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## YOUTH INVOLVEMENT AND THEIR BARRIERS TO TILAPIA FARMING IN CENTRAL MALAWI

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## ABSTRACT

Despite the growing importance of aquaculture in enhancing food security and livelihoods in Malawi, youth participation in the sector remains alarmingly low. This study explored the barriers limiting youth engagement in tilapia farming. Using a multi-stage sampling technique, data was collected between January and February 2022 from 102 respondents across Dowa and Mchinji districts in Central Malawi comprising both tilapia farming participating and non-participating youths. A mixed methods approach was employed, combining descriptive statistics, Garrett ranking, thematic analysis, and Probit regression to analyze socioeconomic factors and rank the severity of entry barriers. The findings revealed that participating youths were significantly older (29.0 vs. 26.0 years,  $p = 0.007$ ), more likely to own land (73.2% vs. 36.1%), and had substantially higher access to extension services (92.7% vs. 21.3%), training (75.6% vs. 24.6%), and fish farmer clubs' members (51.2% vs. 11.5%) than non-participants. Major deterrents included lack of capital (36.2%), high feed costs (34.5%), limited availability of quality fingerlings (35.3%), and poor access to profitable markets (23.2%). Cultural norms restricting land inheritance further constrained young women's ability to own ponds or production assets. Access to extension services had the largest marginal effect, increasing the probability of participation by 71.5 percentage points. Membership in farmers' clubs raised the likelihood by 43.9 points, land ownership by 54.4 points, and access to training by 52.2. Household size also had a significant positive influence, increasing the probability by 7.5 percentage points. The Garrett ranking analysis identified lack of capital and credit as the most severe barrier (78), followed by high feed costs (77) and lack of quality fingerlings (75). In contrast, water scarcity and disease outbreaks were ranked as less critical but still offered relevant challenges. The study concludes that structural, institutional and perceptual barriers must be addressed through targeted interventions such as youth inclusive policies, subsidized input schemes, expanded extension services and land access reforms. Additionally, enhancing financial literacy and creating youth-tailored financial products could increase participation. These insights are critical for policymakers, development partners, and private actors working to promote inclusive aquaculture development in Malawi and similar contexts across sub-Saharan Africa.

**Key words:** Entry barriers, Malawi, Youths, Participation, Fish farming, Tilapia, Probit Regression Model

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## INTRODUCTION

Youth are important to global development, playing a role as drivers of progress and ambassadors for driving the sustainable development agenda. However, they play a limited role in championing sustainable food approaches like aquaculture. They face significant resources and socio-economic barriers to inclusion in sustainable development approaches that hinder their meaningful participation [1,2]. While youth constitute 15% of the global population, Africa has 75% of its population aged under 35 years and 60% under 25 years. This demographic trend presents a major employment challenge, with only 3 million jobs created annually against 11 million job seekers [1]. Developing countries in sub-Saharan Africa (SSA), despite being rich in agricultural potential, face limited economic pathways and lags in achieving Sustainable Development Goal (SDG) targets [1,3]. In 2023, 21.9% of youth in sub-Saharan Africa were classified as Not Employed, Educated and Trained (NEET) [3]. Barriers to youth inclusion, particularly in agriculture, restrict their participation and limit overall agricultural development [4,5]. Additionally, inadequate rural and structural transformations have exacerbated youth unemployment, leaving many in precarious and insecure jobs [6,7]. This poses a challenge for emerging agricultural initiatives, such as aquaculture, which is viewed as a sustainable solution to counter declining natural fish stocks. Limited involvement of youths also raises questions regarding the future of fish farming initiatives and the ability to drive conservation of endangered species such as *Oreochromis spp.* from Lake Malawi.

In Malawi, aquaculture has been widely adopted, with tilapia being the most farmed species [8,9]. However, only 13% of the 15,000 fish farmers are youths aged 35 years and below [8]. Their limited participation stems from various factors, including low affinity for agriculture [10], cultural and social norms, resource constraints and limited technical capacity in aquaculture [11]. Social norms often restrict youth and women's access to productive assets and income opportunities [12]. These norms, combined with perceptions that aquaculture is less lucrative, discourage youth engagement. High investment costs, lack of collateral and limited access to affordable financing further constrain youth participation [13]. Additionally, poor sector performance characterized by weak demand signals, reliance on expensive imported feed, and the absence of standards for feed and poor-quality fingerling reduces sector productivity and hence reduces interest in youth participation [9,14]. Insufficient investment in research and development limits innovation and the creation of cost-effective technologies that could attract youth to the sector [9,12]. These barriers have restricted aquaculture growth, with annual production remaining below 10,000 tonnes, contributing only 5% to the total fish catch [8]. The lack of empirical studies on youth participation has led to oversimplified policy responses, leaving critical challenges unaddressed. For instance, although the 2016 National



Fisheries and Aquaculture Policy [15] and Malawi Vision 2063 [16] acknowledge the limited participation of youth in aquaculture, they lack responsive strategies to address these gaps. Where youth do participate, they are often relegated to casual labor, such as pond construction, while young women are confined to processing and trading roles [12]. This limited involvement, coupled with underperforming aquaculture, is concerning for a country that heavily relies on fish as a primary protein source [8,17]. Despite the critical importance of youth participation in aquaculture sustainability, there is a significant research gap in understanding the barriers hindering their involvement [10]. Notwithstanding that, the rise of aquaculture presents an opportunity for youth to contribute towards improved food security and income opportunities while indirectly supporting capture fisheries conservation. Therefore, understanding the barriers to youth participation and their limited interest is crucial for attracting and retaining youth in aquaculture. Youths possess technical capacity, adaptability and innovation, enabling them to adopt sustainable technologies [1,7,12].

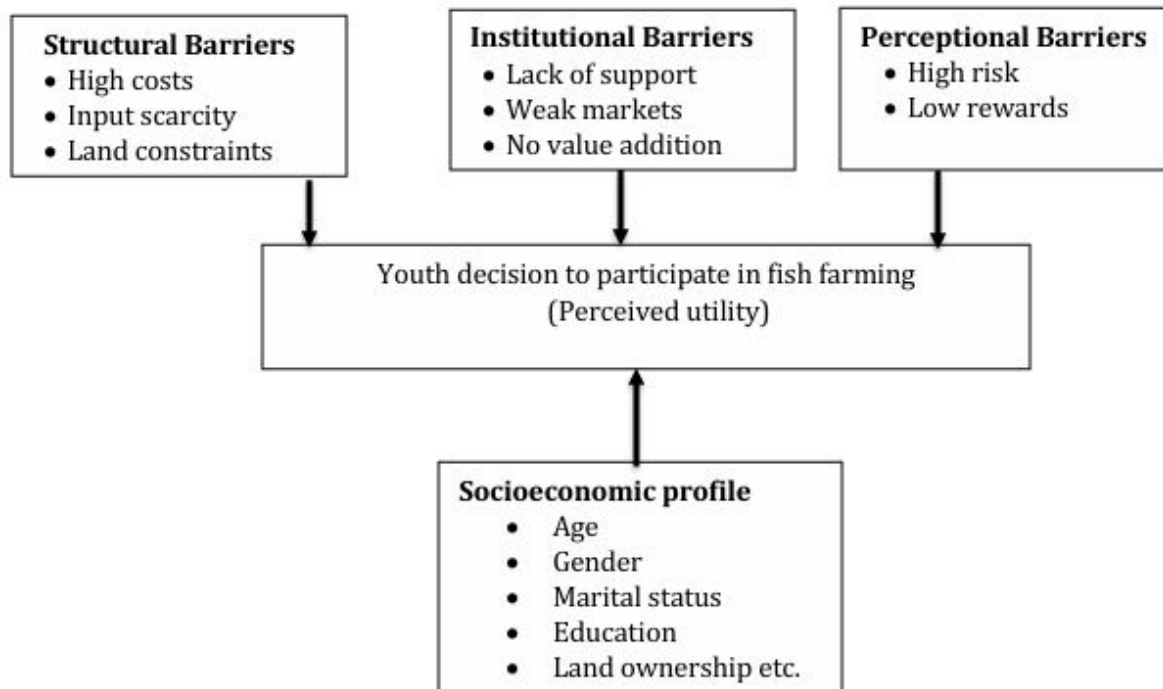
In the present study, Malawi's tilapia farming is used as a case study to understand the barriers limiting youth involvement. Despite efforts by the Malawi government and non-governmental organizations to promote fish farming among youth, many young people remain uninvolved [9]. This limited participation undermines food security and economic growth, as it results in unrealized production potential and missed employment opportunities [8,15]. However, little information exists on the specific barriers impeding youth participation in tilapia farming. Most studies have focused on broader issues such as profitability, women's roles, consumer preferences and general interest in fish farming [14,18,19]. This study analyzed the entry barriers affecting youth participation in tilapia farming in Dowa and Mchinji districts. The study addresses three research questions: Which socioeconomic factors influence youth participation in tilapia farming in these districts? What barriers hinder youth involvement in tilapia farming? How do these barriers rank based on their severity?

### **Conceptual framework**

The conceptual framework for entry barriers associated with youth involvement in tilapia farming is illustrated in Figure 1. This framework posits that a youth's decision to participate in tilapia farming is a function of the perceived utility they expect to derive from the enterprise, as grounded in random utility theory [20]. This decision is directly inhibited by a set of interconnected barriers, which are also influenced by the youth's socioeconomic characteristics.

The core barriers include structural, institutional and perceptual. Structural barriers relate to tangible and material constraints.





**Figure 1: The conceptual framework for the study**

In this study, these include the inability to access start-up funds, loans, or credit facilities [7,13]. They also include the high cost and limited availability of essential inputs, especially quality feed and fingerlings [9,14]. Another major barrier is the lack of access to suitable land for constructing fish ponds. For women, this challenge is often worsened by cultural norms that restrict land ownership [1,12]. These barriers collectively limit youth participation in aquaculture.

Institutional barriers are associated with constraints related to systems, services, and policies, and in this study lack of knowledge and extension service technical support on modern aquaculture practices [12]. In addition, unreliable market linkages, low fish prices, and a lack of knowledge on value addition [7,14] also affect fish farming participation. As for perceptual barriers which look at subjective beliefs and attitudes, this study also views that fish farming is a high-risk, low-reward activity compared to other livelihoods such traditional crop farming [10].

Furthermore, youth socioeconomic profile (for example age, gender, land ownership, club membership) influence their ability to overcome these barriers. The greater the cumulative weight of these barriers, the lower the perceived utility of participation, leading to the decision not to engage in tilapia farming. Conversely, interventions that reduce these barriers increase perceived utility and the likelihood of participation.

Such entry barriers include high costs of feed, a deficiency in extension services, restricted access to better markets, theft, an increased risk of disease outbreaks, limited access to improved fingerlings, insufficient government incentives and policies, and water scarcity during the dry season [21].

### **Theoretical framework**

This study is based on the application of choice models, which are grounded in utility theory and provide precise predictions of individual responses in specific scenarios [22]. According to random utility theory, the utility of individuals is derived from a choice that consists of a systematic component, which captures attributes of the alternatives and characteristics of the decision-maker, and a random idiosyncratic component [22]. In this study, the decision of youths to participate in tilapia production can be influenced by the systematic component, with socio-economic factors serving as the characteristics that determine their participation or non-participation in tilapia farming.

Choices to participate can be best described by McFadden [20], who highlighted that choice models are precise and versatile tools for predicting human decision-making behavior. This approach allows for the specification of the sample covariance matrix [22]. For instance, discrete choice modeling, which is closely linked to utility theory, examines the decision-making behavior of individuals facing discrete economic alternatives [22]. However, Utility theory, which is concerned with people's choices, decisions, and preferences, plays a crucial role in predicting actual choice behavior or prescribing how rational decisions should be made [20]. In economics, qualitative response models, which are closely tied to utility theory, have been extensively used to explore factors influencing individuals' choices among alternatives [22]. Models estimating dichotomous choices with a binary dependent variable trace their roots to the threshold theory of decision-making. According to this theory, reactions occur only when the strength of a stimulus surpasses the individual's reaction threshold [23,24].

In the context of this study, the threshold theory suggests that when youths decide whether to participate in tilapia production, each youth has a reaction threshold determined by certain factors [24]. These factors may be socio-economic factors outlined in the conceptual framework. The binary choice model is represented as  $Y_i = BX_i + U$  where  $Y_i = 1$  indicates a choice is made, and 0 otherwise. This implies that every young person in the study areas has a reaction threshold dependent on specific factors, leading to either participation or non-participation in the tilapia production. The utility derived from participation, often in terms of income, social status, and nutritional value, motivates youth to engage in the tilapia production.



## MATERIALS AND METHODS

### Area of study

The study was conducted in central Malawi, focusing on Dowa and Mchinji Districts, which are prominent in aquaculture [25,26]. The study was conducted in Mponera, Madisi, and Mndolera Extension Planning Areas (EPAs) in Dowa, and Mkanda and Msitu EPAs in Mchinji (Figure 2). These areas were selected based on the significant number of fish farmers present. Dowa is located at coordinates 13°35'S, 34°00'E, about 40 km north of Lilongwe, covering an area of approximately 3,041 km<sup>2</sup> with a population of 772,569 [27]. Mchinji, situated at 13°45'S, 33°05'E, lies 110 km west of Lilongwe, spanning 3,356 km<sup>2</sup> with a population of 602,305 [27]. Both districts share similar agroecological conditions, including annual rainfall ranging from 750 to 1,000 mm and temperatures between 23°C and 36°C [25,26]. Aquaculture in these areas is supported by the presence of small water bodies such as rivers, along with soils with good water retention, making them suitable for earthen ponds fish farming [25,26]. Over the past five years, donor-funded programs aimed at promoting youth and women's involvement in aquaculture have been implemented. Despite these efforts, youth participation remains low. Mchinji has 516 fish farmers while Dowa has 301 fish farmers [25,26].

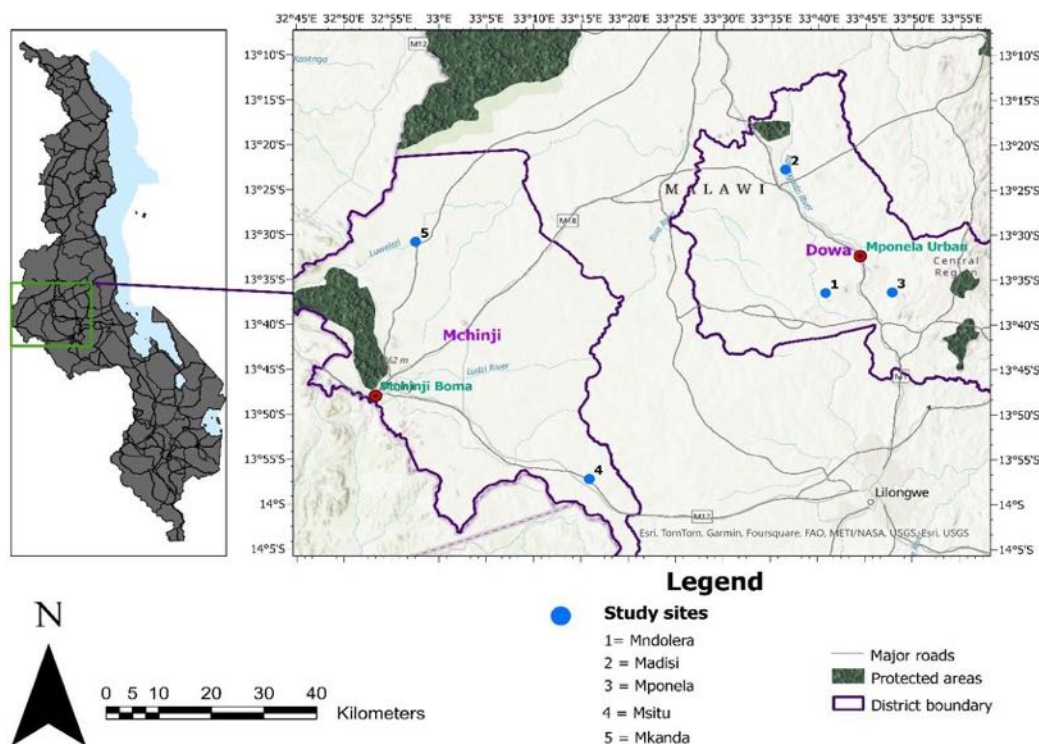


Figure 2: Location map of the study area showing five key survey locations in Dowa and Mchinji districts in central Malawi

## Sampling

A mixed-methods research design was employed, integrating quantitative and qualitative data collection and analysis. A multistage sampling technique was used to sample participants, and it incorporated both purposive and simple random sampling methods. In the initial stage, five out of the fifteen Extension Planning Areas (EPAs) in Dowa and Mchinji were purposively selected based on the number of fish farmers in each EPA. Secondly, 41 young individuals below the age of 35 who were not fish farmers were randomly sampled. Finally, a sample of 61 young fish farmers aged 35 years and below were randomly sampled. To ensure a representative sample, the distribution of participants across each EPA was adjusted based on the number of respondents in that specific EPA.

## Data collection

The data collection process was carried out between January and February 2022 using mixed methods. Qualitative data was collected using Focus Group Discussions (FGD) and Key Informant Interviews (KII) using checklists, while household interviews using semi-structured questionnaires were used to collect quantitative data. Focus Group Discussions were conducted with youths who were fish farmers and those who were not. Key Informant Interviews were conducted with leaders of farmer groups and District Fisheries Officers (DFOs). A total of 4 Focus Group Discussions (FGDs) (2 with participating youths, 2 with non-participating youths, with 8-10 participants each) and 8 Key Informant Interviews (KIIs) (4 with leaders of farmer groups and 4 with District Fisheries Officers) were conducted. These provided insights into the barriers faced by youths and the ongoing promotional activities aimed at enhancing youth participation in tilapia farming. In addition, household interviews were conducted with both youths in tilapia farming and non-farming households. The questionnaire covered key aspects of socio-economic characteristics, barriers hindering youth participation, factors motivating youth participation in fish production, promotion activities aimed at enhancing youth participation in tilapia farming and determining the ranks on the severity of each entry barrier affecting youth participation in fish farming.

## Data analysis

Descriptive statistics (means and frequencies) and inferential statistics were analyzed in Stata version 17. The chi-squared test of independence was used to determine if association between farmers participating in tilapia farming or not existed. Furthermore, the Garrett ranking method was used in ranking severe entry barriers affecting youth participation in tilapia farming. To determine factors affecting youths' participation in tilapia farming, a Probit regression model was selected as it is appropriate for modelling binary dependent variables and is grounded in random



utility theory, which aligns with the theoretical framework of this study [20]. The model is expressed as follows:

$$P(Y_i=1) = \Phi (\beta_0 + \beta_1 \text{HouseholdHead}_i + \beta_2 \text{Age}_i + \beta_3 \text{Education}_i + \dots + \beta_{12} \text{Training}_i)$$

Where:

- $Y_i = 1$  if the youth participate in tilapia farming, 0 indicating non-participation
- $\Phi$  = cumulative distribution function (CDF) of the standard normal distribution

The independent variables used in the model, along with their expected signs, are presented in Table 1.

Qualitative data underwent thematic analysis, following the framework proposed by Braun and Clarke [28]. This process involved familiarization with the data, generating initial codes, searching for themes, reviewing themes and defining and naming themes.

## RESULTS AND DISCUSSION

### Demographic and socioeconomic characteristics

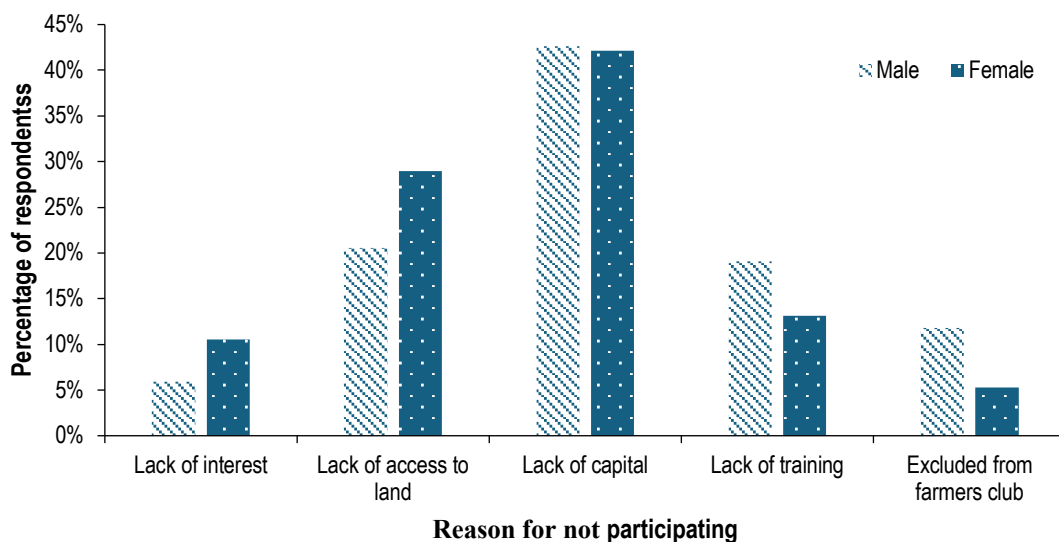
The socioeconomic and demographic information of the respondents is presented in Table 2. The mean age of both participating youths ( $29.02 \pm 5.10$ ) and non-participating youths ( $26.00 \pm 5.66$ ) in tilapia farming was below 30 years. However, participating youths were significantly older than non-participating youths ( $p = 0.007$ ). This aligns with findings by Mulema *et al.* [29], who noted that older youth tend to have more stability, access to resources and confidence to invest in long-term agricultural ventures such as aquaculture. However, younger youth may still be in transitional stages, facing uncertainties in career direction or lacking access to enabling assets such as land and capital. Marriage status also emerged as a distinguishing characteristic, within these age groups, as most respondents were married (80.5% of participants and 70.5% of non-participants). This supports the argument by Asfaw *et al.* [30] that marital status can influence livelihood decisions and labor allocation. Married individuals often face more economic pressure to secure income, thus making them more inclined to participate in productive ventures such as aquaculture. The household structure showed a predominance of male-headed households (58.5%), with a mean family size of  $5.14 \pm 2.42$  people for participating youths and  $4.51 \pm 1.73$  for non-participants. Larger family sizes as is the case with youths participating in fish farming may provide additional household labour, which is a critical asset in labour intensive practices like fish farming [31]. However, female-headed households may face more barriers due to cultural norms restricting land access and control over assets [11].



In addition, both participating and non-participating youths had low levels of education, spending less than 8 years in school. Previous studies by Mussa *et al.* [18] and Thidza *et al.* [19] confirm the dominance of less educated individuals in fish farming. These low levels reflect broader challenges in rural youth development. Despite low formal education, many youths showed potential interest in agriculture-based livelihoods, which suggests that targeted non-formal and vocational training programs can bridge the skill gap and promote inclusive aquaculture development [24]. Comparing participating and or non-participant youths, a significantly higher proportion of males had land for fish farming (73.2% vs. 36.1%), accessed extension services (92.7% vs. 21.3%), were members of fish clubs (51.2% vs. 11.5%), and had access to fish farming training (75.6% vs. 24.6%).

### Reasons for not participating in tilapia production

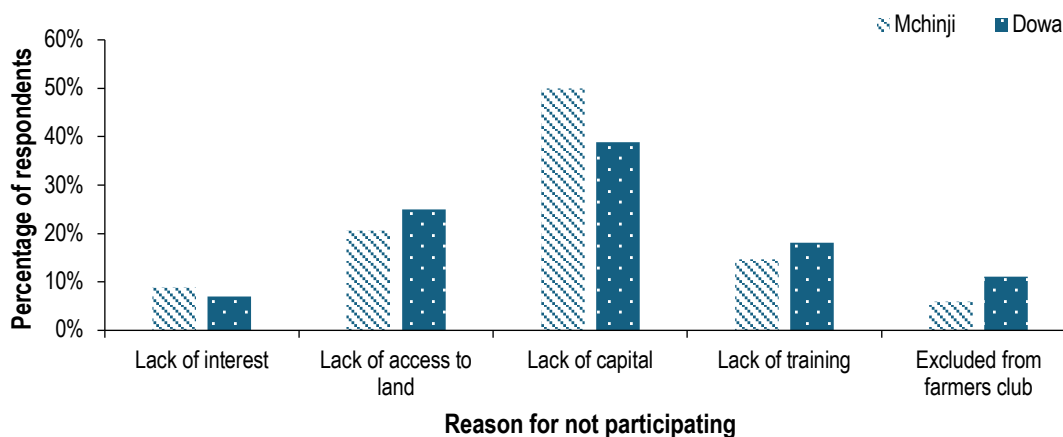
Five main reasons were attributed to not participating in tilapia farming: lack of access to land, lack of capital, lack of access to fish farming training, exclusion from farmers' club membership, and lack of interest (Figures 3 and 4). When compared by sex (male - 43%, female - 42%) and between districts (Mchinji - 50%, Dowa - 39%), a lack of capital was identified as a major obstacle. On the other hand, a smaller proportion of respondents (male - 6%, female - 11%; Mchinji - 7%, Dowa - 9%) lacked interest in tilapia farming.



**Figure 3: Perceived reasons for not participating in tilapia production based on the sex of youths from Dowa and Mchinji districts**

The same sentiments were echoed during an FGD discussion with youths from Mponela EPA... "Lack of capital is a significant challenge for both males and females

because there are no financial interventions or specific projects aimed at attracting us to farm tilapia. However, in many cases, males are more likely to inherit fish farming land from parents compared to female youths due to cultural influences."



**Figure 4: Perceived reasons for not participating in tilapia production from Dowa and Mchinji districts**

Furthermore, Klls with District Fisheries Officers indicated that the design of many projects or interventions in fish farming is tailored to work with existing farmers, with little effort made to entice non-participating youths into these programs. Additionally, to qualify as a farmer, individuals are often required to have land suitable for fish farming, which many youths lack because land is typically owned by their parents. If they have land, in many cases, they are small size, which they prioritize for maize farming to support their family.

### Socioeconomic factors affecting youth participation in tilapia production

The Probit regression model results for factors influencing youth participation in tilapia farming are shown in Table 3. The model was statistically significant ( $\text{Prob} > \chi^2 < 0.01$ ), indicating that the variables collectively influenced youth participation in tilapia farming. The Hosmer-Lemeshow test confirmed the model's goodness-of-fit ( $\chi^2 (8) = 3.53$ ,  $\text{Prob} > \chi^2 = 0.8972$ ). The high p-value indicates failure to reject the null hypothesis, confirming the model fits the data well. Youth participation in tilapia farming was significantly influenced by access to extension services, membership in farmers' clubs, land ownership, training and household size. Access to extension services had the largest marginal effect, increasing the probability of participation by 71.5 percentage points. Membership in farmers' clubs raised the likelihood by 43.9 points, land ownership by 54.4 points, and access to training by 52.2. Household size also had a significant positive influence, increasing the probability by 7.5 percent. In contrast, household headship, age, years of education, marital status,



and migration intent had no statistically significant impact points. Household size is closely linked to human capital [32] since larger families can provide the labor required for the labor-intensive tasks of pond preparation, feeding and harvesting, which are often manual in developing countries [9]. Large household sizes also encourage diversification of livelihoods to reduce vulnerability to risk, with fish farming offering an additional source of income and protein [33]. Studies by Mussa *et al.* [18] also found that household size positively influences fish farming participation. In addition, access to extension services and training was found to have a significant positive effect on youth participation, as they provide the necessary knowledge and expertise for fish farming [32]. Extension services may help youths to view fish farming as a business, further encouraging their involvement [12]. These findings align with the work of Mussa *et al.* [18] and Ragasa and Mzunda [33], who emphasized the vital role of extension services in transferring new farming techniques and technologies to farmers, thus increasing household participation in tilapia farming.

Furthermore, youth participation in farmers' cooperatives increased their ability to participate in fish farming. Group membership enables youths to learn more effectively about fish farming, access fish seeds, markets, feed, and financial support, which can be challenging when operating independently [34,35]. Extension services providers and lead farmers also find it easier to disseminate important information through farmers' clubs rather than visiting individual farmers. Cooperatives provide easier access to finance and help spread aquaculture risks among members [36]. For example, the ongoing Government of Malawi initiative of the Malawi Agricultural Commercialization (AGCOM) Project, which provides financial grants to youth in cooperatives, has been vital in boosting youths' participation in aquaculture. In addition, land ownership has been a motivating factor for youth involvement in fish farming, as pond-based practices in Malawi require land with specific characteristics, such as proximity to water and suitable soil types [9]. Government and international organizations also target individuals with land suitable for pond-based aquaculture. However, while land ownership increases youth participation, it may limit the involvement of young women, as tenure systems often deny them land rights, which are typically inherited by boys [1, 12].

### **Entry barriers that hinder the participation of youths in tilapia farming**

The results in Table 4 present the main entry barriers limiting youth participation in tilapia farming as capital, feed, fingerlings, marketing, and predation and vandalism. On capital, the respondents cited lack of formal credit providers (36.2%), lack of material and input capital (28.4%), collateral (19.2%), and high interest rates (16.2%) as key deterrents limiting their participation. Furthermore, high cost of quality feed



(34.5%), scarcity of floating feed (25.6%), limited knowledge of producing feed (23.1%), and lack of training in feed production (16.8%) were some of the key limiting factors hindering youth engagement. The respondents also indicated that continued reliance on recycled seeds (35.3%), high cost of quality fingerlings (27.2%), scarcity of good-quality fingerlings (21.4%), and lack of training in seed production (16.1%) were additional barriers that together act to limit their participation in fish farming. Predation (38.4%), theft/vandalism (31.1%), and the devastating effect of fish diseases (22.1%). When asked about marketing, youths perceived a lack of profitable markets (23.2%), low fish prices (22.1%), insufficient training in fish marketing (20.3%), and limited knowledge of value addition (17.1%) as key limiting drivers.

The barrier of high feed cost is not purely financial but is compounded by a technical knowledge gap. Respondents cited limited knowledge of producing feed (23.1%) and lack of training in feed production (16.8%) (Table 4). This suggests that interventions addressing only credit access without parallel training on low-cost feed formulation may be insufficient. Enhancing knowledge to reduce dependency on expensive commercial feed could lower the financial entry threshold for youths.

Fish farming requires substantial initial investments in infrastructure and operational inputs such as feed, which are often beyond the financial capacity of many youths [14]. This challenge is exacerbated by stringent lending criteria, the lack of youth-focused financial programs in commercial banks, and the demand for collateral, which restricts access to credit [1,7]. Furthermore, high-interest rates on loans, whether from formal or informal financial institutions, discourage potential youth entrants. The absence of targeted policies and financial initiatives in key aquaculture value chains such as seed production, feed manufacturing, processing, value addition, and marketing limits youth opportunities in the sector [7]. Additionally, the high cost of inputs, especially feed, places youth at a disadvantage even before entering industry. Furthermore, Malawi also faces technical challenges, including the limited availability of quality and all year supply of quantity fingerlings due to the scarcity of hatcheries [9]. This drives up the cost of production [9,18]. While limited access to extension services was rated as a less critical barrier, increasing public awareness of aquaculture's potential as a source of employment, income and food security could enhance youth participation by building their technical capacity and motivation to engage in the sector. While youth are described as potential drivers of sustainability and innovation in agriculture [36], their low participation in tilapia farming limits the sector's ability to meet national goals in food security, employment, and rural development.



## **Ranking of entry barriers based on the perception of youths on the severity of each entry barrier in their communities**

The Garrett ranking method results are presented in Table 5 and reveal that the top barriers limiting youth participation in tilapia farming are lack of capital and credit (rank 1), high feed costs (rank 2), and limited access to improved fingerlings (rank 3). These findings align with Hasimuna *et al.* [20] and Mulema *et al.* [29], who found financial constraints and input inaccessibility to be critical barriers. Conversely, issues such as disease outbreaks, inadequate extension services, and water scarcity were considered less severe, echoing findings by Limuwa *et al.* [37] that structural constraints outweigh environmental or technical concerns.

## **CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT**

The study identified multiple constraints, that are structural (lack of land, capital, infrastructure and access to quality inputs (feed, fingerlings); institutional (limited youth-targeted financial services, weak extension support, and exclusionary land tenure systems (especially affecting women) and perceptual (youth seeing the sector as low status and economically unviable). The study identified leverage points for increasing youth engagement in fish farming. Further, the study reinforced the argument that education, while valuable, can be a barrier in a poorly modernized sector, unless structural and institutional improvements are made. Future research should focus on critical component like financial matters such as the loan structure tailored for aquaculture farmers which may need specific models of financing for the youth.

## **ACKNOWLEDGEMENTS**

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**Table 1: Expected signs for the socioeconomic factors that influence youth participation in tilapia farming from Dowa and Mchinji**

Variable	Description	Expected sign
Household head	Sex of household head; 1= Male, 0= Female	+
Age	Age of respondent.	+
Education	Number of completed years in school.	+
Married	Marital status of respondent; 1= Married, 0= Not married	+
Household size	Household size.	+
Experience	Number of years of experience in farming	+
Extension	Access to extension services; 1= Access, 0= No access	+
Farmers club	Membership to farmers' club; 1= Member, 0= Not member	+
Own land	Own land for fish farming; 1= Owner, 0= Not owner	+
Fish farming is Beneficial	Believe fish farming is beneficial; 1= Beneficial, 0= Not beneficial	+
Desire to Migrate	Desire to migrate; 1= Migrate, 0= No desire to migrate	+
	Respondent is in Mchinji district; 1= Mchinji, 0= Dowa	+
Receiving Training	Received training in fish farming; 1= Received, 0= not received	+

**Table 2: The summary of socio-economic and demographic characteristics of youth respondents from Dowa and Mchinji districts**

Variable name	Participants (n =61)	Non-participants (n = 41)	p-value
Age of respondent (Mean ± SD)	29.02±5.10	26.00±5.66	0.007
Household size (Mean ± SD)	5.14±2.42	4.51±1.73	0.124
Years of education (Mean ± SD)	7.34±3.40	7.54±3.52	0.777
Year of farming (Mean ± SD)	4.71±4.06	3.92±2.67	0.234
Male-headed household (%)	58.54	57.38	0.907
Married (%)	80.49	70.49	0.256
Land for fish farming (%)	73.17	36.07	0.000
Access to extension services (%)	92.68	21.31	0.000
Membership in farmers' club (%)	51.22	11.48	0.000
Access to fish farming training (%)	75.61	24.59	0.000

**Table 3: Probit regression results showing the socioeconomic factors influencing youth participation in tilapia farming in Dowa and Mchinji districts**

Independent variables	Probit estimates		Marginal effects	
	Coefficient	Std. Error	Coefficient	Std. Error
Household head	0.449	0.575	0.147	0.182
Age of respondent	0.037	0.047	0.012	0.016
Years of education	-0.043	0.069	-0.014	0.024
Married	0.749	0.608	0.219	0.152
Household size	0.223*	0.12*	0.075*	0.041*
Access to extension	2.513***	0.543***	0.715***	0.104***
Membership to farmers' club	1.222**	0.568**	0.439**	0.201**
Own land for fish farming	1.781***	0.627***	0.544***	0.164***
Desire to migrate	-0.252	0.496	-0.083	0.159
Received training	1.613***	0.539***	0.522***	0.154***
Log likelihood	-20.573			
Pseudo R2	0.701			
Prob > chi2	0.000			
Pr(Ca) (predict)	0.2774			

Dependent variable: youth participation in tilapia farming, ME = marginal effect, \*\*\*=significant at 1%, \*\*=significant at 5%, \*=significant at 10%. Probit coefficients indicate and marginal effects indicate the change in predicted probability of participation associated with each explanatory variable. The dependent variable is youth participation in fish farming (1 = participate, 0 = not)

**Table 4: Main entry barriers in limiting youth participation in tilapia farming in Dowa and Mchinji districts in Malawi**

Entry barrier	Proportion of respondents
<b>Capital</b>	
Lack of formal credit providers	36.2%
Lack of capital (land, money, and inputs)	28.4%
Demand for collateral	19.2%
High interest rate	16.2%
<b>Feed</b>	
High cost of quality feed	34.5%
Scarcity of floating feed	25.6%
Limited knowledge on producing feed	23.1%
Lack of training in feed production	16.8%
<b>Fingerlings</b>	
Use of recycled seeds	35.3%
High cost of quality seeds	27.2%
Scarcity of good-quality fingerlings	21.4%
Lack of training in the production of quality seeds	16.1%
<b>Predation and vandalism</b>	
Predation	38.4%
Theft and vandalism	31.1%
Fish diseases	22.1%
Parasite's infestation	8.4%
<b>Marketing</b>	
Lack of profitable markets	23.2%
Low prices of fish	22.1%
Lack of training in fish marketing	20.3%
High transportation cost	17.3%
Lack of knowledge on value addition	17.1%

**Table 5: Garrett ranking of entry barriers to youth participation in tilapia farming in Dowa and Mchinji districts**

Rank	Barrier to entry	Sum of ranks	Average rank
1	Lack of capital and credit facilities	3,198	78
2	High cost of feed	3,163	77
3	Lack of access to improved fingerlings	3,059	75
4	Inconsistent government incentives and policies	3,024	74
5	Theft	2,907	71
6	Lack of access to a profitable market	2,871	70
7	High risk of disease outbreak	2,832	69
8	Lack of extension services	2,799	68
9	Scarcity of water during the dry season	2,747	67

1 = garret 81, 2= garret 70 and 3= garret 62

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