Determinants of Compliance to Formal Choice Rules among Artisanal Fishers in Laguna Lake, Philippines

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Abstract - *The primary aim of this study is to identify determinant factors influencing cooperative behavior, measured as consistent compliance to formal choice rules, of artisanal fishers in the context of coastal fishery management. A questionnaire survey was conducted with the artisanal fishers of Barangay Bucal, Calamba City, Laguna, Philippines on August 2015 regarding the characteristics of contextual variables found by Agrawal to be recurrent in sustainable common pool resources (CPRs) and the fishers' mode of compliance to the formal choice rules in their fishery. Based on the skewness of their Compliance Index (CI), cooperation among the fishers is deemed moderate. Using phi, the fishers' wealth, age, educational attainment, use of Laguna de Bay catfish, and membership in the local fishermen's association were found to be strongly associated with consistency of compliance to the formal choice rules. Specifically, through simple logistic regression the odds for consistent compliance is higher if a fisher a) has medium to high number of household fixtures, b) is more than 50 years old in age, c) has finished high school, d) markets his Laguna de Bay catfish catch, and e) is a member of the local fishermen's association. These results indicate that by ensuring the fishers: a) are not experiencing survival constraints; b) have the necessary set of cognitive skills, interest, and knowledge of the political and ecological issues surrounding the management of the coastal fishery; and, c) have strong moral norms favouring compliance to the formal choice rules, cooperation among them can potentially be increased.*

Keywords*: Cooperative behavior, artisanal fishers, CPRs, institutional analysis, Laguna Lake, Philippines.*

INTRODUCTION

Institutions are rules that are shared, normative and have the effect of influencing human behavior [1]-[3]. They cover social norms, conventions, and legal laws [4]. Consequently, "institutional arrangements" are sets of related institutions that establish the relationships between individuals in relation to things [5], [6]. They are necessary in situations where coordination of two or more individuals are needed [7]. Such situations include management of common pool resources (CPRs) where "free riding" if not "tragedy of the commons" is a real constant threat [8], [9], [10]. Sustainability is therefore achieved in CPRs when the actions of their appropriators are effectively coordinated by means of their compliance to the established institutional arrangement.

According to the Institutional Arrangement and Development (IAD) framework, users' compliance to institutional arrangements is structured by contextual variables which include a) the resource being exploited, b) the resource users, and c) the local resource management institutional arrangement [10]. However, there is no universal configuration of the characteristics of these variables that automatically generates consistent compliance in any CPRs [11], [10]. Rather, [11] noted 32 "critical enabling conditions" recurring in situations where small groups of users are able to sustain their CPRs. These enabling conditions fall into six categories consisting of the a) resource system characteristics, b) group characteristics, c) relationship between resource system characteristics and group characteristics, d) institutional arrangements, e) relationship between resource system and institutional arrangements, and f) external environment.

In the Philippines, determinants of compliance to established institutional arrangements in CPRs have not been studied until now. Laguna Lake, which is the largest and most important lake in the [12] provides an opportunity for this kind of study as resource management is clearly occurring in it [13]. This is evident in the regulation of artisanal fishing in the

municipal waters of Calamba City which is located on the southern coast of Laguna Lake. To ensure the success of this coastal fishery management, which is a case of CPR management [10], coordination of the artisanal fishers' appropriations should be strengthened by concentrating management interventions on factors determining their compliance to the institutional arrangement. These determinants are however unknown.

OBJECTIVES OF THE STUDY

To identify the determinants, characteristics of the contextual variables that have strong association with the fishers' consistent compliance to the formal choice rules are determined in this study. Agrawal's list of critical enabling conditions provided the scope of characteristics examined. Formal choice rules are used in this study since 83.33% of the rules formally instituted in Calamba's municipal waters are choice rules in type. Aside from this, formal choice rules can also have the most direct effect on the fishery's sustainability as they are the written prescriptions of actions the artisanal fishers must, must not, or may take [14] in the various circumstances of their artisanal fishing activity.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in Barangay Bucal (14°11'8"N, 121°10'13"E) which is one of the coastal villages of Calamba City. The city is found in the province of Laguna which is located on the southern part of Luzon, the Philippine's largest island (Fig 1a). The village was chosen as it has an artisanal fisher-population of moderate size, easy accessibility, availability of secondary data on its local artisanal fishing industry, and fish sanctuary in its offshore area. Barangay Bucal has a total land area of 2.65 km^2 divided into six *puroks* or boroughs. It is classified as urban and is three kilometers south of Calamba City. As of 2010, the village has a total population of 11,346.

The City Fish Sanctuary and Garden (Fig 1b) is a 100 m^2-offshore structure built within the 300 m-protected zone of the village. *Yankaws* or fish shelters made of cut branches of Camachile tree (*Pithecellobium dulce* (Roxb.) Benth.) are laid within its sanctuary part (i.e. red points) and fish garden part (i.e. yellow points). Bamboo poles had been put up every 1.5 m along the perimeter of the latter. This provides a well-defined boundary that is easy to observe. The bamboo fence also serves as physical barrier against errant fishers trying to harvest within the protected area. This, however, is not the case for the fish garden immediately outside the fish sanctuary as well as the 300 m-protected zone extending the entire coastline of Calamba City.

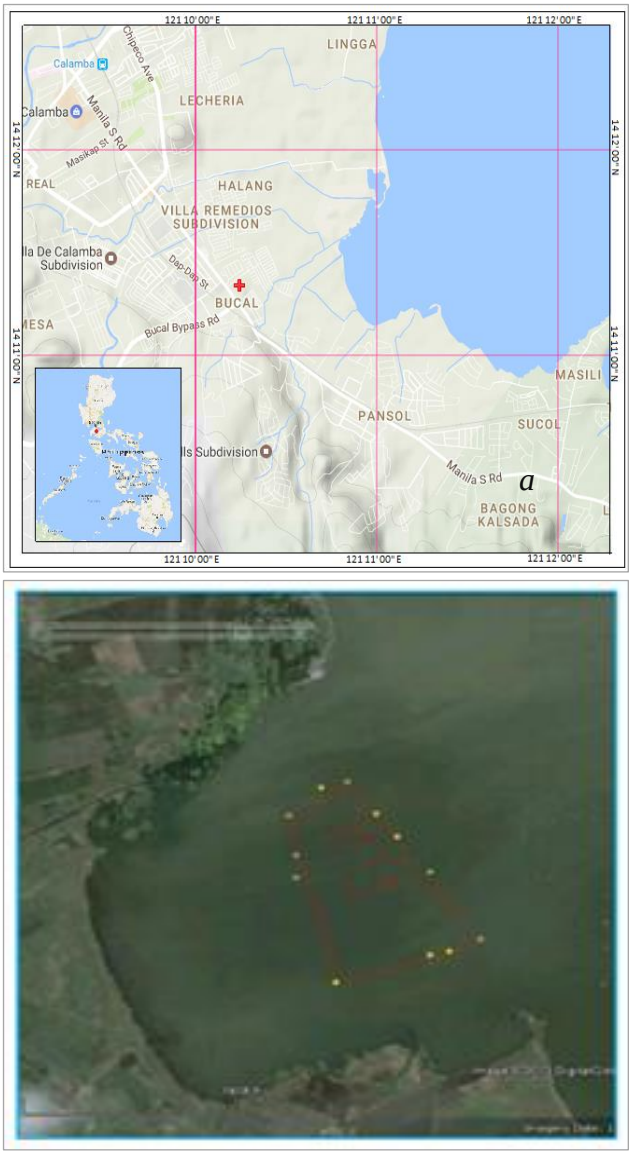

Figure 1. *a*) Terrain map showing Barangay Bucal, Calamba City, Laguna, Philippines; *b*) Calamba City Fish Sanctuary and Garden (Adapted from [15])

Research Design

The study is divided into two phases. The first is the preliminary investigation phase where background data on the village's artisanal fishing industry was collected. In the following formal survey phase, data on

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the demographic characteristics of the fishers, their perceptions of the different contextual variable characteristics, and perceptions of their consistency in complying with the formal choice rules were collected.

Semi-structured interview method was used in the preliminary investigation phase while in the formal survey phase, data collection was done primarily through structured interviews.

Respondents of the Study

The first phase of the study primarily collected data from key informants representing the local artisanal fishing industry, Barangay LGU and City LGU. In the secondary phase, the researcher surveyed all 57 artisanal fishers in Barangay Bucal. Except for a few that the researcher traced through interviews, most of the survey respondents were identified by a master list coming from the City Agricultural Services Department (CASD). As such, the survey respondents were all small scale commercial fishers that have lived in the barangay for at least six months and catch fish mainly within the protected zone of its waters.

Research Instrument

The interview schedule used in the semi-structured interviews was constructed in Tagalog, the language of the respondents. The interview schedule had the following parts: a) fishing grounds and protected area locations; b) species and gear seasonality; c) policy making, adjudication and marketing of fish catch; d) organization of the fishers, formal and informal rules, and e) overall compliance to the rules.

In the secondary phase, the survey instruments used were also constructed in Tagalog. The instrument had the following parts: a) demographic characteristics of the artisanal fisher community; b) characteristics of the resource variable; c) characteristics of the resource user variable; d) characteristics of the institutional arrangement variable; and e) compliance to formal choice rules.

Methods of Analysis

Analysis of Variable Characteristics, Rule Compliance and Incompliance

After data collection, frequency counts and percentages were used to analyze the demographic characteristics of the fishers, the characteristics of the different variables, the fishers' compliance to the formal and informal choice rules, and the different forms of incompliance.

The equivalent numerical values of the respondents' mode of compliance to each of the 6 formal choice rules covered in the study were summed to determine their respective *Compliance Index* (CI). Considering that never breaking a formal choice rule has a numerical value of 3, occasionally breaking a formal choice rule gets a numerical value of 2, and frequently breaking a formal choice rule gets a numerical value of 1, a CI of 18 therefore signifies that a respondent has never broken any of the 6 formal choice rules, while an index below this indicates some configuration of incompliance. Consequently, a CI of 6 indicates consistent incompliance to all of the formal choice rules.

The population CI skewness was then used to describe the asymmetry of the CI data for the artisanal fisher population. To graphically represent the said asymmetry, the distribution of probability functions of the CI was used. For comparison, the respondents' CI for the informal choice rules were also derived using the same procedure. Similarly, skewness was also used to describe the asymmetry of its distribution.

Analysis of Characteristics Determining Consistent Rule Compliance

Phi (φ) was used in determining the factors that were strongly associated with the fishers' consistent compliance to the formal choice rules. In proceeding with the correlation analysis, some nominal and ordinal data for the demographic and exogenous factors were dichotomized to fit 2x2 contingency tables. The fishers' modes of compliance to the formal choice rules were also dichotomized wherein those with CI's of 18 were classified as consistently complying while those having less than 18 were classified as being inconsistently complying. Furthermore, simple logistic regression was utilized to determine how the strongly associated factors (i.e. those with $\varphi > 0.3$) were associated with the fishers' consistent compliance to the formal choice rules as well as their odds ratios of doing so.

Pairwise association using phi was then used to determine the degree of associations between the identified characteristics. After which, simple logistic regression was again used to determine how the strongly associated factors associate with each other.

RESULTS AND DISCUSSION

Characteristics of the demographic and contextual variables used in the study

Demographic characteristics of the artisanal fisher community

The number of artisanal fisher population in Barangay Bucal is decreasing. In 2012, the population totaled 73 fishers [16]. This dropped to 56 in 2014 [16] and 42 in 2015. The lack of interest of the younger generation in artisanal fishing as suggested by a low number of young fishermen (≤ 30 years old) fishing with older artisanal fishers could be causing such drop. Majority of the artisanal fishers (52.38%) are old (≥ 51 years old) while middle-aged artisanal fishers (31 to 50 years old) comprise 42.86 percent of the population; this leaves only 4.76 percent of the population that is composed of young fishermen. Consistent with this, only very few artisanal fishers (11.91%) were found to be engaging in artisanal fishing for minimal number of years (≤ 14 years) as compared to those who have been in the industry for a short (15 to 30 years) and intermediate (31 to 45 years) number of years which comprise 38.10 percent and 28.60 percent of the population respectively.

Low immigration of artisanal fishers into Barangay Bucal could also be contributing to the said decline. This is underscored by the results showing that majority (76.19%) are native to the barangay and a total of 80.96 percent of the fishers have resided there for an extended (31 to 45 years), long (46 to 60 years) and very long (> 60 years) periods of time as compared to only 19.05 percent that have lived there for minimal number of years (15 to 30 years).

Characteristics of the contextual variables

Characteristics of the resource variable

Physical characteristics

Most of the artisanal fishers (61.91%) perceived the physicochemical condition of the fishery to have seriously deteriorated but still remediable. Many blame the fishery's pollution, shallowing and size reduction. These attributions are supported by its Most of the artisanal fishers (61.91%) perceived the physicochemical condition of the fishery to have seriously deteriorated but still remediable. Many blame the fishery's pollution, shallowing and size reduction. These attributions classification as Class C by the Laguna Lake Development Authority (LLDA) [17], [18]; the overabundance of fish cages and fish pens in its coastal waters; and its shallow mean depth of 2.25 m [19], which according to a local key informant have already shoaled from 9 m in the 1970's.

The coastal fishery of the respondents spans the contiguous fishing grounds of villages from Barangay Linga to Sucol (Fig 1), aside from "*pulo ng* Calamba" which is accessible only by motorized fishing vessel. Half of the respondents (50.00%) deemed its total size as large while 31.00 percent found it intermediate. Hence, 69.10 percent of the fishers have difficulty in observing everyone in the fishery at any one time. According to [5] and [20], large ecological resources with its great dimensions constrain its users' senses from directly detecting the actions of other resource users.

Biological characteristics

A decrease in fish catch has occurred in the last 20 years in Laguna Lake [21]. Accordingly, [15], estimated past catches to be 1 kg/fishing trip before it improved recently. In the study, 50.00 percent of the respondents perceived to be still able to harvest sufficient fish catch from the fishery, with 11.91 percent even indicating their catch as more than enough. As it is, the fishers had reported that at the present, their catch/fishing trip already ranges from 1 to 10 kg. A decrease in fish catch has occurred in the last 20 years in Laguna Lake (Santos-Borja & Nepomuceno, 2006). Accordingly, CASD (2012), estimated past catches to be 1 kg/fishing trip before it improved recently. In the study, 50.00% of the A decrease

While all the species in the survey have catchers, only three species - tilapia (*Oreochromis sp.;* 73.81%), Laguna de Bay catfish (*Arius manilensis* Valenciennes; 57.14%) and white shrimp (*Macrobrachium sp.*; 26.19%) - have significant number of frequent catchers. Laguna de bay catfish's number of frequent catchers could be due to being unintentionally caught along with tilapia as they are found all over the fishery, exist throughout the year, and are caught using the same types of fishing gears. Incidentally, there is low demand for it as it is one of those species with the least number of sellers (28.57%) and lowest market price. Many of the respondents' attribute this to its strong ramish taste. On the other hand, the survey also shows that only 26.19 percent of the fishers are frequently catching white shrimps despite its availability and high market value due to its capital and labor intensiveness.

Technological characteristics

Among the different fishing gears used in the village, gillnet, which is the primary gear for catching tilapia, has the most number of frequent users (83.33%). It is followed by *tibog*, which is a bamboo rod with plastic cap tip, with 21.43 percent. This

underscores the close relationship between the 2 gears. According to the fishers, all *tibog* users are also gillnet users, since the former is used to scare fishes into gillnets; however, not all gillnet users are *tibog* users. Also, most of the fishers (64.29%) in the village only use non-motorized fishing vessels in their fishing activities.

Currently, five methods of artisanal fishing are prohibited in the fishery. These are the use of: *tibog*; dredge; motorized push net; fine mesh net; and electrofishing gears. About 57.14 percent of the respondents indicated that these methods are observable, while 35.17 percent indicated that only some are. Many fishers consider *tibog*-use easiest to observe since striking the water with bamboo rods create loud noises that can be heard from a distance. Electrofishing gears meanwhile are deemed the most difficult to monitor since they are largely used in the littoral parts of the lake and inland inundated areas which are far removed from other fishers and Bantay Lawa fishwardens.

Characteristics of the resource user variable

Social characteristics

Most fishers (59.52%) perceived to have low ecological knowledge of the fishery despite majority of them have been fishing in the area for about 15 years to more than 60 years. With respect to the deterioration of Laguna Lake over the years [21], such result is consistent with previous literature showing that users of resources that have changed rapidly during recent decades are likely to be imperfectly informed about its ongoing processes [22]. Most fishers (54.76%) also indicated heterogeneity of views pertaining the management of the fishery, particularly on the issues of following the management rules and the establishment of the fish sanctuary. Such heterogeneity is expected since low levels of understanding and perception of the resource's deterioration could make it difficult for the acceptance and adoption of conservation rules [22].

In terms of the size of the fishery-users, 66.67 percent of the respondents perceived a large number of fishers is using "their" fishery. They attributed this to the intrusion of artisanal fishers from other villages. However, almost all of them (97.62%) find such intrusion acceptable. Since majority of the respondents felt able to harvest sufficient fish catch from the fishery, and that 73.81 percent perceived no unfair harvesting happening in it, this general favorability of the fishery's open-access characteristic could imply that most respondents find its fishes to be still abundant. Reference [22], defined abundant natural resources as those experiencing no scarcity and which cannot be threatened with the risk of degradation even when they are openly accessible.

In terms of availability of communication among the respondents, 92.86 percent indicated that a mechanism is present with 74.16 percent citing the meetings of Barangay Fisheries and Aquatic Resources Management Council/*Sagisag ng mga Mangingisda ng* Barangay Bucal (BFARMC/SAMBBU) as a form of this mechanism. Nevertheless, 73.81 percent of the respondents find gathering the fishers into these meetings difficult. Regarding the perceived large number of fishery users, this result is expected since pre-play communication in large groups is challenging due to high communication and bargaining costs [22]. As for their personal attendance during these meetings, 45.24 percent of the respondents have only occasional presence while 21.43 percent are always absent or have never attended any of the meetings. This result substantiates the previous suggestion that gathering the fishers into their meetings is not easy.

Economic characteristics

Based on the respondents' household income from artisanal fishing, 57.14 percent of them have low dependence (i.e. less than one-half of total household income) on artisanal fishing as an income source. The high level of occupational multiplicity among the respondents and their other household members is indicative of this. As it is, 73.81 percent of the respondents are shown to have non-artisanal fishing occupations. The most common of which are farming and working in construction sites. The same is also true for the other household members of most respondents (78.57%), of which most are factory workers.

Market characteristics

At the present, artisanal fishers in Barangay Bucal use the fishery for income generation with 66.67 percent of them selling their fish catch directly in the village. However, white-shrimps are sold in Calamba City as a viable market for it is not yet established in Barangay Bucal. Overall, the current price situation for the fish catch is satisfactory with most of the fishers finding the prices to be easy to predict (92.86%), regularly changing (80.95%), and intermediate (59.52%). Regular price fluctuation is linked to the annual occurrence of algal blooms and typhoons. As for the level of demand, almost all of the artisanal fishers in Barangay Bucal (92.86%) find that it is high as their supply of fish are almost always sold out.

Characteristics of the institutional arrangement variable

Rule dissemination among the fishers needs improvement. While 90.48 percent of the respondents found the rules easy to understand, only 33.33 percent have complete knowledge of them. Pertaining the policy choice level, 78.57 percent of the fishers perceived the decision-making process as inclusive with many citing the meetings of BFARMC/SAMBBU as the venue where they participate in policy-making. Despite this perceived inclusivity of the decision-making process, 52.38 percent of the fishers still feel that violation of the rules should be allowed during difficult periods of the year, while 52.38 percent perceived that there is a need to change the rules. These support previous findings that while the fishers have a channel through which they can all participate in matching the rules to the local condition of the fishery, such channel is not optimally used thereby making it hard for all respondents to learn of new rules and to provide their input when the rules are made.

Rule violation was perceived by 73.81 percent of the fishers to be low (i.e. only less than half of the total artisanal fishers using the fishery are involved in any form of rule violation). Fig 3 and Fig 4 show that majority of the respondents are consistently complying with the informal and formal choice rules. On the various forms of rule violations observed, *tibog*-use and electrofishing gear-use are the most known to the fishers. Enforcement of the rules was seen by 66.67 percent of the respondents to be selective. Consistent with the forms of violations observed, the rules on the use of electrofishing gears and *tibog* were cited as the most selectively enforced.

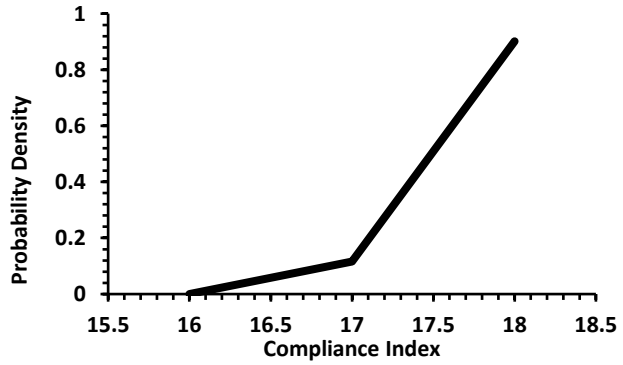

Figure 2. Probability distribution of the CI with respect to the fishers' compliance to the informal choice rules

Compliance to choice rules

With a population CI skewness of -3.105, the distribution of the CI for the informal choice rules is highly skewed (Figure 2). This is expected as most artisanal fishers in the village are consistent compliers to the informal choice rules (Figure 3). Table 1 shows the different forms of incompliance to it.

Figure 3. Distribution of CI for the informal choice rules

Table 1. Forms of incompliance to the informal choice rules by the five identified rule breakers

Form	Frequency	%
Occasional use of electrofishing gears	2	40.00
Frequent use of electro fishing gears	1	20.00
Occasional fishing inside the Fish Sanctuary	1	20.00
Occasional use of fine mesh net	1	20.00

In follow up interviews, occasional users of electrofishing gears revealed that they only use it when fishing in the lake becomes difficult. This usually happens at the end of the dry season when the lake water is at its lowest level. Difficult periods are known to be crucial for rule compliance since severe scarcity lowers the discount rates of resource users which can result in rapid exploitation [22].

Despite the existence of the informal choice rules, the artisanal fishers' rate of compliance to the formal choice rules remains high. Although its CI skewness (-0.761) is relatively lower, its asymmetry is still moderately skewed (Figure 4). As it is, slightly more than half of the population are deemed to be consistent compliers to the formal choice rules which is consistent with Figure 5.

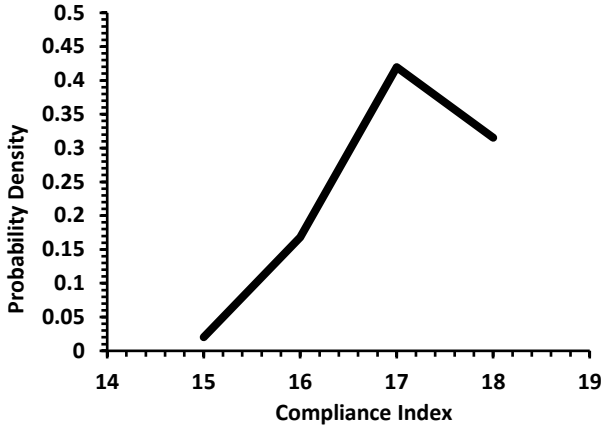

Figure 4. Probability distribution of the CI with respect to fishers' compliance to the formal choice rules

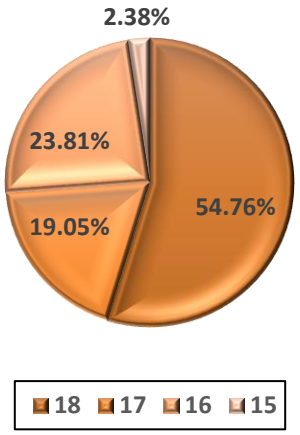

Figure 5. Distribution of CI for the formal choice rules

Table 2. Forms of incompliance to the formal operational rules by the 19 identified rule breakers from Barangay Bucal

Form	f	%
Frequent use of tibog	9	47.36
Occasional use of tibog	7	36.84
Occasional use of electrofishing gears	2	10.52
Frequent use of electro fishing gears	1	5.26
Occasional fishing inside the Fish Sanctuary	1	5.26
Occasional use of fine mesh net	1	5.26

Table 2 shows that for formal choice rules, the most prevalent form of incompliance is *tibog*-use which violates Section 90 of the Department of Agriculture Ordinance (DAO) No.3 Series of 1998. Violations of Section 88 and 89 also exist in the form of electrofishing gear-use and fine mesh net-use. Occasional fishing inside the fish sanctuary meanwhile violates Calamba City Ordinance 495 Series of 2011.

The prevalence of *tibog*-use could be due to the obstinacy of its users who may feel inequitably constrained by its regulation [22]. Furthermore, as there are many of them, it can also be caused by the "diffusion-of-responsibility" problem wherein pressure against *tibog*-use is lessened as it does not focus on anyone and the responsibility is shared by all [22].

Relationships of demographic/contextual variable characteristics and mode of compliance to formal choice rules

Relationship of demographic factors and mode of compliance to formal choice rules

Table 3. Measure of association between demographic factors and the mode of compliance to the formal choice rules

Factors	Phi-coefficient
Age	0.3786*
Household size	0.2390
Educational attainment	0.4175*
Duration of residency in the Barangay	0.1212
Duration of engagement in artisanal fishing	0.1435
Houses structure type	0.2781
Size of household fixtures	0.4397*
Motorboat ownership	0.0026

**Exhibits strong association to mode of compliance to formal choice rules*

Table 3 shows a strong association between the artisanal fishers' mode of compliance to the formal choice rules and their age, educational attainment, and number of household fixtures. These factors are respectively dichotomized as: a) whether the fishers are ≤ 50 years of age or older; b) whether they have finished high school or not; and c) whether the number of their household fixtures are classified as minimal to low or medium to high. Mode of compliance to formal choice rules is dichotomized as whether the artisanal fishers are consistently complying, in which case their CI = 18, or inconsistently complying, with CI < 18.

As these factors have positive coefficients (Table 7), their associations with the fishers' mode of compliance are all "positively" oriented. The odds for a consistent compliance to the formal choice rules was found to be 9.2727 times higher when an artisanal fisher has medium to high number of household fixtures than

when he possesses minimal to low number of household fixtures. This supports the notion that more economically well-off resource users are freer to follow conservation rules compared to those who are very poor. Resource users that are hard-pressed by survival constraints heavily discount the future benefits of conservationist strategies and overweigh its present costs due to concerns about sheer survival. Thus, they are likely to precommit to non-cooperation when asked to contribute in the conservation of the resource they are using [22].

The odds for a consistent compliance to the formal choice rules was found to be 4.9524 times higher when an artisanal fisher is > 50 yrs. old than when he is ≤ 50 yrs. of age. Since there is strong "positive" association between the artisanal fishers' age and number of household fixtures found in the pairwise association, this odds ratio could be due to the said group being wealthier compared to those that are younger. If this is so, being more privileged has therefore allowed the > 50 years old artisanal fishers to adopt more conservative use of the fishery. However, old age can also be "positively" linked to cooperative behaviour as it influences security values. According to [2], security values become more important as capacities to cope with change wane. Therefore, the > 50 years old artisanal fishers in Barangay Bucal could have higher odds in complying with the formal choice rules since their heightened security values underlined by their slowed capacities to respond to shut-down practices necessitate in them the safe and predictable environment of a formal rule-dominated coastal fishery.

In the case of educational attainment, the odds for a consistent compliance to the formal choice rules was found to be 6.9333 times higher when the fisher has finished high school than when he has not. This observation together with the strong "positive" association between the respondents' status of being a high school graduate and their membership in BFARMC/SAMBBU found in the pairwise association, indicate that education has a "positive" effect on their civic participation [23], [24]. According to Young *et al.* (2011), these social benefits of education may have accrued as a result of their education equipping them with cognitive skills enhancing their ability to understand the salient management issues in the coastal fishery. It could also be that their education has increased their interest and knowledge of environmental and political issues, their involvement in the political process, and the effectiveness of their political participation [23].

Table 4. Measure of association between resource-related factors and the mode of compliance to the formal choice rules

Factor	Phi-coefficient
Open-lake fishery condition	0.2706
Size of the open-lake fishery	0.0912
Sufficiency of fish catch	0.2205
Able to catch silverperch from the fishery	0.0389
Able to catch snakehead from the fishery	0.0338
Able to catch white goby from the fishery	0.1647
Able to catch catfish from the fishery	0.0535
Able to catch white shrimp from the fishery	0.2981
Able to catch bighead carp from the fishery	0.1353
Able to catch milkfish from the fishery	0.0391
Able to frequently catch tilapia from the fishery	0.1114
Able to frequently catch Laguna de Bay from the fishery	0.2071
Able to frequently catch white shrimp from the fishery	0.2150
Sells Laguna de Bay catfish caught from the fishery	0.3630*
Sells snakehead caught from the fishery	0.1664
Sells white shrimp caught from the fishery	0.0454
Sells bighead carp caught from the fishery	0.1212
Sells milkfish caught from the fishery	0.1353
Sells gourami caught from the fishery	0.2494
Uses screen in the fishery	0.1276
Uses pole and line in the fishery	0.1114
Uses motorized boat in the fishery	0.2202
Frequently uses non-motorized boat in the fishery	0.1212
Owns a screen	0.1114
Owns a pole and line	0.1664
Owns a motorized boat	0.0588
Owns a non-motorized boat	0.2202
Observability of banned fishing methods	0.0302

**Exhibits strong association to mode of compliance to formal choice rules*

Relationship of contextual variable characteristics and mode of compliance to formal choice rules

Relationship of the characteristics of the resource variable and mode of compliance to formal choice rules

Mode of compliance to the formal choice rules has also been found to be strongly associated with the fishers' mode of utilizing their Laguna de Bay catfish catch (Table 4). Specifically, the odds for an artisanal fisher consistently complying to the formal choice rules is 6.5385 higher when he is into selling his caught

Laguna de Bay catfish than his odds for the same when he is not (Table 7). Interestingly, it was also found during the pairwise correlation analysis and its subsequent simple regression analysis that marketing Laguna de Bay catfish has a strong and "positive" association with medium to high number of household fixtures.

Artisanal fishers who market Laguna de Bay catfish and are compliant are deduced to be so as the additional income from selling Laguna de Bay catfish augments their income from artisanal fishing. But while Laguna de Bay catfish is one of the least marketed species owing to its strong ramish taste, the fact that it is also one of the easiest to catch in the fishery could mean that the income derived from its marketing is high enough to support conservationist strategies.

Table 5. Measure of association between resource user-related factors and the mode of compliance to the formal choice rules

Factor	Phi-coefficient
Level of ecological knowledge	0.1276
Diversity of interest in the management of the fishery	0.0572
Number of artisanal fishers using the fishery	0.0338
Level of ease in gathering the artisanal fishers	0.2150
Frequency of fishery management related gatherings	0.0338
Attendance of the respondent in gatherings	0.2367
Degree of other-regarding behaviour of the respondent	0.0389
Degree of other-regarding behaviour of fellow artisanal fishers	0.0676
Leader efficiency	0.0677
Equality of harvesting in the fishery	0.0026
Proportion of household income from artisanal fishing	0.1795
Non-artisanal fishing occupation of the respondent	0.1062
Proportion of household income from non-artisanal fishing occupation	0.0605
Job satisfaction: inclination of respondent to choose fishing again as an occupation if given the chance to live one's life all over	0.1353
Job satisfaction: inclination of respondent to changing fishing with another occupation at the present	0.1003
Number of memberships in fishermen's organization	0.4378*
Proportion of fish catch marketed	0.1062
Destination of fish catch	0.1062
Level of price of fish catch	0.0123

**Exhibits strong association to mode of compliance to formal choice rules*

Relationship of the characteristics of the resource user variable and mode of compliance to formal choice rules

For the resource user variable, it was found that the number of fishermen's association joined by the artisanal fishers is strongly associated with their mode of compliance to the formal choice rules (Table 5). However, since BFARMC/SAMBBU is the only fishermen's association in Barangay Bucal, this factor has become a representation on how they perceived their state of membership in the said association. As such, the odds of an artisanal fisher consistently complying to the formal choice rules is 9.4500 higher when he considers himself a member of the BFARMC/SAMBBU as compared to his odds for the same when he no longer sees or does not see himself to be a part of the association (Table 7).

The strong "positive" association between the respondents' mode of compliance to the formal choice rules and number of membership in fishermen's association could indicate the positive impact of group membership on cooperation. According to [22], group membership can have strong effects on the willingness of members to act unselfishly in the service of the group by preferring greater cooperation with fellow group members and having enhanced willingness to engage in altruistic punishment when fellow group members are the victim of defection. Thus, it is speculated that membership in BFARMC/SAMBBU has increased the rate of cooperation among its members as they believe strongly that other members of the group will also consistently comply with the formal choice rules and that free riders will eventually be punished by their fellow association members.

Table 6. Measure of association between institutional arrangement-related factors and the mode of compliance to the formal choice rules

Factor	Phi-coefficient
Rule violation tolerance	0.1003
Scope of rule-change needed	0.2919
Level of rule violation	0.0026
Level of rule enforcement	0.1946
Level of rule monitoring	0.1276
Mode of sanctioning rule violations	0.0464
Ease in dispute adjudication	0.0751
Accountability of officers	0.1158
Performance of officers	0.0302
State intervention	0.0605

As shown in Table 6, none of the institutional arrangement variable characteristics included in the

study exhibited strong association with the fishers' mode of compliance to the formal choice rules.

Table 7. Summary of simple regression coefficients and odds ratios of demographic and contextual variables exhibiting strong association with mode of compliance to the formal choice rules

Factor	Regression coefficient	Odds ratio
Age	1.5999	4.9524
Educational attainment	1.9363	6.9333
Size of household fixtures	2.2271	9.2727
Selling of Laguna de Bay catfish	1.8777	6.5385
Number of memberships in fishermen's association	2.2460	9.4500

CONCLUSION AND RECOMMENDATION

As found in the study, consistent compliance to the formal choice rules among the artisanal fishers of Barangay Bucal is moderate. This disproves the notion that they cannot be implemented in their entirety in the study area. Furthermore, cooperation among artisanal fishers in using the formal choice rules could be increased a) if artisanal fishers are not experiencing survival-constraints that can prevent them from absorbing the cost of consistently complying the formal choice rules; b) if they have the necessary set of cognitive skills, interest, and knowledge of the political and ecological issues surrounding the management of the coastal fishery that can enhance and broaden their participation in the collective action needed; and c) if they have developed strong moral norms that would allow them to believe that other artisanal fishers would reciprocate their consistent compliance to the formal choice rules.

These findings provide empirical basis for considering the enactment of pay-off rules mandating compensation to artisanal fishing households suffering from severe poverty, in exchange for consistent compliance to the formal choice rules. They also show the practicality of revising the access rules of some fishery-related research and training programs of the BFARMC/SAMBBU officers. Primarily, these programs should allow the participation not only of the officers but the rest of the fishers too.

Furthermore, it is recommended that similar studies should be conducted in the future. Specifically, these should focus on the other nine coastal villages in the area under study. This must be done as the artisanal fishers of these villages, just like those in this study, also harvest from the same municipal water.

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