Passive Participation in Illegal Fishing and the Welfare of Fishmongers in a Developing Country

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Abstract

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Keywords: illegal fishing, welfare, gender, Ghana.

JEL Codes:

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1. Introduction

Despite compelling evidence of declining global fish catches and depleting fish stocks owing to overfishing (FAO, 2007; Pauly and Zeller, 2016), illegal, unreported, and unregulated (IUU) fishing persists in many parts of the world, including in developing countries where livelihoods are the most at risk (Agnew et al., 2009). Coastal developing countries depend primarily on capture fisheries for animal protein, food security, and livelihoods (Béné 2006; Béné et al. 2007; Allison 2011; Srinivasan et al., 2010), making IUU a significant threat to the livelihoods of fisherfolks in several communities. Understanding the drivers of illegal fishing in developing countries is necessary to inform policy for sustainable capture fisheries management. Although a few studies on the socioeconomics of fisheries crime have been undertaken in developing countries and several factors such as risk and severity of punishment have been identified, all studies so far have focused on the extractors (fishermen), neglecting the (often female) fish processors and fishmongers who play a critical role in the value chain. Mojola (2011) and Pearson et al. (2013) note that, among fishers in African countries, 'men fish and women sell fish'.

Traceability could be important for sustainable management of seafood, including in the global south (see e.g., Bailey et al., 2016). However, illegal fish are impossible to trace in the value chain. For instance, it may be difficult to identify illegal catches bought by fishmongers. As a result, fishmongers typically face a lower risk of detection than fishermen who directly engage in illegal fishing. In Ghana, the severity of punishment is also less for fishmongers than for fishermen. While the expected profitability of these criminal activities is determined by the probability of detection and the severity of punishment, these are not the sole determinants of the decision to engage in them. Social factors are also important (Akpalu, 2008; Dresdner, 2015), mainly when illegal

activity affects the productivity of a natural resource stock on which others in the community also depend.

The Leyden group first developed studied the relationship between welfare and relative income, led by van Praag (1968) and later collaborations by van Herwaarden and Kapteyn (1981). This study addresses these issues by modeling the effect of welfare sensitivity to income changes and factors such as social pressure or peer effect, individual discount rate, and risk preference, on the decision to passively participate in an illegal fishing activity by trading in fish caught illegally, and the impact of participation on food security and household expenditure. We investigate the role of *welfare sensitivity*, i.e., the responsiveness of human welfare to changes in income over an income range, on participation in this potential welfare-enhancing criminal activity. To our knowledge, no study on fisheries crime has considered welfare sensitivity effect on violation of regulations.

The specific illegal activity considered in this study is called *saiko* fishing and trading in Ghana. It entails the transshipment of fish and fish products at sea from industrial trawlers to some artisanal fishers in specially adapted canoes out at sea (EJF and Hen Mpoano, 2019; Cabanelas et al., 2020). The main aim of such transshipment is to minimize the operating cost of fishing. This activity entails trawlers targeting and landing unauthorized (small pelagic) species and juvenile fish in unauthorized fishing zones, and the illegal transshipment of the resulting catch to fishers in locally adapted canoes for transport to the beach where it is sold to fishmongers (EJF and Hen Mpoano, 2019; Cabanelas et al., 2020). The trawlers that engage in *saiko* typically commit four infractions: catching of juvenile fish, targeting small pelagic species, illegal transshipment at sea, and fishing within unauthorized zones (i.e., the inshore exclusive zone (IEZ), which is supposed to be reserved for small-scale and artisanal fishers). It is estimated that saiko catches constitute approximately

40% of the artisanal fishing sector's total landings and more than twice the official landings of small pelagics off Ghana (EJF and Hen Mpoano, 2019).

The study results reveal that the decision to participate in the saiko trade and to achieve some food security or household expenditure status are joint decisions. That is, the decision to participate in the saiko trade is taken to help achieve food security or to raise household expenditure. Fishmongers from households that, register high average household expenditures or are food insecure are more likely to engage in saiko. Those most likely to participate in saiko are those sensitive to changes in income over a narrow income range, report below-average household expenditure, and have a high food security score. Fishmongers who indicate that a large proportion of their peers participating in saiko are also more likely to do so, which points to the role of social norm perception in compliance behavior.

The remainder of the paper is organized as follows: the next section presents the econometric model and discusses how welfare sensitivity is measured. Section 3 explains the primary data and discusses the empirical results, and Section 4 presents the conclusions.

2. Empirical Methods

Endogenous Treatment Effect (RTE)

Saiko fishing and trade affect household expenditure (HHE) and a household's food insecurity, as measured on the Food Insecurity Experience Scale (FIES). To investigate these effects we use an endogenous treatment effect (RTE) model (Cong & Drukker, 2000; Maeda, 2008; Hübler and Hartje, 2016; Ma et al., 2017). This linear regression model estimates the average treatment effect (ATE) in the presence of endogenous binary-treatment effects. Thus, the participation decision is

reflected using the equation of a binary variable, while the outcome equation has a continuous variable, estimated simultaneously. In this study, the binary variable is the decision whether or not to participate in the saiko trade, while the outcome variables are HHE and FIES. Following Cong and Drukker (2000), let the outcome variable and the endogenous treatment be y_i and t_i, respectively, where i is an individual household identifier. Suppose the vectors $\mathbf{X}_i$ and $\mathbf{W}_i$ are exogenous covariates used to model the outcome and treatment assignment, we have:

$$y_i = \mathbf{x}_i\boldsymbol{\beta} + \delta t_i + \varepsilon_i \tag{1}$$

$$t_i = \begin{cases} 1, & if \ \mathbf{w}_i\boldsymbol{\gamma} + u_i > 0 \\ 0, & otherwise \end{cases} \tag{2}$$

where β, δ and γ are the parameters to be estimated, and ε_i and u_i are error terms, that are bivariate normal with mean zero and covariance matrix:

$$\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \tag{3}$$

If the parameter $\rho\sigma$ is statistically significant, there is selection bias resulting from unobservable factors. Thus, for example, a negative (positive) $\rho\sigma$ implies negative (positive) selection bias, hence an Ordinary Least Square (OLS) estimate is likely to underestimate (overestimate) the effects of the treatment on the outcome variable.

Measurement of welfare sensitivity

As indicated, a key contribution of the present study is that it adds to the literature on fisheries crime by investigating the role of welfare sensitivity on the decision to participate in saiko fishing in Ghana. Following van Praag (1968), Akpalu et al. (2018) and Christian and Akpalu (2020), we measure welfare sensitivity by posing a set of income evaluation questions (IEQs). Each respondent is asked to provide income levels and to what extent the income reflects their perceived income needs. An example of the income evaluation questionnaire is presented below.

Considering your own situation with respect to the physical characteristics of your family and job, what would you call your net-income (including gifts from family and friends, and tips) per year:

	GHS	Comment
a. *More than what you need (if it were above)*	------------------------	*The respondent provides just one figure*
b. *Exactly what you need (if it were between)*	---------- and----------	*The respondent provides a range (lower and upper value)*
c. *Barely what you need (if it were between)*	----------and----------	*The respondent provides a range (lower and upper value)*
d. *Less than you need (if it were between)*	-----------and----------	*The respondent provides a range (lower and upper value)*
e. *Much less than what you need (if it were below)*	------------------------	*The respondent provides just one figure.*

Except for statements a and e, which require the respondent to provide one number, the respondent is expected to provide lower and upper values, with the lower value of, say, 'b' being the upper value of 'c'. Suppose the values provided are 7200, 4800, 3600, and 2000 currency units, and are represented by the variable $z_{ij} = \{7200, 4800, 3600, 2000\}$; where $j = 1, ..., k$, and $i = 1, 2, ..., n$ is individual/respondent identifier. The respondent's *welfare sensitivity* (σ) is computed as:

$$\sigma_i^2 = \frac{1}{k-1} \sum_{j=1}^{k} \left(\ln\left(z_j\right) - \mu_i \right)^2 \tag{4}$$

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where $\mu_i = \dfrac{1}{k}\sum_{j=1}^{k} ln\left(z_{ij}\right)$ is termed the *want parameter.* This measures the median value of the

welfare evaluation. From the figures above, the computed values of the want parameter and the

welfare sensitive parameter are 8 and 0.3, respectively. The value of the welfare sensitivity

parameter reflects how sensitive the individual is to changes in income. A fairly low *welfare*

sensitivity implies the individual is sensitive to a change in income over a narrow income range,

implying the subjective income ranges provided by the respondent are clustered around the median

income, hence a small change in income may significantly impact their well-being. For example,

a *welfare-sensitive* parameter of 0.1 is sensitive over a narrower range of income than a welfare-

sensitive value of 0.3.

3. Data Description

This study uses data from a household survey of female fish retailers in the Western and Central

Regions of Ghana where the major saiko fishing landing sites are located (EJF and Hen Mpoano,

2019). Elmina and Apam in the Central Region are the busiest sites for saiko landings in Ghana,

and Axim in the Western Region is the third busiest (EJF and Hen Mpoano, 2019). The survey

was carried out between July and October 2020. The representative sample of 900 fishmongers

contains some who trade in illegally caught fish, and some who do not.

The data collected included the household's expenditure, its food insecurity experience scale

(FIES), the respondent's age, education, religion, rate of time preference, risk preference,

perception of saiko, social capital, and welfare sensitivity. The FIES was scored from 0 to 8, where

0 is completely food secure and 8 is completely food insecure. The questionnaire also had a

question on the trader's involvement in saiko. The trader's perception of saiko was captured through questions on the fairness of banning saiko, whether saiko should be banned, and whether saiko is made up of fishes caught that are not purposely targeted (i.e., a bycatch).

4. Results

The descriptive statistics of the variables used for the analysis are presented in Table 1. The differences between saiko trading and non-saiko trading households are shown in Table 2. Almost half (43%) of the respondents have been engaged in processing and retailing saiko, for an average of 15.7 years. About a third (28%) of the respondents indicate that a trader is likely to face reprisals from saiko operators (fishermen) if she refuses to participate in the saiko business. About 59% of the respondents indicate that it is fair to ban saiko fishing. About two-thirds of traders are married, their average age is 43 years, and 44% claim to oversee significant household decisions. The mean household size is 5.7, with a standard deviation of 2.6. The mean household size is greater than the national and rural averages of 4.0 and 4.5, respectively, but close to the reported value of 5.5 for aquaculture households (Akuffo and Quagrainie, 2019). The average fish-trading household spends GHS2,150 monthly, well above the national average of GHS776. Only 2% of the respondents identify as non-Christian (i.e., Muslim, African Traditional Religion and Others), and the average respondent had less than four years of formal education.

Table1. Descriptive Statistics of Variables related to Decision to Participate in Saiko and the Impact of Saiko on Household Welfare

Variable	Definition	Mean	Std. Dev.
Total expenditure	Total expenditure (Year)	25737.409	17392.181
Age	Age of respondent (Year)	43.336	12.271
Household size	Number of people in the household	5.725	2.572
Education	Level of education of Respondent (years)	3.421	4.033

Married	1 if married, 0 otherwise	0.665	0.472
Christian	1 if Christian, 0 otherwise	0.974	0.158
Risk averse	Risk aversion (0 to 5)	0.850	1.701
Welfare sensitivity	Welfare sensitivity measure	0.463	0.565
Time allocation to agric	1 if allocate time to agriculture, 0 otherwise	0.037	0.190
Rate of time preference	Rate of time preference measure	0.204	0.095
Retailed saiko	1 if retailed saiko, 0 otherwise	0.433	0.496
Proportion of retailers in saiko	What is the proportion of retailers retailing saiko	32.199	32.841
Major Household decision	Who makes major household decisions, 1 if husband, 0 otherwise	0.439	0.497
Fish Retailing Experience	How long have you been retailing saiko (months)	189.429	168.139
Face reprisal	Face reprisal if refused to retail saiko (1 if likely, 0 otherwise)	0.273	0.446
Fair to ban Saiko	1 if fair, 0 otherwise	0.591	0.492
Social Network	# of people who can offer financial support	0.780	1.530
By-catch	(1 if saiko is by-catch, 0 otherwise)	0.030	0.172
Falling Total Catch Trend	(1 if total catch-trend of artisanal fishers is declining, 0 otherwise)	0.966	0.180

Table 2. The Mean differences of Variables Used for The Endogenous Treatment Effect Model

	Retail saiko		
	No	Yes	Difference in mean
Total expenditure	25260.740 (862.451)	25880.2 (725.594)	-619.454
Age	43.789 (0.587)	43.839 (0.591)	-0.050
Household size	5.752 (0 .124)	5.751 (0.133)	0.000
Education	3.415 (0.180)	3.319 (0.213)	0.095
Married	0.638 (0.022)	0.678 (0.023)	-0.039
Christian	0.968 (0.008)	0.982 (0.007)	-0.015
Risk averse	0.843 (0.076)	0.879 (0.087)	-0.036
Welfare sensitivity	0.483 (0.027)	0.447 (0.025)	0.036
Time allocation to agric	0.024 (0.007)	0.048 (0.011)	-0.024**
Rate of time preference	0.205 (0.004)	0.195 (0.005)	0.009

Proportion of retailers in saiko	27.298 (1.406)	44.617 (1.711)	-17.319***
Major Household decision	0.416 (0.022)	0.438 (0.025)	-0.022
Fish Retailing Experience	205.619 (16.187)	207.476 (13.478)	-1.856
Face reprisal	0.286 (0.020)	0.257 (0.022)	0.029
Fair to ban Saiko	0.662 (0.021)	0.501 (0.025)	0.161***
Social Network	0.698 (0 .058)	0.907 (0.089)	-0.209**
By-catch	0.018 (0.006)	0.046 (0.011)	-0.028**
Falling Total Catch Trend	0.979 (0.006)	0.949 (0.011)	0.030**
Food insecurity experience scale	5.765 (0.137)	5.922 (0.143)	-0.157

Paired t-tests were used to establish the characteristics of fishmongers who participated in the saiko trade and those who did not.The results are reported in Table 2. The results indicate that although more than half of traders who deal in saiko think it is fair to ban this form of illegal fishing, this view is held by significantly more among those who do not deal in saiko. A significantly lower proportion of saiko dealers perceives the trend of total landings of artisanal fishers to be falling than non-saiko traders. The mean values of most other socio-economic characteristics did not differ significantly across the two groups. These variables include

rate of time preference, food insecurity experience, fish retailing experience, participation in major household decisions, age, household size, education, marital status, risk aversion, and welfare sensitivity

The results of the ETR model for participation in saiko and its implications for the food insecurity experience scale (FIES) and influence on household expenditure are presented in Tables 3 and 4. The Wald tests for the two models are both statically significant at a 1% level, indicating that the participating decision is endogenous in each of the two models. Thus, the decision to participate

in saiko and decisions related to household spending targets are taken jointly, as is the decision to participate in saiko and FIES goals. Next, the parameter $\rho_{\delta\varepsilon}$ is positive and statistically significant at a 1% level in both models. Being statistically significant implies selection bias due to unobserved factors (Cong and Drukker, 2000; Ma et al., 2017), and the positive sign suggests that fishmongers from households that, on average, spend more or are food insecure were more likely to engage in saiko. This implies that food expenditure among fishing households may constitute a small proportion of total household spending.

Table 3. Results for the Endogenous Treatment Effect Model: Household Expenditure as the Outcome Variable

VARIABLES	1	2
	Retail saiko	Ln (total expenditure)
Retail saiko fish (1/0)		-0.639 (0.115)***
Risk averse	0.020 (0.026)	0.0542 (0.0123)***
Welfare sensitivity	-0.219 (0.092)**	-0.046 (0.042)
Ln (Rate of time preference)	-0.195 (0.088)**	-0.121 (0.044)***
Age^2	-0.0006 (0.0003)**	-0.0005 (0.0001)***
Age	0.063 (0.023)***	0.0427 (0.012)***
Education	-0.011 (0.011)	0.00303 (0.006)
Married (1/0)	-0.020 (0.119)	0.108 (0.0503)**
Proportion of retailers in saiko	0.007 (0.002)***	
Major Household decision	0.195 (0.103)*	
Experience in retailing fish	-0.001 (0.000)***	
Face reprisal	-0.147 (0.096)	
Fair to Ban Saiko	-0.260 (0.087)***	
Social Network	0.089 (0.025)***	
By-catch	0.925 (0.252)***	
Falling Catch Trend	-0.293 (0.258)	
Household size		0.062 (0.008)***
Christian (1/0)		-0.101 (0.099)
Time allocation to agric (1/0)		0.074 (0.099)
Constant	-1.584 (0.604)***	8.760 (0.258)***
rho	0.727 (0.081)***	

athrho	0.922 (0.171)***
lnsigma	-0.472 (0.053)***
Wald test	28.96***
Observations	801

<div align="center">
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
</div>

The results of the joint decision to participate in saiko trade and household expenditure decisions are presented in Table 3. From the participating decision equation, the coefficients of the age of the respondent and age-squared are statistically significant and are positive and negative, respectively, indicating that age has a non-linear effect on the participation decision. Further, fish traders are increasingly likely to engage in the saiko trade until age 54, beyond which their participation declines. One explanation is that the number of income-earning alternatives to fish trading may decrease when the fishmongers are older, but older fishmongers have a better understanding of the negative effect of saiko on the fishing industry and/or are more socially responsible and are therefore less likely to participate in the saiko trade. The literature has established that crime increases with age to a peak and then decreases (see e.g., Farrington, 1986).

The coefficient of the welfare sensitivity parameter is negative and statistically significant at a 5% level, implying that a trader who is sensitive to changes in income over a narrow income range is more likely to participate in the saiko trade. Respondents with a high individual discount rate are less likely to participate in saiko. This result appears counterintuitive, but studies have established a positive correlation between poverty status and individual rate of time preference (see e.g., Harrison et al., 2002). Thus, traders who are poor, and therefore have a high discount rate, but are dependent on natural resources are unlikely to participate in an illegal fishing activity which is destructive to fishery.

Next, the social pressure or peer effect, proxied by the stated proportion of the respondent's peers who participate in the saiko trade, is positively correlated with the likelihood that the household will itself participate. This is consistent with the finding that peer effects influence the decision to fish illegally (Sutinen and Kuperan 1999; and Nielsen 2003; Dresdner et al., 2015) and the intensity of illegal fishing activities (Akpalu, 2008). In addition, a significantly higher proportion of those who report that saiko is a by-catch of trawl landings, participate in saiko trade. This finding highlights ignorance about or or lack of information access on the source of saiko among fishmongers.

Interestingly, we find that fish traders with stronger social networks, proxied by the number of people outside of the immediate family on whom the respondent can count for financial support, were more likely to participate in saiko. The positive relationship between non-compliance with fishing regulations and fishing households' income has been reported in other studies (see e.g., Dresdner, et al., 2015). Respondents who indicate that it is fair to ban saiko are less likely to engage in illegal trade. This finding is consistent with studies that have found that fishermen who perceive a fishing regulation to be unfair or illegitimate are more likely to violate it (Sutinen and Kuperan 1999; and Nielsen 2003; Akpalu, 2008; Dresdner et al, 2015).

Next, respondents who oversee major household decisions are more likely to engage in saiko. This may stem from the economic empowerment of women in these households. That is, a fishmonger who provides for their family is more likely to engage in an unsustainable but immediately rewarding practice. Finally, respondents who have traded in fish for an extended period were less likely to engage in saiko trade, all else being equal, when household spending and participating decisions are being taken jointly. This is probably due to their dependence on fishery for their livelihood and possibly a better understanding of the bio-physical dynamics of the stock.

Table 4. Results for the Endogenous Treatment Effect Model: Household Food Insecurity Experience Scale as the Outcome Variable

VARIABLES	1	2
	Retail saiko	FIES
Retail saiko fish (1/0)		-3.579 (0.585)***
Risk averse	0.012 (0.028)	-0.147 (0.078) *
Welfare sensitivity	-0.222 (0.081)***	-1.144 (0.238)***
Married (1/0)	-0.0129 (0.119)	-0.772 (0.265)***
Ln (Rate of time preference)	-0.168 (0.090)*	-0.549 (0.235)**
Age	0.054 (0.019)***	-0.0212 (0.012)**
Education	-0.005 (0.012)	-0.00913 (0.031)
Proportion of retailers in saiko	0.008 (0.001)***	
Major Household decision	0.161 (0.099)	
Experience in retailing fish	0.0005 (0.0003)*	
Face reprisal	-0.138 (0.092)	
Fair to Ban Saiko	-0.333 (0.083)***	
Social Network	0.096 (0.028)***	
By-catch	0.285 (0.281)	
Falling Catch Trend	-0.799 (0.295)***	
Age^2	-0.0006 (0.0002)***	
Household size		0.113 (0.040)***
Ln (Total expenditure)		-0.294 (0.200)
Christian (1/0)		-0.698 (0.541)
Time allocation to agric (1/0)		0.271 (0.543)
Constant	-0.957 (-0.593)	11.490 (2.076)***
rho	0.735 (0.077)***	
athrho	0.939 (0.167)***	
lnsigma	1.232 (0.049)***	
Wald test	31.680 ***	
Observations	801	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The covariate of the respondent's joint decision to participate in saiko and their food insecurity experience (FIES) status differs in statistical significance, size, and the sign of the coefficients, from that in the household expenditure model (i.e., Table 4). Regarding the signs of the coefficients of the other variables, as was the case in the household expenditure model, high welfare sensitivity,

perceived fairness in banning saiko, and a high individual rate of time preference all reduced the likelihood that respondents would participate in the saiko trade. Once again, the peer effect (i.e., social pressure) and the strength of social networks positively correlate with the decision to trade in saiko. As in the household expenditure model, the age of the respondent has a non-linear effect on the decision to participate. Participation increases with age until 44 years, after which the trend reverses. This younger turning point indicates that meeting a food security goal is more critical than attaining a household spending target.

Concerning the covariates that had different signs in the two models, we find that, unlike in the household expenditure model, those who perceive total capture fish landings to be increasing were more likely to participate in the saiko trade. Given the abundant evidence of overcapitalization of artisanal fishery, biological overfishing, and persistent declines in catch per unit, this may be a psychological defense mechanism to mitigate the respondent's sense of wrongdoing. When studying socio-psychological factors influencing illegal fishing behavior, Dresdner et al. (2015) find that fishers were less likely to participate in an illegal fishing activity if they perceived such activity to have a detrimental effect on fish stocks.

The covariates of the two outcome variables (household expenditure and FIES) are the respondent's decision to participate in saiko, degree of risk aversion, age, individual rate of time preference, welfare sensitivity, marital status, household size, years of formal education, religion, and amount of time devoted to other agricultural activities. The coefficient of participating in saiko is statistically significant at 1% level, and has a negative sign in both models. Thus households who participate in saiko trade are more food secure but spend less than household who do not. This suggests that saiko trading is a coping strategy.

The respondent's age had a non-linear (concave) relationship to HHE and FIES, implying that total household spending and food insecurity initially increased with the respondent's age, but subsequently decreased. This may indicate that older fishermen have already accumulated assets and their households are more food secure as they spend less on other household items. Respondents with high rates of time preference had lower household expenditure levels but greater food security. This provides further evidence that those with higher RTP are more likely to focus on providing food for the household while lowering overall household spending. As noted, the literature finds a positive correlation between time discounting and the poverty status of individuals (see e.g., Harrison et al., 2002). Greater overall spending, but less food security was also a feature of larger households spending more in total but being less food secure. With the fast-declining trend of artisanal catches, fishing households may find it harder to meet their food requirement.

A few results had opposite signs. First, more risk-averse households spend more and are less food insecure (i.e., had lower FIES). Thus, fishing households that are more risk averse may spend more on food as a form of security, providing a sense of comfort and stability. On the other hand, married respondents report greater household expenditure and greater food security.

5. Conclusion

Fish caught illegally by artisanal fishermen in developing countries often enter the value chain through local fishmongers. In tropical Africa many of these 'passive' participants in the illegal fishing sector are women whose decision to sell illegally harvested fish is driven by a mix of psycho-social and economic forces. Hitherto, studies of the socioeconomics of fisheries crime have

focused on the fishers themselves and neglected the role of those selling these illegal catches. We investigate the role of welfare sensitivity and a range of other factors on the decision to participate in Ghana's saiko trade, and the effect of such participation on households' food insecurity experience scale and overall expenditure. One of these factors is peer pressure, proxied by the perceived proportion of retailers involved in saiko trade. This correlated positively with a fishmonger's decision to trade in illegally caught fish. That is, when a fishmonger perceives that others are engaged in illegal behavior and that such behavior is normative or socially accepted, it can lead them to engage in similar illegality.

Another influential factor was misperception and ignorance about the consequences of illegal fishing activity. Traders who express the view that catch levels have been declining and those who do not perceive saiko as a bycatch are less likely to engage in saiko. This emphasizes the need for environmental education on fisheries. Furthermore, we find that fishmongers who engage in saiko are from households that concentrate their spending on food as opposed to other household items and are consequently more food secure. Households who are sensitive to changes in income over a narrow income range are also likely to be more food secure, but to spendless in total.

The results of this study suggest measures to reduce participation in Ghana's illegal saiko trade. First, fisheries stock assessments should be regularly conducted, and their results effectively communicated to fisherfolk. Our results suggest that this would discourage participation in the illegal saiko trade. Second, strengthening welfare programs that would improve food security situations among fisherfolk might reduce the incentive to participate in illegal saiko trading in Ghana.

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