weaning to formulated feeds and adaptation to different culture methods i.e. cages and earthen ponds thus higher ability to transform mariculture management [9]. In East Africa, initial research trials have been undertaken in Tanzania on the nutrition requirements and response to different environmental variables in cages [22,23].

This paper provides a comparative assessment of market preference and dynamics for different marine fish in East Africa. Therefore, closing the gaps on information required to support choice of species for mariculture management while considering different marine finfish species (milkfish, Nile tilapia grown in sea water, rabbit fish and silver pompano). Indeed, there are limited studies on the preference, market and consumption of farmed marine finfish species in relation to the widely caught and consumed finfish species in East Africa to guide mariculture interventions. Yet there is a link between preference, consumption, nutrition, exploitation, farming and trade. Therefore, the current study helps to provide critical information to influence policy direction and management of mariculture investments. Overall marine finfish production, preference and market dynamics will affect livelihoods and poverty levels in coastal communities where there are limited economic options. The results further guide on what transformative change is needed in the different nexus issues of consumption, preference, market, production (capture fisheries and mariculture), food security and nutrition in relation to policy interventions and blue growth initiative and sustainability for ocean economies.

2. Methodology

2.1. Study site

The research was conducted in three coastal counties of Kwale, Mombasa and Kilifi in Kenya. Nine ocean riparian sub-counties (Lungalunga, Msambweni, Matuga, Mvita, Likoni, Kisauni, Kilifi north, Kilifi south and Malindi) were sampled from the three counties i.e three per county (Fig. 1). Studied counties were selected because of the long-term interactions with inshore and offshore fishing activities and history of mariculture development [35].

2.2. Research approach

The study employed a clustered and randomized design to collect data. Respondents were clustered into counties (Kwale, Kilifi and Mombasa) and further into sectors (fish farming, fishing, fish trade and other sectors like transport, banking, teaching etc). The respondents were randomly selected from the different sectors of the economy. A closed and open ended questionnaire was developed, pre-tested and used in the field survey to collect social economic data. Each questionnaire was partitioned into four; fishing, fish farming, fish market and Consumers. The questionnaires gathered information that evaluated among other things, availability of the target species, market trends, pricing and consumption. Both qualitative and quantitative data was collected during the survey.

2.3. Sampling design

The study sampled a total of 323 respondents in the three coastal counties covering diverse sectors that included; fish farming 5.8%, fish trade 47.1%, fishing 31.8%, other sectors 15.2%. To assess consumption, 71.8% of all respondents were interviewed covering different proportions from each sector (Table 1). Sampling employed a randomized design to reach respondents between and within the different sectors.

Structured interviews were administered randomly on fishers, fish shops, fish farmers, fish traders and consumers using the designed questionnaire. Respondents were either interviewed at home or in the places of work.

Fish shops: To access fish shops, both small and main market centers/towns in the counties were targeted to take representative samples with a consideration of both small and large fish shops (based on quantities of fish traded). Sampling was randomized and ensured shops sampled were far from each other.

Fishermen: Main fish landing sites were identified in the counties. Sampling was done by visiting the fishers at the different landing sites by employing random sampling on the return from fishing expeditions or prepared for fishing.

Fish traders: This category comprised of open air traders selling fresh fish and fish products. Randomized sampling was done to interview traders in each county.

Fish monger/mama karanga: The respondents were randomly sampled at the landing sites, major fish shops, market centers and at home during fish preparation.

Fish farmers: Sampling was done randomly on marine fish farmers within the counties at the respective farms.

Consumers: The sampling was done for different fish value chain actors and on representatives from different sectors of the economy in a completely randomized design.

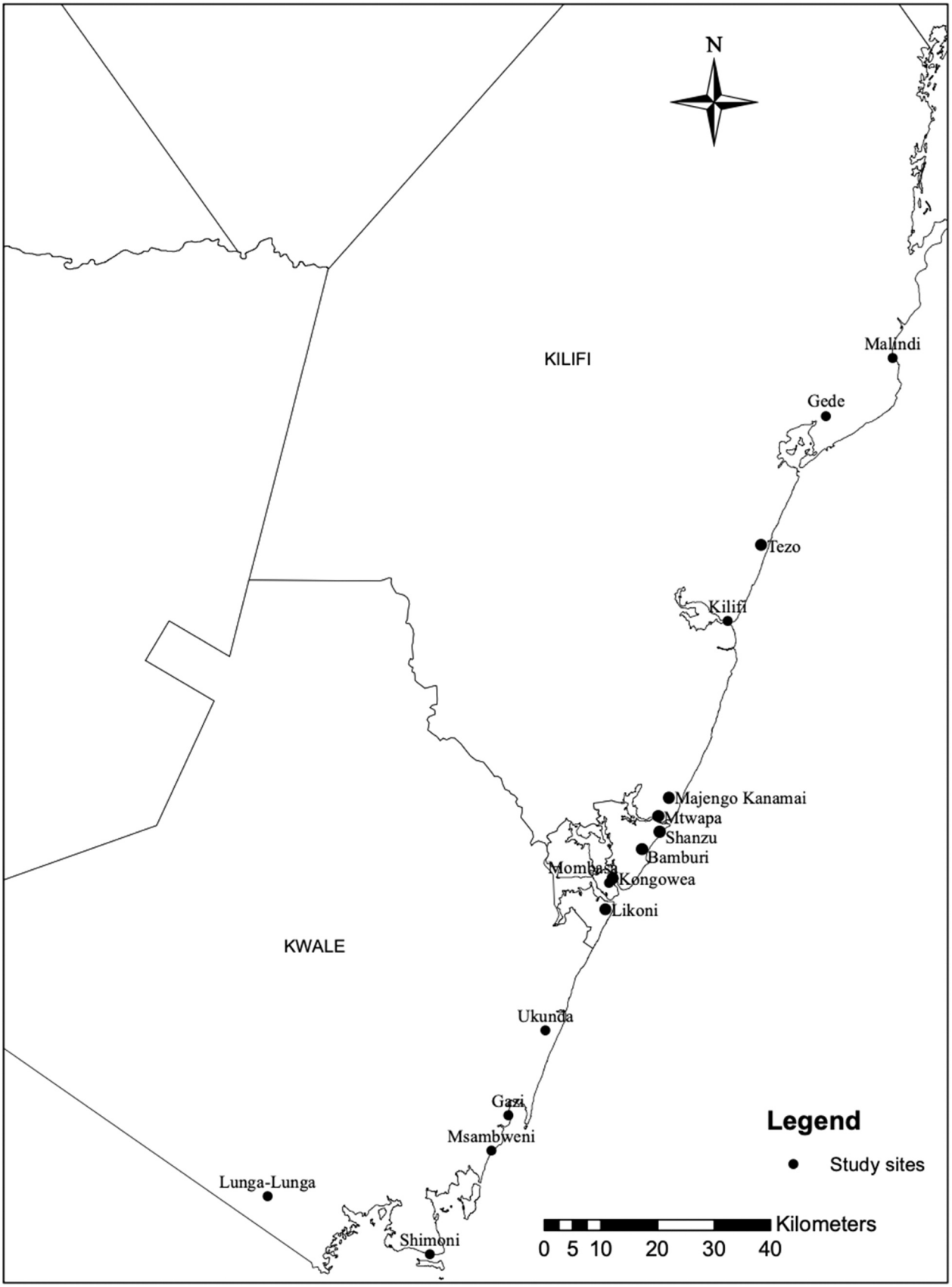

Fig. 1. : Map of study area indicating the three counties (Kwale, Mombasa and Kilifi) where the survey was conducted.

Table 1
Proportion of respondents interviewed under different categories and sub- categories in the three coastal counties of Kwale, Mombasa and Kilifi (n = 323).

Category of respondent	Proportion interviewed	
	% within category	% of total
Fish farming		5.8
Fish trade		47.1
• Fish traders	21.9	
• Mama karanga	49.5	
• Fish shops	28.6	
Fishing		31.8
Other sectors		15.2
• Hospitality	14.7	
• Banking	8.8	
• Small scale business	29.4	
• Casual employment	23.5	
• Civil servants	14.7	
• Road transport	14.7	
• Seamen	8.8	
• Student	2.9	
Fish consumption		71.3
• Fish farmers	8.2	
• Fisher's	27.7	
• Fish traders (Fish shops – 12.6%, Mama karanga - 22.6%, Fish traders – 10.7%)	45.9	
• Other sectors	21.4	

2.4. Data analysis

Both quantitative and qualitative data was collected. Data was coded, compiled and cleaned for consistency. Descriptive statistics were employed to generate quick summary of the characteristics of the variables, frequency analysis of responses was done and presented graphically. Data was analyzed using statistical package for social sciences (SPSS) and Graph pad prism. Inferential statistics was analyzed using one way and Two way ANOVA for different variables and significant difference was pegged at $p < 0.05$. Before the ANOVA test, all data was subjected to normality test.

3. Results

3.1. Demographic characteristics of the population

The study interviewed a total of 323 respondents that comprised of 36 % women and 64 % men in three coastal counties (Kilifi, Mombasa and Kwale). More than 60 % of respondents were aged more than 35 years (Fig. 2). A majority of respondents (79 %) represented nuclear families, 16 % extended families and 5 % single parent families and 67.1 % were family heads and bread winners. The sampled interviewees were mainly married people with representation from each level (Fig. 3).

The family size was estimated at 3.4 persons (largest 11 and smallest

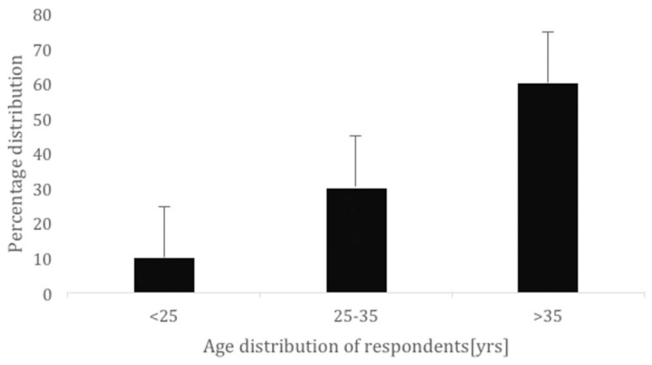

Fig. 2. Distribution of respondents by age in the three coastal counties covered by the study.

Fig. 3. Marital status of respondents sampled during the study from Kwale, Kilifi and Mombasa counties.

1). Most respondents (67 %) were either head or breadwinner of the families. Main income generating occupation of respondents was quite varied with a male domination except fish trade (Fig. 4). Urban and rural categorization of respondents varied depending on main occupation i.e. fishing and fish farming dominated rural setting while fish trade and other occupations dominated urban settings. Most fishers had been in the business for more than 10 years (21 %) while most fish traders (22 %) had been in the business for less than 5 years (Fig. 5). More than 33 % of the respondents had education levels and above, 44 % primary education, 5 % religious education while 17 % did not have any education at all.

The mean monthly income from main occupation was estimated at Ksh. 63,969 (minimum Ksh 3000, maximum Ksh 250,000) at an exchange rate of 1 USD = 120 Ksh. Secondary occupation income was averaged at Ksh. 40,808. Fish traders took home more monthly income compared to other occupations while hospitality industry provided the least monthly income - (Fig. 6).

3.2. Fish price variations and landings

According to fishers, rabbit fish and silver pompano attracted higher price/kg in all seasons compared to Nile tilapia grown in sea water and milkfish. The price of milkfish and Nile tilapia grown in sea water was generally 25–35 % lower than that of rabbit fish and silver pompano according to fishers, farmers, traders and consumers (Fig. 7).

Fishers mainly landed 5–50 kg daily irrespective of season based on fishing area and vessel used and more fishing days were made per week during NEM (5.3 days) compared to SEM (3.9 days). Few fishers landed more than 50 kg in the South East Monsoon (SEM) season. There was an

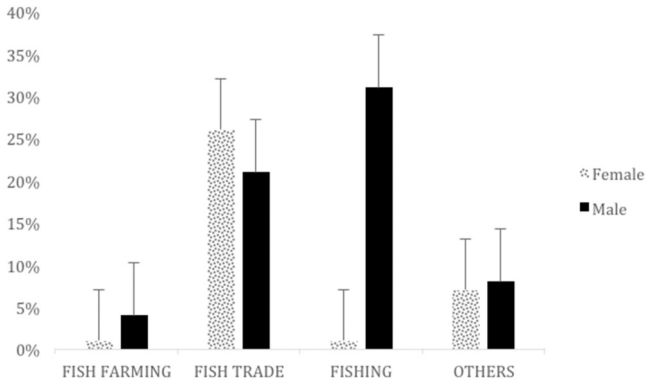

Fig. 4. Composition of male and female gender in the different main income generating occupations in the three coastal counties of Kilifi, Mombasa and Kwale.

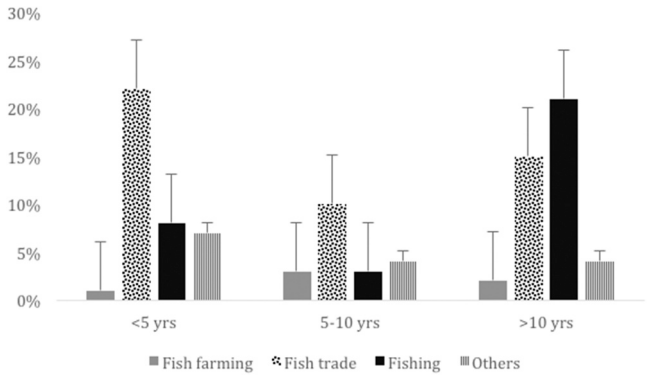

Fig. 5. Length of time respondents have participated in the main income generating occupation.

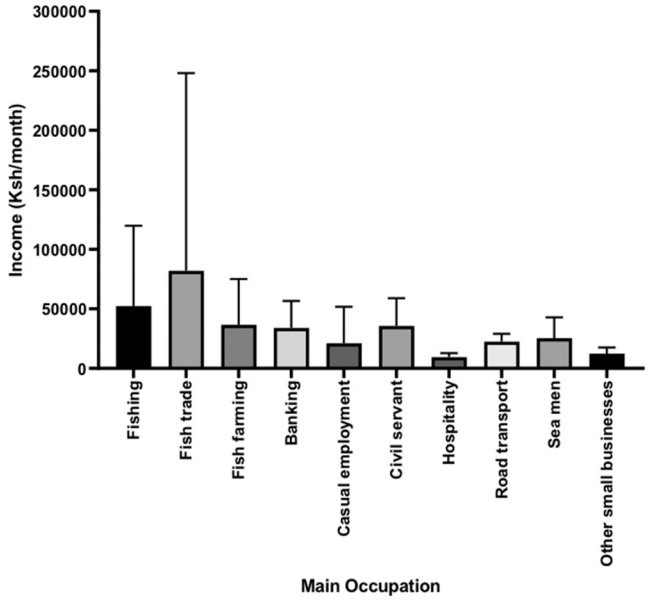

Fig. 6. Variations in monthly income n Ksh (1 USD = 120 Ksh) from different main occupations in the three coastal counties (Kilifi, Mombasa, Kwale).

observed variation in landings during the North East Monsoon (NEM) compared to SEM (Fig. 8). Highest frequency of fish landing was from deep sea/open water fishing and minimal landings from other fishing areas like mangroves, sea grass and other near shore areas (Fig. 9).

3.3. Fish consumption and preference

All value chain actors indicated higher preference for rabbit fish compared to other farmed marine finfish species (milkfish, Nile tilapia grown in sea water and silver pompano). Fish consumers rated rabbit fish preference higher than other value chain actors. Fishers had a high preference for silver pompano compared to the other actors while fish farmers had higher preference for Nile tilapia grown in sea water and milkfish (Fig. 10). Fishers preferred a specific fish species mainly because of its palatability according to 31 % of the respondents while only 1 % of fishers could prefer a fish because of low spoilage and suitability of fishing gear (Fig. 11). Value chain actors provided diverse factors that influence preference for a particular fish species like; palatability, affordability, demand and quality meat (Table 2). Farmers cited varied reasons for preference to farm different species that included availability of seed, technology requirements and management complexities (Table 3).

4. Discussion

The research critically assessed dynamics in state of knowledge on marine finfish consumption at different levels of society (fishers, fish traders, fish shops, fish mongers, fish farmers and consumers) as an indicator of market availability to inform management of mariculture. Generally, the findings show that high value fish attracted higher prices in the market and hence high returns. Consumption preference for species was influenced by palatability, price, demand and quality meat as key attributes while farming preference was influenced by farming skills, seed availability and management requirements. We take cognizance that there has been a global increase in demand of fish among the populations due to its perceived health benefits and availability especially in coastal and river/lake regions thus a likelihood of influencing mariculture management [30,41]. Progressively, aquaculture management has enhanced fish production and thus supply to the market. Whereas marine aquaculture (mariculture) has been low, there is deliberate effort to exploit its potential in the global blue economy expansion and organisation. To advance mariculture management, there is a need to understand perceptions of different value chain actors in relation to factors influencing fish consumption and farming to inform enabling government policies on production, consumption and market development [53].

4.1. Social demographic and influence on fish consumption

A higher proportion of respondents in the current study comprised of male populations though females dominated the trade value chain where fish mongers (mama Karangas) constituted 50 % of the respondents. Higher participation of men in the sector implies that resource deficits will have far reaching impact to coastal management which calls for strategies to improve resource availability through mariculture management. Greater participation of women in the fish monger trade (mama karangas) is an indication that women are more interested with fish since the value chain level require huge time investment to collect the fish from landing sites, fish shops or farms, prepare through gutting and removal of scales, fly to value add and then take to the market. According to De Salva, [11], demographic characteristics (gender, literacy/education, family size, income, family type and culture) of a population have significant influence on fish demand and consumption. Indeed, a voluntary consumption study conducted by Maciel [29] found out that women were the highest participants indicating that women are more interested in fish and health.

Most of the respondents (62 %) in the current study were more than 35 years of age an indication that participation in fish value chains attracts more elderly populations who are either family heads or bread winners which has huge implications on livelihood contributions of the fisheries sector and mariculture reorganisation. In a study involving women of 30 – 44 years, it was found that fish consumptions increases with age thus insinuating the significance of age in fish value chains (Mayrland et al., 2000). Further, previous studies have indicated influence of level of education in fish consumption [44,46]. However, the current study had 17 % of the respondents with no formal education. Overall, education levels could influence choices of fish species to be consumed and consequently mariculture management as a source of fish supply for the market.

We found that 67.1 % of respondents were family heads and bread winners while 75 % of respondents were married with family size of 3.4 person. High dependency rates and high prices of fish leads to unavailability of fish for consumption that affects market demand leading to diversification of fish market into high value and low value fish. Family size and family type could influence frequency of fish consumption with respect to budget allocation, fish species available and prevailing market prices [5,57]. High fish market prices make fish unavailable for poor households with limited income [14,42]. The situation is even complicated when there are huge family size number and in

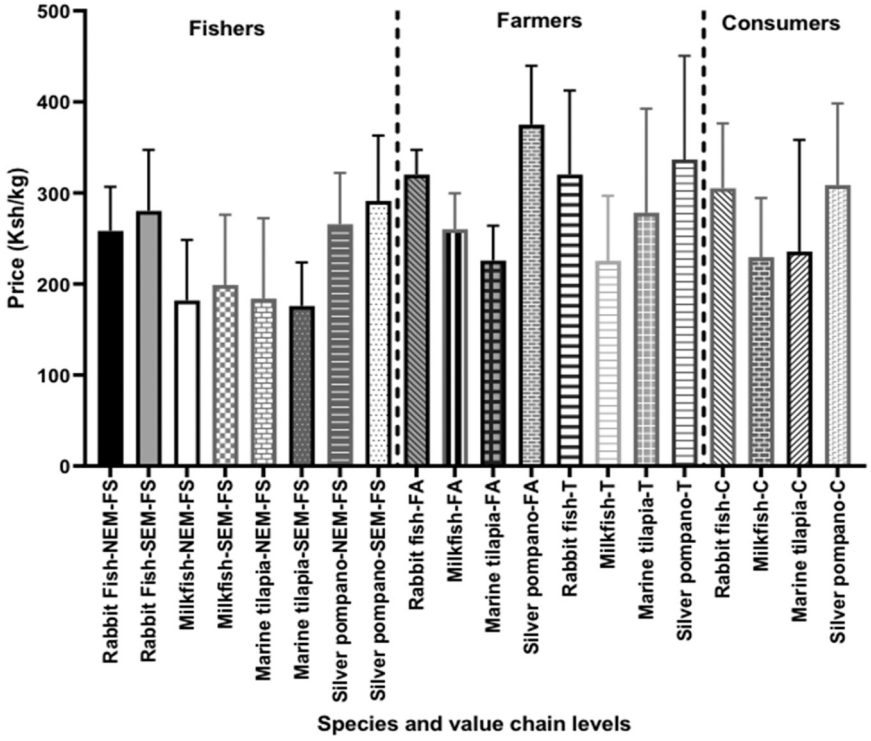

Fig. 7. Price variations per kg in Ksh (1 USD = 120 Ksh) as observed by different value chain actors (fishers, farmers, traders and consumers).

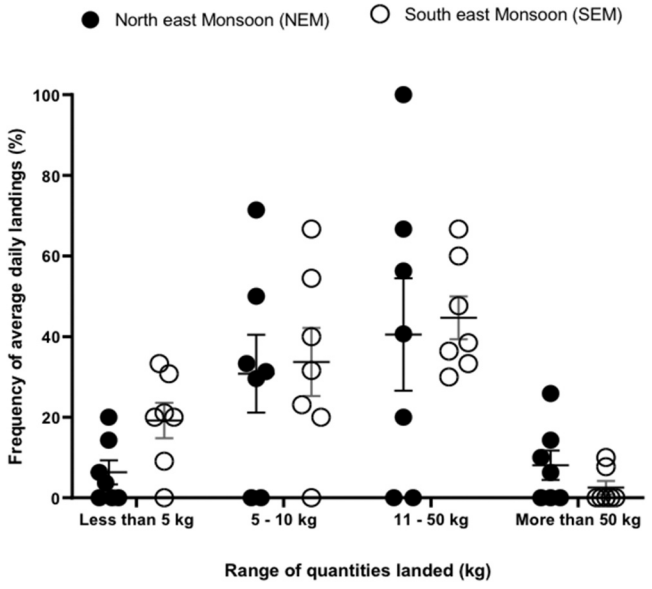

Fig. 8. Variations in fish landings by artisanal fishers during SEM and NEM in the three coastal counties (Kilifi, Kwale and Mombasa).

extended families where breadwinners have to meet the family needs and thus affordability dictates consumption trends. This leads to diversification of market where low value fish is available to one category of consumers at low prices while the high value fish are available to another category of consumers at higher prices [14,42]. However, if the high value fish could be produced through mariculture availability of fish could be enhanced and poor households could be able to access preferred fish species at affordable market prices.

4.2. Fish supply and influence on consumption

The findings show that fishers landed between 5 kg and 50 kg/day in all seasons. There were more fishing days/week during Northeast monsoon -NEM (5.3 days) compared to Southeast monsoon - SEM (3.9 days). The harsh conditions during SEM leads to few fisher's landing more than 50 kg per day. The fact that the supply chain of most coastal fish species start from the oceans (fishers or farmers) and end up with consumer markets locally or thousands of miles away is underscored [21,25]. Artisanal fisheries channel has the highest number of actors and handles the largest marine fish volumes (88%) in coastal Kenya [25]. Therefore the observed seasonality significantly impact fish supplies in the market and creates a deficit that may be filled with proper mariculture management. According to De Salva [11], convenience and availability of fish year round availability influences fish preference and consumption. Consumers argue that higher volumes of fish give them room to choose from a variety to meet their specifications and are able to get value for money. However, traders are usually never comfortable with high landings since excess supply impacts on price per unit due lack of storage and processing facilities.

Also, the current study observed that most of the landings was from deep/open sea with minimal landings coming from mangroves, sea grass and other near shore areas. Conversely, most fishers operate in near shore areas due to limited capacity to go offshore thus impacting fish supply in the market. With the decline in nearshore capture fisheries, mariculture management may help to improve fish production from nearshore areas thus leading to more economic activities and relative less productive area. According to Karuga and Abila [25], most of the value chain sub-sector stakeholders, ranked rabbit fish as one of the main species with high potential for outreach and market demand along the coast of Kenya and yet the fish cannot be easily accessed by nearshore fishers. Therefore, to address the fish supply gap, mariculture management has been initiated where previously low value finfish like milkfish [35] and recently Nile tilapia grown in sea water (Mirera and Okemwa, 2023 in press) have been produced. However, the little information on the consumer preferences and perceptions on the currently

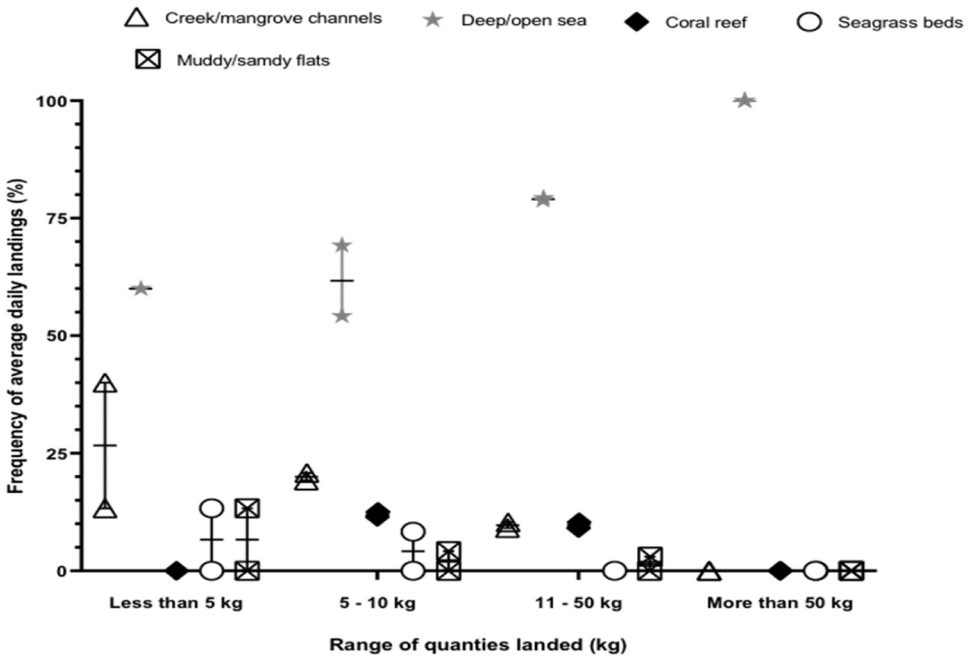

Fig. 9. Frequency of daily landings by fishers based on fishing areas in the three coastal counties.

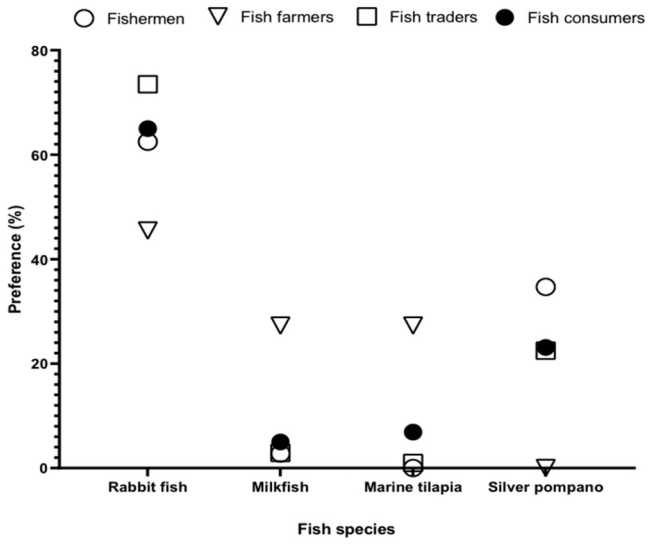

Fig. 10. Preference of different fish species by value chain actors in the three coastal counties (Kilifi, Mombasa, Kwale).

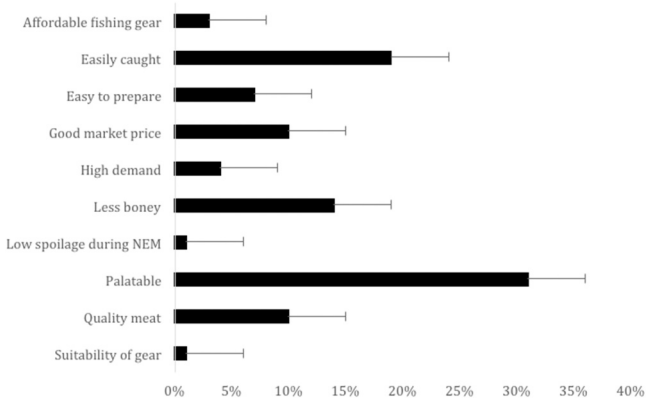

Fig. 11. Reasons influencing preference of fish species by fishermen in the three coastal counties (Kilifi, Kwale, Mombasa).

farmed finfish and those envisioned for culture like rabbit fish and silver pompano that are sourced from artisanal capture fisheries along the coast of Kenya have previously impacted mariculture management.

4.3. Fish market dynamics and consumer preferences

Milkfish and Nile tilapia grown in sea water were observed to be less popular in the study since they are restricted only to the areas of aquaculture production and have not been available to wider consumers which impacts market demand and mariculture management for improved food security and livelihoods. Also, inability to capture large milkfish in the sea due to its ecological and biological characteristics made the fish less popular to most of the fishermen in addition to being regarded as a low value fish. Consumer preference is one of the drivers that govern change of demand in the market [11]. Myrland et al. [41] and Uilde et al. [54] observed that greater availability of fish and fish products to a large extent influenced consumer behaviour as observed in the current study.

Table 2
Reasons influencing preference of fish species by traders and consumers.

Fish traders	Fish consumers
• Affordable	• Affordable
• Affordable price	• Affordable price
• Easily available	• Allergic reactions
• Easy to prepare	• Quality meat
• High demand	• Easily available
• High market demand	• Easy to prepare
• Less boney	• High demand
• Low demand	• Less boney
• Palatable	• Palatable
• Profitable	• Quality meat
• Quality meat	• Spoilage rate

According to the fishers in the current study, rabbit fish and silver pompano attracted higher market price/kg in all seasons compared to

Table 3
Reasons influencing preference to farm different kinds of fish in the three coastal counties of Kilifi, Kwale and Mombasa.

Rabbit fish (*Siganus sutor*)	Milkfish (Chanos chanos)	Nile tilapia gron in sea water (*Oreochromis niloticus*)	Silver pompano (Trachinotus blochii)
• Easy to feed • Lack of hatchery seeds • Limited technology • Easy to manage culture system • Lack of wild seeds	• Availability of wild seeds • Easy to feed • Seasonality • Well adapted to pond • Easy to feed	• Ease of reproduction • Faster growth • Low adaptability to changing salinity	• Limited technology • Unavailability of seeds • High feeds demand • Well adapted in ponds

Nile tilapia grown in sea water and milkfish. Overall, the price of milkfish and Nile tilapia grown in sea water was perceived to be 25–35 % lower than rabbit fish and silver pompano an aspect that tends to impact the consumption of the species in the market but may be a motivator for more entry into the mariculture by entrepreneurs. Price is regarded as one of the barriers to fish consumption since consumers will always prefer to have value for money [26,41,52,57]. Demand for fish consumption in the market has also been observed to be associated to perceptions of its benefits in health and longevity by the consumers ([51]; Tronsen et al., 2003; [30]). Despite the increasing demand of fish associated with health benefits, fish consumption is negatively impacted by high prices [59].

The study established that fish markets occurred at different levels including fishermen (fishing in the ocean) and fish farmers (farming in ponds and cages in the ocean), fish mongers (selling fried fish), fish traders (dealing either with fresh fish or dry fish) and fish shops (selling frozen fish). Fish mongers occupied the higher proportion of fish market in the study spreading from landing sites to local urban and rural villages. It was observed that availability of fish to the consumers led to increased demand by consumers. The observed diversity in market nodes confirms the fact that fish marketing systems that are in most cases complex and to some extent less competitive play a vital role in connecting the fisher's, farmers and consumers thus contributing significantly in the value-adding process [1].

To ensure sufficient fish in the market, there is need to increase production from mariculture to reach the untouched market segments. Farmers cited different reasons impacting the farming of diverse species that included lack of seeds, technologies needed to farm, feed requirements among others that are key for the reorganisation of mariculture in the region. The smaller number of farmed finfish species in Kenya provides limited options for the market. Therefore, diversification of mariculture to include different finfish species will provide diverse options for the market to meet consumer demands and ensure food security and improved livelihoods. Indeed, studies in Brazil showed consumer complaints due to little diversity in fish and fish products available in the market thus affecting fish demand [54].

Most respondents preferred to consume rabbit fish to the other fish species. According to more than 30 % of the fisher's rabbit fish is palatable, less bony and easily caught. The finding resonated well with findings by Pieniak et al., [43] and Honkanen et al., [20] that fish consumption levels and frequency may be influenced by fish attributes among other factors. These attributes that include quality, easy to prepare, availability, less bony, affordable, palatable as observed in the current study dictates fish preference and thus categorisation (high value and low value) of fish in the market as observed by Trondsen et al., [53]. Its therefore evident that such consumption attributes also need to guide management of mariculture especially on species to be farmed for food security and income generation. More often, it's assumed that low-cost fish like milkfish will contribute to food and nutrition security of low-income consumers while high cost - fish like silver pompano will contribute to food and nutrition security of high income consumers [42]. Conversely, rabbitfish was preferred by both low-income and high income consumers and market prices were not skewed thus falling outside this categorisation. The finding creates a unique pool of demand for rabbitfish thus making it a suitable candidate for mariculture management. The study further raises a new research question on convergence of consumer preference with respect to fish species that needs more research.

The findings showed that Nile tilapia grown in sea water was less preferred by fishers and other consumers along the coastal areas an aspect that could be associated to the traditions and cultural consumption behaviour. Nile tilapia is not historically or culturally a marine species but rather a freshwater tilapia species recently introduced to marine systems to address the challenge of limited seed for stocking by small scale farmers ([36] – in press). Based on the fact that previous studies have underscored the influence of cultural differences in consumer perceptions and fish consumption, the current finding establishes a need for more studies in the area to guide future mariculture management [44,53,54,57].

4.4. Food security versus income generation aspects

We found out that respondents engaged in more than one occupation to help meet family needs (Main occupation and secondary occupation) which implied that they could be having more budget allocation to fish consumption. Further, there were varied monthly remunerations from different sectors ranging between 10,000 ksh. in the hospitality industry to 85,000 ksh. in the fish trade industry (exchange rate of 1 USD = 120 Ksh). Based on the attained income, it's possible that more budget could be allocated to food security aspects and thus more preference for low value fish like milkfish and Nile tilapia grown in sea water as opposed to rabbit fish and silver pompano. However, the findings show higher preference for rabbit fish and silver pompano that attract higher price/kg in all seasons as opposed to milkfish and Nile tilapia grown in sea water. This finding justifies the argument by Slater et al., [49] that the willingness of individuals to engage in aquaculture or other alternative livelihoods is influenced directly and indirectly by a number of personal, social and economic factors. Although, the findings contradicts the argument that foreign exchange earnings from high value fish exports can be used to import much larger volumes of low cost food to supply the domestic market, thus contributing to national food security [15,16,55].

The study found out that fishers, traders and farmers selected to deal with a given fish species if it provided high returns while consumers (customers) selected a particular species to get value for money. Therefore, a species that provides the much needed return on investment (income) and satisfies consumer preferences could be given top priority with regards to mariculture management. This implies that a fish species that is able to provide hard cash and is quality could be preferred by all in the market. The findings support the pro-fish trade narrative where revenue generated from fish sales can be used to enhance economic growth and livelihoods of the masses [1,7,56,58]. Also, a large number of people, many of whom live below the poverty line, find employment in coastal fish marketing as fishermen, assemblers, processors, traders, intermediary transporters and day labourers, including women and youth thus leading to livelihood improvement with more projected contribution from mariculture management [1].

5. Conclusion

This study has provided a new perspective with which to view fish consumption behaviour in different value chains. The results demonstrate a higher preference of rabbitfish compared to other farmed species; milkfish, Nile tilapia grown in sea water and silver pompano. This

observation makes rabbitfish a suitable candidate for mariculture management in the region. The results further show that gender, age, education, family size and occupation influence the fish consumption behaviour due to budget allocation and prevailing market prices. The findings of this study show that species that provided the needed return on investment and also satisfies consumer preference is given top priority in the market and therefore need to be considered for mariculture.

CRediT authorship contribution statement

David Mirera: Experimental design, data collection, data analysis and manuscript development. **Esther Magondu:** Data collection, data analysis and manuscript development. **Miriam Wainaina**: Data collection and analysis. **Brendan Muli**: Data collection and analysis. **Douglas Okemwa**: Data collection and analysis. **Rose Angulu**: Data collection and analysis. **Irene Heba**: Data collection and analysis. **Hellen Moyoni**: Data collection and analysis.

Data Availability

Data will be made available on request.

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