
Contract Fishing in Africa and Inputs Markets for Artisanal Fishers: The Analysis of Impact Factors around Lake Victoria

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Abstract

Artisanal fishers in Africa suffer from income insecurity and exploitation from patron-client system (contract fishing) mainly due to informal governance structure. The objective of this study was to analyze the fishery inputs market factors applied in contract fishing on selected landing sites around Lake Victoria, Tanzania. Two districts were selected purposely in Mwanza region followed by proportionate sampling of six landing sites. A logistic multiple regression analysis was applied for questionnaire data from a sample of 289 artisanal fishers selected randomly using lottery approach in each landing site. Focused group discussions and key informant interviews were employed to triangulate questionnaire data results. Vessel ownership, market access, cash loans, and fishing experiences are significant ($P < 0.05$) input market factors influencing participation in contract fishing for both contracted and freelance fishers. Artisanal fishers are recommended to establish fisher's organization institutions for a collective agreement with buyers on market input factors, including access to market and provisions of other social capital facilities. Provision of fishing facilities, vessels and loans by financial institutions is recommended for sustainability of fishery business and income security among artisanal fishers.

Keywords: Contract fishing, Input's market, Income security, Lake Victoria, Artisanal Fishers

JSSBT, Vol. 2 No. 1 (June, 2021), pp. 11 – 21, © 2021 The Co-operative University of Kenya

INTRODUCTION

Globally fishery activities are acknowledged for contribution to food needs, employment and income to artisanal fishers' (AF) for developing countries. However, these activities suffer from insecure sustainable governance structure (Zelasney *et al.*, 2020; Lancker *et al.*, 2019), hence failure to enable sustainable trade and equitable market access for AF. Contract fishing is considered as appropriate governance framework in fishery for sustainable fishery businesses and ecological management (Samy-Kamal, 2020). Contract fishing (CF) refers to a binding relationship between fishers and other actors, each part with defined and governing rights and duties for a mutual benefit. The benefits include access to fishing

resources, markets access, and improving artisanal fisher's wellbeing (Barthélemy *et al.*, 2015; Satria & Li, 2017).

Understanding of CF in ecological governance system has been diversified over time (Crona *et al.*, 2010; Thyresson *et al.*, 2011; Fabinyi, 2013; Zamroni and Yamao, 2013; Ferrol-Schulte *et al.*, 2014; Nurdin and Grydehøj, 2014; Miñarro *et al.*, 2016). Though these studies have focused on different contract arrangements, like reciprocal agreements, credit arrangements, middlemen patron-client relationships and patronage in small-scale fisheries, managing fishing resources among AF remain a challenge. Consequently, fishery institutional managements for sustainable fishery, market access and lower price at local level to ensure

income security by AF has been seldom attained (Crona *et al.* 2010).

Contract fishing (patron-client system) has shown small contribution to AF livelihood (Ferrol-Schulte *et al.*, 2014). Most of AF in Africa are continuing facing the market access barriers causing difficulties to obtain better price from buyers (Mpenda, 2010 & Sharma & Biswas, 2018). Inappropriate lending and procedures for loan applications is another challenge identified by Zelasney (2020) which also affects amount of loans issued by the buyer to a fisher as part of contract arrangements. Having focused on mitigating long distances to meet vessel's cost (Satria & Li, 2017), inaccessible equipment for fish handling, processing and marketing through contractual arrangements (Canarje, 2007; Mpenda, 2010; Chandrashekar, 2014; Frank & Umoh, 2015), little attention has been given to resolving income insecurity and endless credit provision among AF as part of contractual arrangements (Crona *et al.*, 2010).

Comparing with the agriculture sector, current contractual arrangements in fishery activities in African countries are mostly informal (Crona *et al.*, 2010; Penca, 2021). There is a missing formal and sustainable CF model adopted in the region that caters for AF sustainable income and wellbeing achievements (Mpenda, 2010) mainly due to the fact that fishery business remains a risky. Further, access to and availability of fishery resources have continued to change. Many fishers remain powerless with low income (Asche, 2015; Phillips and Subasinghe, 2010; Pollnac and Poggie, 2008). Contrary to AF sustainable achievements, research continues to reveal higher income from fishing is high-rated to non-indigenous fishers (potential agents/middlemen) with high financial assets (Bennett *et al.*, 2021) who provide fishing equipment via informal arrangements with AF. Moreover, the inputs market support is usually for a short-time (Ferrol-Schulte and Glaser, 2014) and therefore sustainable income security and less dependency on

credit provision from these agents remains an issue (Ferrol-Schulte *et al.*, 2014). So, for how long will AF sustain income insecurity? This gap is uncovered in this paper by exploring AF levels of education and opportunities for alternative income sources (Ferrol-Schulte *et al.*, 2014). With regard to Sustainable Development Goal 14b, this paper contributes to policymaking by addressing input market factors for fishery sustainability pertaining to contract fishing.

The objective of this study is to investigate critical market input factors of contract fishing that influence income insecurity and dependency on credits provision from upper chain actors (middlemen, traders and buyers) among artisanal fishers. Specifically, the paper identifies fishing resources that if available and endowed by AF can contribute to sustainable income from fishing among AF henceforth improving wellbeing.

LITERATURE REVIEW

The fishery sector in Tanzania harvests different fish species, specifically from the Lake Victoria. The country is earns about 2.5% of real GDP annually predominantly from the main freshwater species of commercial interest which are Nile perch, Nile tilapia, and Sardine (FAO, 2020; BOT, 2017; URT, 2017). Around Lake Victoria alone, 104,000 people are directly employed and about 500,000 more are indirectly employed in fishery activities (URT, 2017; Luomba, 2013). These species which are largely for trading and exporting, form part of 85% of country's fish production from inland fisheries. Global statistics show that Africa's fishing production was 10.4 million tonnes and US\$ 164.1 billion of the world value of fishery output in 2018. More than 3.3 billion people in the world had almost 20 percent of their average per capita intake of animal protein from fish (FAO, 2020).

Despite this contribution, AF experience lack of organisation, unequal fishing capacities (vessels, facilities, income, labour), (Penca *et al.*, 2021) varied value chain organizations and market structures

that might lead to unsustainable trajectory and obligated to long term exploitation. Others are, inadequate mechanism for landing price determination, autonomy on price determination by buyers, lack of proper payment method, cold storage (Sambuo, 2019). Contract fishing has also found a weakness in meeting demands of input market factors by producers, however buyers may prefer to enter into contract fishing so as to ensure reliable governance and supply of landed fish (Bennett *et al.*, 2021; Penca, 2021; Crona *et al.*, 2010).

This study employed Economic Governance Theory (EGT) Williamson and Ostrom (2009) to explain producer-buyer relationship on the input market factors enforced by contractual arrangements. The theory provides that, markets are guided by rules and enforcement mechanisms placed by institutions, and societies (bilateral or multilateral) to govern common property (Williamson and Ostrom, 2009). Enforcement mechanism depicted by the EGT towards fishing contractual arrangements may due to bound rationality of certain problems and constraints that face AF to attain sustainable income from sustainable fishery.

Literature has shown that among the problems and constraints are mechanisms for determining price, autonomy on buyers, inadequate fishing vessels, lack of freezing storage facilities, long-distance from fishing sites, fisher's socio-demographic characteristics and lack of reliable buyer (Sambuo *et al.*, 2019).

This paper examines factors that could influence fisher's participation in contract fishing around Lake Victoria, Tanzania. The focus is on decision to participate because Ostrom's principle for collective-choice arrangements states that, individuals are affected by contractual arrangements and can make adjustments on guiding rules through participation (Botto-Barrios and Saavedra-Diaz, 2020). It is hypothesized that there are no significant input market factors influencing artisanal fishers' participation in

fishery contract fishing.

Several approaches have been used to analyze factors which influence contract engagement. For example, Satria & Li (2017) employed probit regression to analyze factors influence contract engagement in the small-scale tuna fishing economies in East Java, Indonesia. The study by Frank & Umoh (2015) used multinomial logit model to examine the determinants of fishermen participation in contract fishing in Nigeria while Espinoza (2014) used the generalized propensity score (GPS) methodology and the dose-response function approach to study the share contract choices and economic performance from the artisanal fisheries sector in Chile. In the Philippines, Canarje (2007) used qualitative approach to explore contractual arrangements in Philippine fisheries. The analytical approach of these studies differs and has yielded conflicting results on factors influencing participation or non-participation in contract fishing arrangements.

With regard to decision to participate in contractual arrangements, Ton (2017) presents a review on approaches used to study in effectiveness of contractual arrangement participation including Heckman Two-Stage Selection models, Instrumental Variables (IV), Propensity Score Matching (PSM). Among the approaches, the Heckman selection model is widely used because it controls for potential selection bias that influence contracts participation. Meanwhile, propensity score matching (PSM) is often used to evaluate the impacts of a binary treatment variable (Ragasa *et al.*, 2018).

The present study employed logit model because independent variables constitute both dichotomous and continues variable and dependent variable is a binary choice variable on decision whether to participate or not to participate (Greene, 2003). Due to scanty literature to inform input market factors influence artisanal fishers' participation in contract fishing, the existing factors are inferentially diversified in fishery economics to conclude the same around Lake, Victoria

Tanzania.

METHODS

The study was conducted around Lake Victoria in Mwanza Region because it is the ‘leading fish market stop centre’ in Tanzania (URT, 2017) with about 52 942 fishers and high poverty rates of 34.6 percent (URT, 2014; NBS, 2019). Two districts within Mwanza Region: Sengerema and Buchosa were purposely selected. A cross-section study design was used with six landing sites: Busisi, Kijiweni, and Nyakalilo in Sengerema District, and Kanyala, Itabagumba, and Bulyaheke in Buchosa District being selected with the assistance of the respective District Fishery Officials. A sample of n = 300 fishers was selected from the N = 1200 total fishers’ population of the two districts (URT, 2017). Sampling frame per landing site was obtained with the assistance of the District Fishery Officers and Ward Executive Officer. Proportionate sampling technique was used with a sampling fractional of n/N = 300/1200 = 0.25 (Table 1), which was followed by simple random sampling of fishers from each landing site using a lottery approach.

Table 1: Sample size determination

Landing Site	Sampling frame	Sample size
Busisi	N ₁ = 254	n ₁ = 63
Kijiweni	N ₂ = 184	n ₂ = 46
Nyakalilo	N ₃ = 118	n ₃ = 30
Kanyala	N ₄ = 296	n ₄ = 74
Itabagumba	N ₅ = 156	n ₅ = 39
Bulyaheke	N ₆ = 192	n ₆ = 48
Total	N=1200	n=300

Questionnaire was used to collect quantitative data from 300 respondents. 289 out of 300 fishers, that is a 96 percent response rate, completed the questionnaires.

Qualitative data were collected through six Focused Group Discussions, one at each landing sites. Each FGD had eight artisanal fishers. In addition, Key Informant Interviews (KII) were also conducted. Key informants were selected based on their availability using purposive sampling and

constituted leaders from fishers, one buyer from Sengerema, one agent from Buchosa, two Beach Management Unit (BMU) leaders, two District Fishery Officers, one representative from the Tanzania Fisheries Research Institute (TAFIRI) and two Village Executive officials, amounting to 12 key informants.

Econometric Model and Estimation:

Suppose that U_a and U_b represent a AF utility for two choices on whether to participate or not to participate in contract fishing, which are denoted by Y_a and Y_b respectively (Ragasa *et al.*, 2018). The decision to participate is on the assumption that income security will change positively and dependency on loans will be minimized, henceforth utility maximization. Therefore, linear random utility model could then be specified as:

$$Y_a = \beta_a X_i + \varepsilon_a \text{ and } Y_b = \beta_b X_i + \varepsilon_b \text{---(1)}$$

where Y_a and Y_b denote perceived utilities of participation or non-participation respectively, X_i is the vector of independent variables that affect the perceived desirability of the choices, β_a and β_b are parameter estimates of independent variables, and ε_a and ε_b are disturbance terms assumed to be independently and randomly distributed (Greene, 2003). In the case of participation in contract fishing, if a fisherman decides to participate, it follows that the perceived utility or net benefit from participation is greater than the utility or net benefit from non-participation depicted as:

$$Y_{ia}(\beta_a X_i + \varepsilon_a) > Y_{ib}(\beta_b X_i + \varepsilon_b) \text{-----(2)}$$

The probability that a fisherman will participate in contract fishing could then be defined as:

$$P(U=1/ X) = P(Y_{ia} > Y_{ib}) \text{-----(3)}$$

$$P(\beta_a X_i + \varepsilon_a - \beta_b X_i - \varepsilon_b) > 0/X$$

$$P(\beta_a X_i - \beta_b X_i + \varepsilon_a - \varepsilon_b) > 0/X$$

Where P is a probability function, Y_{ia}, Y_{ib} and X_i are as defined above, ε = ε_a - ε_b is a random error term, β_p = (β_a - β_b) is a

vector of unknown parameter estimates that can be interpreted as a net influence of the vector of explanatory variables influencing participation, and $f(\beta_{\alpha}X_i)$ is a cumulative distribution function of ε evaluated at $\beta_{\alpha}X_i$. The exact distribution of f depends on the distribution of the random disturbance term ε (Greene, 2003). Using input market factors influence artisanal fishers' participation in contract fishing, a logit model was estimated to determine the likelihood of fishers to engage in contracts fishing. The logistic model was employed because independent variables constitute both dichotomous and continues variable (Greene, 2003).

The logit model for the representative farmer 'i' can be expressed as follows:

$$Y_i = \log\left(\frac{P_i}{1-P_i}\right) = \alpha + \sum_{j=1}^n \beta_{\alpha}X_i \text{ -----(4)}$$

Where; Y_i is a dichotomous dependent variable that had two categories, participated in contract fishing coded as 1 and "otherwise" coded as 0.

$$Y_i = \begin{cases} 1, & Y_i *_{i} > 0 \text{ Participating in contract fishing} \\ 0, & \text{Otherwise} \end{cases}$$

The variable X_i represents the different factors affecting the fisher's participation. In this regression model, the vector consists of

inputs market variables such as vessel ownership, fishing tools on credit, extension services, market access, cash loans, risk reduction, landing price, age, education and experience of fishers. The variables are defined in Table 2.

The Log-odd ratio $\log\left(\frac{P_i}{1-P_i}\right)$ is the logarithm of the odds that a choice will be made by the fisher. P_i is the probability of a proxy variable $Y_i = 1$ and $(1 - P_i)$ is the probability of $Y_i = 0$ and ε_{α} is the error term. The estimated coefficients of the logit are interpreted by the signs of parameter estimate and their statistical significance by using the indicated direction of the response associated with the presence or level of a particular variable. Thus, category-specific marginal effects are often reported (Green, 2003). To ensure data validity and reliability, constant comparison approach by Lewis-Beck *et al.*, (2004) was used. Meanwhile, the maximum likelihood estimation procedure was used to estimate the model coefficients and Wald statistics test was statistically significant ($P < 0.05$) indicated a good model fit. There was no covariance found between variables during checking for multicollinearity. Tolerance statistics was found to be greater than 0.1, which does not signify the presence of multicollinearity.

Table 2: Descriptions of variables

Variable	Meaning	Unit/Value
Vessel Ownership	Number of vessels own by AF	Units
Fishing tools	The total cost of the unit price of tools received	TZS
Extension services	Fishery advice received	Yes = 1; No = 0
Market access	Profit earned from buyers	TZS
Cash loans	Amount of loans in cash issued in advance by the buyer	TZS
Landing price	Price of fish paid by buyers	Satisfied=1; Notsatisfied=0
Risk reduction	Amount of shared distribution per vessel	Kilograms
Age	Number of years since born	Units
Education	Number of years in schooling	Units
Experience	Number of years practicing fishing and selling	Units

FINDINGS

Socio-demographic characteristics

Social and economic characteristics of the fishers have important implications on contract fishing participation. This study found that the mean average age of the fishers is 27 years with a maximum of 44 years of age and a minimum of 15 years and their main income occupation is fishing as responded by 91% (Table 3). This age average concurs with the fact that fishing is labor-intensive, task oriented and needs younger persons (Espinoza, 2015). The study found gender is sensitive as such that only 3.0 % of them were women and 97% are men from the sample selected undertaking fishing activities. Therefore, it is undoubtedly that a large number of men are participating on fishery activities. With regard to

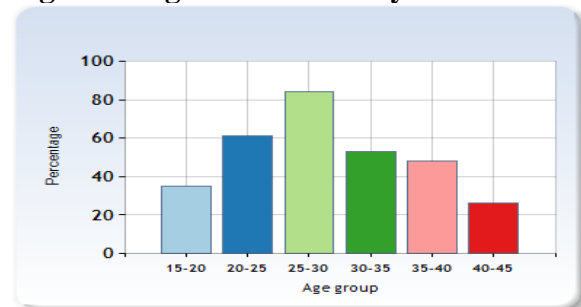
level of education, the study found out that, by an average majority of fishers have 5 years of schooling which is incomplete primary education level. This level of education is thought to lower confidence of AF on negotiating the adjustments of the guiding rules for contractual arrangements. Lower confidence of negotiation hinders meeting the better price that could infect positively, their income earning (Wamukota *et al*, 2015). With this grounds, income insecurity and loans dependency among AF from patron-client system is subject to their level of education. This finding is contrary to Satria & Li (2017) found education do not significantly influence participation in contract fishing.

Table 3: Socio-demographic characteristics of respondents (n = 289)

Variables	Descriptive Statistics		
	Sub-Variables	Mean (Range)	%
Age (yrs)		27 (15 – 44)	
Sex	Male		96.9
	Female		3.1
Household Size		4 (1 – 11)	
Occupation	Fishing		91
Education		5 (0 – 11)	
Experience		14 (1 – 21)	
Contracted fishers		198	
Non contracted artisanal fishers		91	

With regard to fishing experience, AF was found to be 14 years by average. A majority of AFs were aged between 25-30 years (Figure 1) while fishing is the only income source for 91% of AFs.

Figure 1. Age distribution by fishers



During an interview at Bulyaheke, a fisherman explained that, ‘...when I reach 50 years,

it will be difficult for me to be part of the crew and compete with the young ones in fishing...’ He implied that the entrance of youth in fishery activities is positive development. Older AFs are quitting from the contractual fishing arrangements because of the increasing difficulty of meeting required rules. They, instead, opted for other income generating opportunities apart from contract fishing.

Input market factors’ influence income insecurity and loans dependency

Inferential results in Table 4 show the logistic regression results of the input market factors influenced artisanal fishers’ participation in contract fishing. These input market factors—vessel ownership, market access, cash

loans, experience and age of AF—were statistically significant ($p < 0.05$) and they influenced AF participation in contract fishing. The age square coefficient found a negative relationship, implying a decrease in participation in contract fishing with regards to an increase of age of artisanal fishers. The findings concur with result in Figure 1, whereby majority of youth participates in fisheries activities and quit at age 44 and above.

Table 4: Factors influencing contracted artisanal fishers on contract fishing participation

Factors	Coefficients	S.E.	P-value
Vessel Ownership	0.748**	0.027	0.043
Fishing tools on credit	0.422	0.318	0.336
Extension services	0.023	0.094	0.457
Market access	0.136**	0.057	0.029
Cash loans	0.270*	0.114	0.0239
Landing price	0.374	0.228	0.170
Risk reduction	-0.076	0.127	0.499
Age	0.116	0.126	0.907
Age square	-0.821**	0.302	0.0348
Education	0.507	0.411	0.0664
Experience	0.712***	0.234	0.0439
IMR	1.125	0.1415	0.408
R ²	0.73		

***Sign. at 10%, **Sign. at 5%, *Sign. at 1%

With regard to the coefficient of vessel ownership, it was found to be positive and significant at p-value of 0.043 ($P < 0.05$). Thus, fishing vessels remain important input market factor that majority of AF do not own, and accessing these vessels was through a means of contractual arrangements which is impacting AF income earnings. Organization of fishery institution, or rather fishery cooperatives have been found to influence group ownership of these vessels and supplies of quality fish (Chandrashekar, 2014). It was reported during an FGD, that ‘...the cost of owning a canoe, includes being able to pay for a fuel cost, feeding crew with food and maintenance of engine machine are very high to be affordable by us but a rich man can afford...’ (Busisi, April 2017). The highest cost of owning fishing vessels/canoe were found to be

reasons why fishers opt participating in contract fishing.

Market access was also found to be significant ($p < 0.05$) and positive with p-value of 0.029. Availability of buyers, nearby landing sites, and price paid were presumed to facilitate daily fish trading for those who are in contract fishing. However, income from fish trading is thought to be unsatisfactory among AF due to existing informal collusion by buyers (cartel) causing low price paid. Therefore, market access remains a key input market factor. During FGDs, it was found that contract fishing package includes provision of fishing vessels, availability of the contracted buyer, assurance of the purchase of the landed catches and therefore makes market accessible.

The coefficient of cash loans was found to be positive and significant ($p < 0.05$). The cash loan obtained found to be influential to AF participation in contractual arrangements as it serves for income inadequacy through advance loans. This reflecting that a financial institution (FI) would help resolve issues linked to financial resources. The role of FI should be assumed by buyers as it is a loophole for capital exploitation and inadequate sustainable mechanism in fishery business.

With regard to age, the coefficient was found negative and significant at p-value of 0.821. Following descriptive statistics (Figure 1), as age increases, participation in contract fishing increases, but only up to a point before it decreases.

Furthermore, experience in fishing was also positive and significant ($P < 0.05$), which implies that as the number of years in fishing increases, assurance of income and loans increases from contract fishing. AF experience increases on their ability to negotiate on contracts rules for the paid landing price and other items assigned with, as well as recognize the honest buyers. New fishermen need support of the fishery organization to meet their demands on input market factors other than individual experience hence contribute to sustainable business.

Input market factors for non-contracted fishers

Vessel ownership was found positive and significant ($P < 0.05$) with regard to factors for non-contracted fishers (Table 5). This implies that AF are willing to obtain fishing vessels via contractual arrangements to improve their fishing opportunities and income sources. These findings align with FGD data which indicate that ‘...it is profitable to join contracts if fish facilities are provided by buyers, but buyers are sometimes biased by offering quality fishing vessels to their relatives....’

Table 5: Factors influencing non-contracted artisanal fishers on contract fishing

Factors	Coefficients	S>E.	P-value
Vessel Ownership	0.367***	0.013	0.001
Fishing tools on credit	0.012	0.008	0.013
Extension services	0.114	0.107	0.812
Market access	0.018**	0.006	0.000
Cash loans	0.123	0.844	0.011
Landing price	0.234	0.176	0.091
Risk reduction	-0.543**	0.215	0.040
Age	0.102	0.633	0.401
Age square	-0.013	0.002	0.000
Education	0.045**	0.012	0.021
Experience	0.212	0.134	0.173
IMR	0.985	0.213	0.207
R ²	0.81		

***Sign. at 10%, **Sign. at 5%, *Sign. at 1%

When non-contracted AF asked if participating in contract fishing could influence a market access, the coefficient result from the analysis of market access was positive and significant ($P < 0.05$). Thus, there is an influence of shift from domestic fishing to commercial fishing along the landing sites if these group have to access fish market. The opportunities are to access more buyers and fishing vessels, hence increase on income opportunity for non-contracted AF. This finding avails the continuing demands of input market factors for non-contracted AF. The education coefficient for non-contracted artisanal fishers was positive and significant ($P < 0.05$). It implied that an increase in years of schooling among non-contracted artisanal fishers’ contributed positively on the increase in

negotiating confidence and fishing skills that could ensure profitable contractual arrangements.

The economic governance theory validated the results that, fishing vessels required by AF form the basis for sustainability plan of fish market and trading. The financial support in cash loans also attributed to economic governance theory on the importance of government inclusion of FIs to support financial challenges that could not be encountered during contract fishing. However, risk reduction and education are distinct input market factors found influence income opportunities only to a group of non-contracted AF participation.

Risk reduction also remains elusive among non-contracted AF and this influenced participation in contractual arrangements. The result concurs with Balassone *et al*, (2018). By implication, sustainable fishery business should be a risk free and support both social and ecological management. This calls for a policy framework at local level and across the countries on enabling legislation that supports fishery business by utilizing the market access, fishing vessels, age and experience of AF through proper arrangements, exploration of equal benefits and financial inclusions among AF.

CONCLUSION

The study aimed to investigate market input factors that influence income and dependency on credits to both contracted and non-contracted AF. The study concludes that for AF to become sustainable on income security, vessel ownership, market access, cash loans, age, and experiences are inputs market factors for contracted artisanal fishers. Meanwhile non-contracted artisanal fishers identified vessel ownership, market access, risk reductions, and education as input market factors that influence their income security and participation in contract fishing. The study concluded that AF contract fishing life satisfaction initially increases but starts to decline by 45 years, when fishers start quitting their business.

This study recommends that AF should develop fishery institutional mechanism as a means towards owning of fishing vessels and other facilities that could reduce dependence on loans. Government and local authorities should ensure provision of fishery market skills during institutional arrangements and planning. Subsidized technologies in fishing vessels that boost quality and size of fish catches from developed nations in collaboration with recipient countries and local authorities are additional critical inputs needed by artisanal fishers. The recognition of AF membership framework for sustainability of the crews in fishing for collective bargaining and ownership of the vessels was beyond the scope of this study, thus a focus on fishery cooperatives remains a gap for further research.

Acknowledgement

The author is grateful to the anonymous researchers for their extremely useful and mentoring capacity.

Funding

The author received financial support for the research, from Moshi Co-operative University, Moshi-Tanzania.

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