CONTRIBUTION 3.12

Socio-Economic Features of Antigua's Small-Scale Fisheries Sector – Implications for Economic Security and Sustainable Development

Ian Horsford

Fisheries Division, Point Wharf Fisheries Complex, St. John's, Antigua, West Indies. E-mail: ihorsford@gmail.com

Abstract

Effective governance of small-scale fisheries requires a comprehensive understanding of the complex nature of fishery systems. The term "fishery system" is defined here as a functional unit with complex interactions amongst social, economic, cultural, environmental, biological, legal, and political elements. In the Caribbean context, there is a dearth of scientific literature on the social and economic aspects of small-scale fisheries despite a binding *Caribbean Community Common Fisheries Policy* and associated protocols that recognise the importance of taking social and economic factors into consideration regarding fisheries management and development. The objectives of this study were to: 1) update the socio-economic profile of fishers in Antigua as part of the National Fisher Registry programme; and 2) determine the status and trends with respect to key socio-economic metrics and their implications for fisheries management and development. Regarding status and trends, there were significant gains in gender equality with the proportion of females employed in fisheries doubling over the past decade from 2.7% to 5.9%. Significant increases in human capital among fisherfolk was observed as reflected by educational attainment increasing exponentially since the late 1990s with most fishers (77.2%) having a secondary education or higher thereby enhancing labour mobility and resilience. "Occupational pluralism" was a common livelihood strategy or a means of economic security for fishers, depicted by 51.6% of fishers having another occupation or source of income within fisheries or outside of the fisheries sector, in 2019. The small-scale fisheries sector served as a "safety net" in times of economic crisis such as the COVID-19 pandemic, depicted by the number of people renewing their fisher licence or registering and licensing for the first time increased by 262% when compared to the mean number of fisher licences issued in the pre-pandemic years. Given that economic crises tended to result in "spikes" in fishing effort, future studies should focus on understanding the labour market dynamics of fisheries and other related sectors, including recruitment and retention, to ensure the long-term sustainability of fishery resources.

KEYWORDS: socio-economic, small-scale fisheries, Antigua, occupational pluralism, resilience

CITATION: Horsford, I., 2026. Socio-Economic Features of Antigua's Small-Scale Fisheries Sector – Implications for Economic Security and Sustainable Development. Contribution 3.12, p225-237 *IN* CRFM, 2026. Volume I: Technical Papers. Presented at the CRFM 20th Anniversary Scientific Conference, 28-31 August 2023. CRFM Special Publication No. 37, CRFM Secretariat https://www.crfm.int/index.php?option=com_k2&view=item&id=917

1. INTRODUCTION

Effective governance of small-scale fisheries requires a comprehensive understanding of the complex nature of fishery systems. The term "fishery system" is defined here in its simplest form as a functional unit with complex interactions amongst human and nonhuman factors such as social, economic, cultural, legal, political, biological, and environmental factors (Horsford 2000). The human elements of the system involve fishers (including traders, processors, vendors, etc.), fishing communities, fisherfolk organizations, fisheries authorities (managers, policymakers, etc.), ancillary services (suppliers and servicers of boats, engines, gears, and cold storage facilities, etc.), academia, financial services (banks, credit unions, insurance companies, etc.), and social insurance providers (social security, health insurance, etc.). The nonhuman elements include biotic or living components (e.g., algae, parrotfish, reef shark) that interact through the food web and trophic levels, whilst abiotic include the non-living physical and chemical aspects of the ecosystem such as currents, temperature, salinity, pH scale. These components interact and impact on the fishery resources we depend on for nutrition, food security, poverty alleviation, and livelihoods. Garcia and Charles (2007) described fishery system as a "plexus of subsystems" which is also part of broader natural and human systems and is affected by the global environment, economy, and society within which it exists. As arenas for economic and social development, Gracia and Charles (2007) concluded that fishery systems remain difficult to understand, forecast, control, and optimise based on the unpredictable way they evolved, changing natural productivity and species composition, fishing technologies and strategies, markets, and products.

Despite the complex nature of fishery systems, fisheries management goals are often focused on the non-human aspects, specifically the fishery resources. In a seminal paper entitled "Does fisheries science serve the needs of managers of small stocks in developing countries?", Mahon (1997) highlighted the tendency for managers of small stocks to believe that stock assessment is essential for successful fisheries management which often leads to disproportionate allocation of resources to stock assessment rather that other critical components of management. Hence, management efforts for small stocks are often "stock assessment driven" rather than "management objective driven", as they should be. With a management objective driven approach, the entire fishery system is assessed, and human factors such as social and economic considerations are incorporated in the decision-making process. Hence, the approach is "holistic" involving balancing the requirements for nutrition, food security, poverty alleviation, and livelihoods with those of conservation and environmental health. This is critical since it is these human factors that drive man's interaction with the fishery resources and impacts the level of fishing effort. Figure 1 attempts to summarise and simplify the main elements of a small-scale fishery system as well as highlight the various considerations required for effective fisheries governance and management.

In the Caribbean context, there is limited scientific literature on the social and economic aspects of small-scale fisheries despite a binding *Caribbean Community Common Fisheries Policy* and associated protocols that recognise the importance of fisheries to social and economic development, food and nutrition security and the welfare of the peoples of the Caribbean. One of the fundamental principles of the Agreement (Article 5), regarding the use of the best available scientific information in fisheries management decisions, is that consideration be given to social, economic and environmental factors as well as traditional knowledge concerning the resources and their habitats. To achieve this a "participatory approach" is enshrined in the Agreement and member states are required to: 1) collect and compile social, economic and ecological data in addition to catch and effort data, registration and licensing data, and any other relevant data; and 2) conduct research to evaluate the social and economic performance of fisheries including aquaculture in addition to ascertain the status of stocks, and other research goals that contribute to the fulfilment of the Agreement (Article 11).

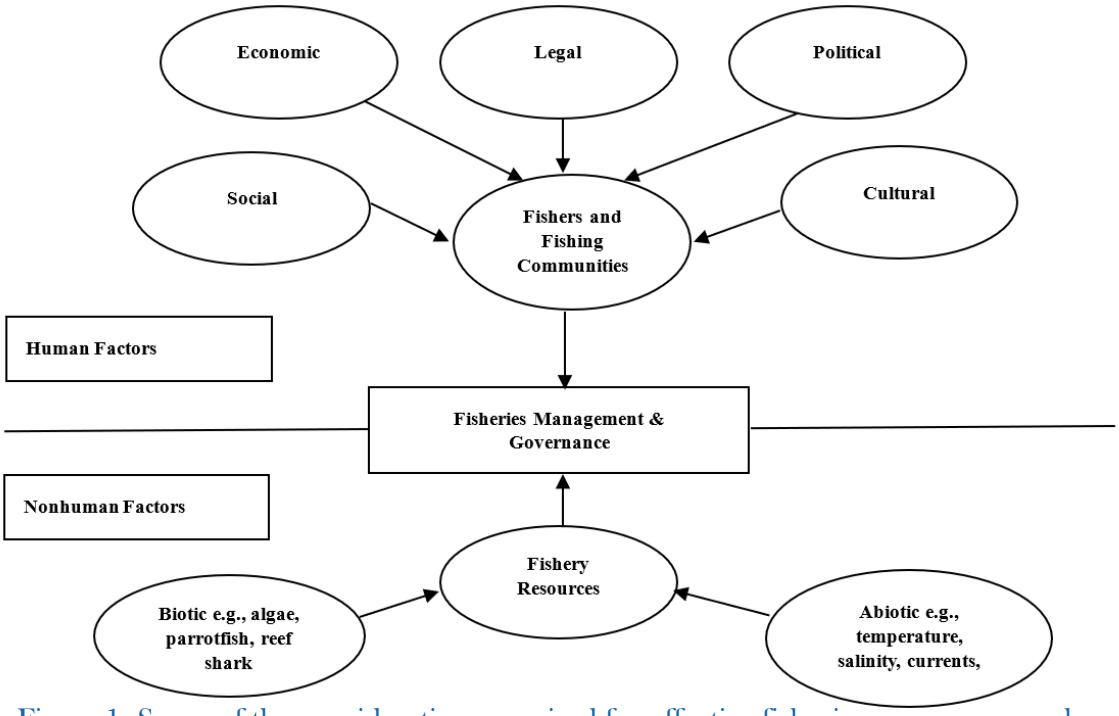

Figure 1. Some of the considerations required for effective fisheries governance and management for small-scale fisheries (adapted from: Horsford 2000)

2. METHODS

In light of the aforementioned and the limited studies conducted, the specific objectives of this research were to: 1) update the socio-economic profile of fishers in Antigua as part of the National Fisher Registry and Licencing Programme; 2) determine the status and trends with respect to key socio-economic metrics (age, sex, role in fishery – ownership and work, educational background, other occupation(s), etc.) and their implications for fisheries management and development. Data were collected or updated in 2019 from various interactions with fishers (e.g., fisher registration, fisher and vessel licence renewals, application for concessions or letter of certification, fisher professional development training). This approach was required since registered fishers were not always "active" in the sector since fishing is a vital complement or alternative to other economic activities (Horsford 2005, 20 February). For instance, when there is a "downturn" in the construction and tourism industry, individuals re-enter or increase their activity in the fishery sector. It is for this reason that a fisher licensing regime was introduced in 2013 to better track changes in the sector as well as individuals involved in ancillary services and subsistence fishing (e.g., fish-pot makers, fibreglass technicians, cockle pickers). Note the Fisheries Regulations 2013 define "fisher" as any person engaged in the harvesting, taking, processing, culturing, or trading of fish or fishery products, to include any aquatic flora or fauna. Upon meeting the required conditions for entry into the record as a licensed local fisher and payment of the prescribed fees, an identification card with licence number is issued signifying that the individual is recorded as a licensed local fisher. Statistical analyses were conducted using Microsoft Excel 365 and IBM SPSS Statistics Version 27. A population pyramid was used to summarise age groups and compare distribution to historical data. Chi-square test for independence was used to explore the relationship between two categorical variables (e.g., sex and ownership, marital status and ownership, sex and occupational pluralism, work status and occupational pluralism). Historical data on fishers was obtained from the computerised Licencing and Registration System (LRS) program which was developed in the 1990s under the Canadian-funded Caribbean Community (CARICOM) Fisheries Resources Assessment and Management Programme. In 2001, the programme was

completely revised, and a new database developed to meet national needs regarding monitoring various socio-economic metrics. Data pertaining to the general population were obtained from various population and housing censuses provided by the Statistics Division.

3. RESULTS

Figure 2 summarises the age distribution for the 219 active fishers surveyed in 2019 as well as for the 841 registered fishers in Antigua in 2002. The 219 sampled fishers represented 21.8% of 1,004 estimated active fishers in Antigua and 10.2% of 2,153 of the registered fishers in Antigua and Barbuda. Note the year 2002 was selected as a baseline since there was a registration drive in that year for both fishers and vessels, hence data on fishers was updated at that time. This was a follow up to the in-depth *Antigua and Barbuda Fishing Frame Survey 2001* (Horsford 2004). For measures of central tendency, mean, median and mode for active fishers sampled were 50, 50, and 48 years respectively. For registered fishers in 2002, the corresponding ages were 47, 45, and 36 years respectively. The age distribution of active fishers was roughly normally distributed or symmetrical whilst the distribution for registered fishers was positively (right) skewed, with the mean greater than the median and the median greater than the mode.

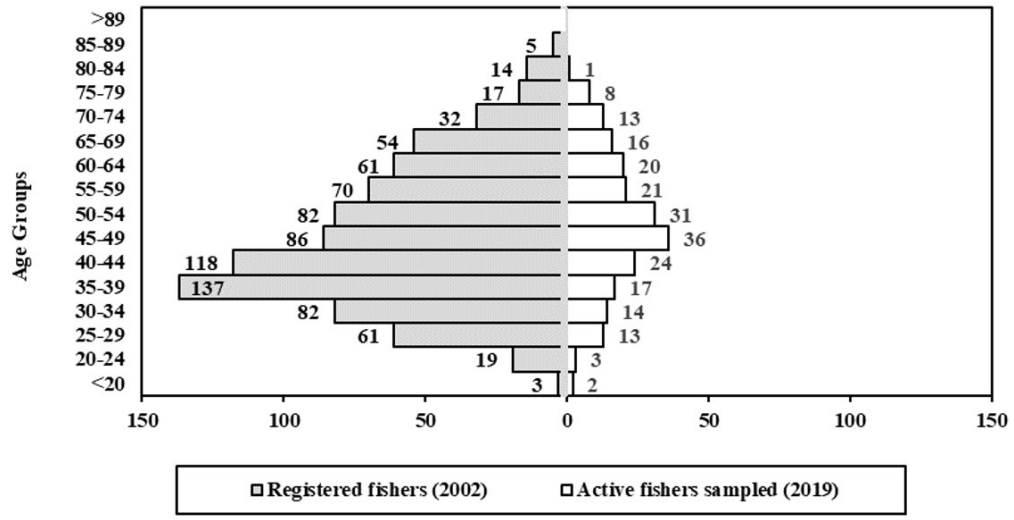

Figure 2. Age distribution of fishers residing in Antigua in 2002 and 2019. Registered fishers N = 841 and active fishers sampled n = 219

To monitor gender equality in the fisheries sector, Figure 3 summarises the registered fishers by sex in Antigua and Barbuda from 2010 to 2019. Note the combined data for both islands are presented since the catastrophic impact of Hurricane Irma in 2017 forced the evacuation of Barbuda's population to Antigua; it was only in late 2018 that around 75% of the population returned home. Consequently, some of the fisher's that were originally registered in Barbuda now reside in Antigua. Of the 219 active fishers surveyed in 2019, female fishers accounted for 5.9%; 1.7 percentage points higher than the proportion based on total registered fisher (4.2%) in 2019 (Figure 3). Hence the proportion of females participating in the industry roughly doubled over the past decade from 2.7% in 2010 to 5.9% in 2019.

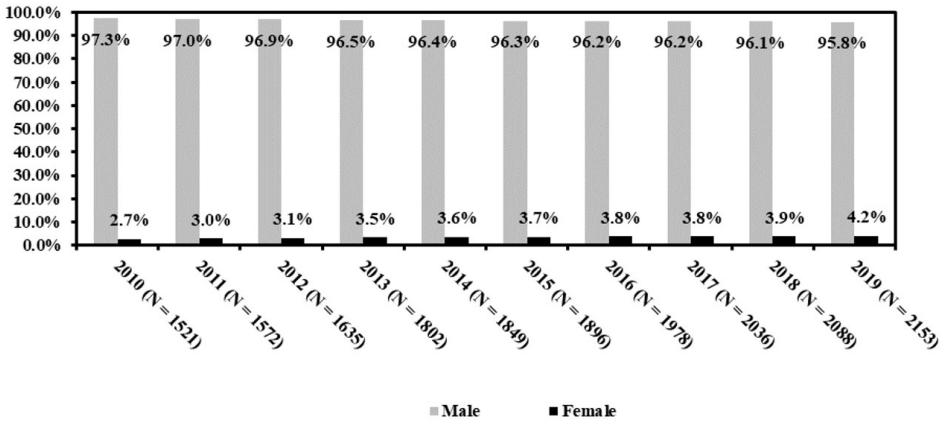

Figure 3. Registered fishers by sex in Antigua and Barbuda in from 2010 to 2019. N = number of registered fishers

Of the 219 active fishers sampled, 51.6% (113) had another source of income and / or occupation. Figure 4 summarises the other (main) source of income or employment by industry for multi-occupational fishers in 2019. Note the industry in which a person is employed is the branch of the economic activity carried out at the individual's place of work (Statistics Division 2018, Statistics Division 2020); this is defined by the kind of goods produced or services supplied by the unit in which the individual works and not necessarily the specific duties or functions of the individual's job. For example, a person may be a fibreglass repair technician or a boat skipper (occupations) in different industries, e.g., in the fishing industry and the transportation sector. In general, service and sales occupations were the most common (e.g., hardware clerk, bank clerk, taxi or bus driver, bartender, tour guide, water-sport operator). Regarding craft and related trades, occupations such as carpenter, mason, construction labourer, and electrician dominated. There were also professional occupations (e.g., medical doctor, flight engineer, teacher, pharmacist) and technical and associate professionals (e.g., dental assistant, lab technician) which required specialised knowledge and skill obtained from study at a tertiary educational institution.

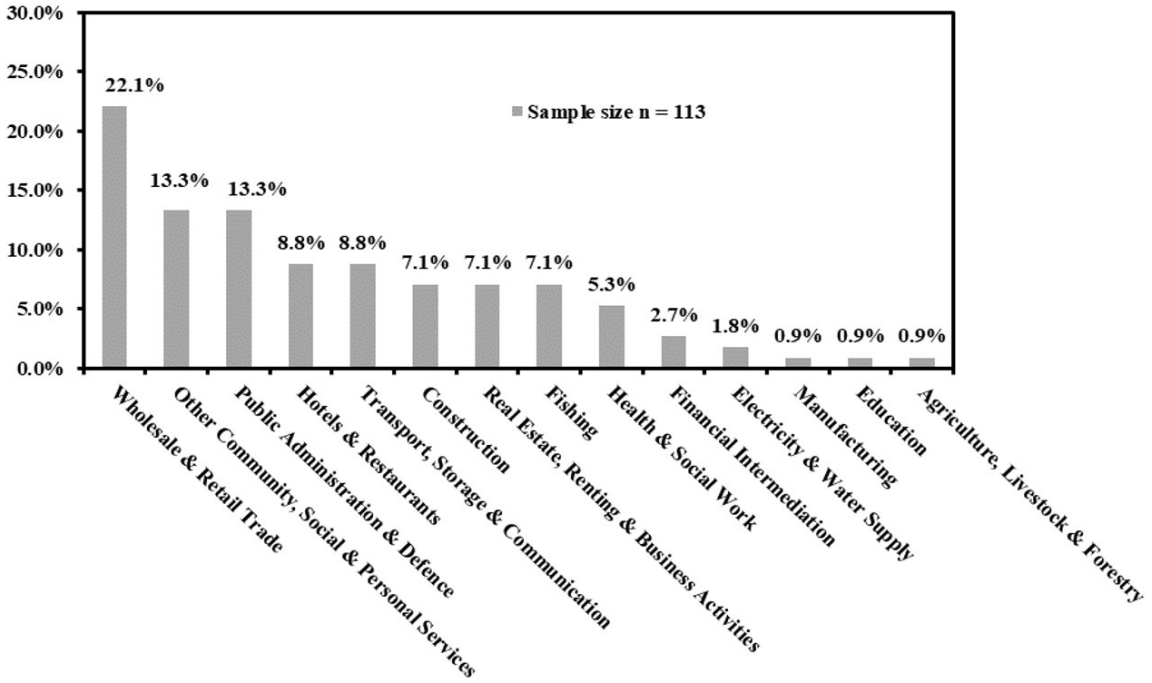

Figure 4. Alternative employment or source of income by industry for multi-occupational fishers in Antigua in 2019

Regarding formal education, 77.2% (169) of the 219 active fishers sampled had attained a secondary school education or higher. Figure 5 summarises educational background by sex for active fishers in 2019. Female fishers were more formally educated than their male counterparts at the secondary school level or higher (84.6% versus 76.7%). Although females led with respect to formal education, males had more skills via apprenticeship in fishing and ancillary services (e.g., gear construction and repairs, outboard engine troubleshooting, fibreglass repairs). Generally, male fishers were proficient in two fishing methods whilst female fishers were only proficient in one fishing method.

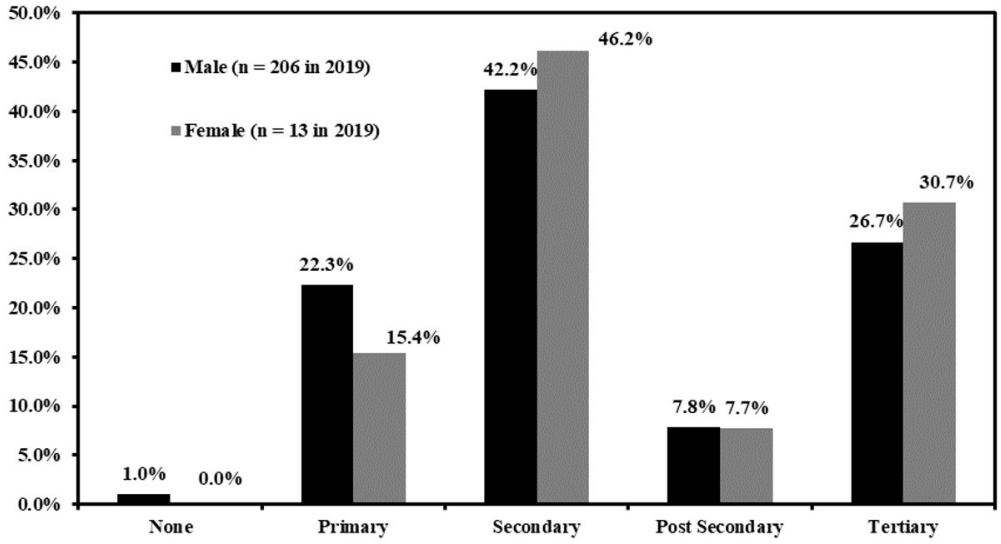

Figure 5. Highest educational level attained by sex for active fishers sampled in Antigua in 2019.

Chi-square test of independence was performed to examine the relationship between sex and ownership. The relationship between these variables was not significant, X^2 (1, N = 219) = 0.66, p = .42. For males, 57.8% of the fishers were owners of fishing vessels or processing facilities while 42.2% were non-owners. For females, 69.2% were owners while 30.8% were non-owners. Overall, 58.4% of the 219 fishers sampled owned their fishing vessel or processing facility, 41.6% were non-owners either as captain, crew, or processing employee. There was a significant relationship between marital status and ownership, X^2 (2, N = 210) = 31.19, p < .001. The relationship was "moderate" (Cohen 1988) between the two variables based on the effect size (i.e., strength of association) as measured by the Phi and Cramer's V values (.38 respectively). For married fishers, a significantly greater proportion ($p \leq .05$) owned vessels or processing facilities (79.0%) as opposed to those who did not (21.0%). For single fishers, a significantly greater proportion ($p \leq .05$) did not own vessels or processing facilities (59.8%) as opposed to those who owned (40.2%). For divorced fishers, there was no significant difference ($p > .05$) between the proportion that owned (53.8%) and those that did not own (46.2%).

Chi-square test of independence showed that there was no significant association between sex and occupational pluralism, X^2 (1, N = 219) = 0.02, p = .89. For males, 51.9% of the fishers (107) had more than one occupation or source of income while 48.1% had one occupation or source of income in fishing (99). For females, 53.8% (7) had multiple occupations while 46.2% (6) had a single occupation. There was a significant relationship between work status and occupational pluralism, X^2 (2, N = 215) = 38.44, p < .001. The strength of association between the two variables was "moderate" (Cohen 1988) based on the effect size as measured by the Phi and Cramer's V values (.42 respectively). For full time fishers, a significantly greater proportion ($p \leq .05$) had a single occupation (70.6%) as opposed to multiple occupations (29.4%). Conversely, a significantly greater proportion ($p \leq .05$) of part time fisher had multiple occupations (71.1%) as opposed to single occupation (28.9%). For weekend only fishers, there

was no significant difference ($p > .05$) between the proportion that had multiple occupations (75.0%) and those that had a single occupation (25.0%).

4. DISCUSSION

Figure 2 summarises the distribution by age cohorts for fishers residing in Antigua in 2002 and 2019. One of the most important features of a population is its age distribution since the shape of the "population pyramid" or "age pyramid" reflects the potential for future growth. Since fisheries in Antigua and Barbuda still have untapped potential for development in the context of capture fisheries for large pelagics (e.g., moored fish aggregating device fishery), recreational fishing (e.g., sportfishing charters), and aquaculture (e.g., freshwater *Tilapia* spp., *Macrobrachium* spp., and sea moss production), a broad-based or "expansive pyramid" with a larger percentage of people in younger age groups is required to support future growth. In the case of Antigua, the "greying" of the fisher's population continues – in 2002, fishers under 35 years comprised 20% of the population; in 2019, only 15% of the sampled fishers were under 35 years. Hence, the age pyramid is "constrictive" at the bottom or base with minimal young entrants into the sector and a bourgeoning middle-aged population. This is of great concern since each succeeding age group is getting smaller and smaller approaching the base, and the median age has shifted from 45 years in 2002 to 50 years in 2019. Note the median age is used as a measure of central tendency for comparison in this case since the distribution for registered fishers was positively (right) skewed as opposed to being symmetrical (Figure 2). The *Caribbean Regional Fisheries Mechanism (CRFM) Strategic Plan 2022-2030* (CRFM 2021) cites limited youth engagement in fisheries and aquaculture as one of the main challenges to member states, and list as strategic objectives: 1) enhanced cross-sectoral collaboration and knowledge generation on differentiated social and cultural factors impacting youth engagement; and 2) increased understanding of the differentiated social and cultural factors impacting youth in fisheries. Key indicators such as a percentage increase in technical and scientific information for planning and decision-making, and percentage participation of youth in community-based management practices, and number of youths trained, are also provided in the Strategic Plan.

At the national level, youth unemployment aged 15 to 24 remains a big challenge despite room for growth in the fisheries sector, 33.9% in 2015 and 25.7% in 2018 (Statistics Division 2018, Statistics Division 2020). To address youth unemployment, Horsford (2021) recommends the following: 1) greater emphasis needs to be place on private sector driven growth through a package of incentives that are performance based (this will allow for greater job creation); 2) youths need to inculcated at an early age with an entrepreneurship mind-set beyond the simple academics (i.e., be able to create a job as opposed to looking for a job); and 3) financing has to be scaled up to support youth entrepreneurship and business incubation. These recommendations also hold true for the fisheries sector however I would add the need for a structured or formal approach to professional development since entry into the sector is typically via "apprenticeship" from a family member or an acquaintance. Unfortunately, there are few dedicated centres for fisheries professional development in the Caribbean (e.g., the Caribbean Fisheries Training and Development Institute) where basic seamanship, and fishing and processing skills can be developed. The Fisheries Division offers basic training in areas such as Navigation and Seamanship, First Aid and Cardiopulmonary Resuscitation, and Seafood Safety and Quality Assurance in collaboration with various partners (e.g., the Antigua and Barbuda Red Cross Society, the Antigua and Barbuda Defence Force Coast Guard) as part of the requirements to obtain a local commercial fisher licence under the Fisheries Regulations 2013. In 2019 under the Food and Agriculture Organization of the United Nations (FAO) Climate Change Adaptation in the Eastern Caribbean Fisheries Sector (CC4FISH) project, 45 fishers and 15 vendors (including youth and women) benefited from certification in *Finfish*

Handling and Processing, and *Handling Fish Aboard Vessel* from the Caribbean Fisheries Training and Development Institute. In collaboration with the Ministry of Education, the project also improved aquaponics systems in schools with the aim of improve learning outcomes and attracting youths to the aquaculture sector.

Regarding gender parity, as a numerical measure of the state of sexual equality in the fisheries sector, female fishers accounted for 5.9% of the 219 active fishers sampled in 2019; 1.7 percentage points higher than the proportion based on total registered fisher (4.2%) in 2019 (Figure 3). Hence there were significant gains with respect to equality of the sexes with the proportion of females roughly doubling over the past decade. Horsford (2020) postulated that it is highly unlikely that more females are actively involved in the sector owing to the difficulty in getting spouses or girlfriends, who invest in fishing operations, to register as investors because of gender roles and stereotypes (i.e., they tend to leave the registration, licensing, and at-sea operations of the vessel to their male counterpart). Coupling this with the social norm of spouses or girlfriends providing unpaid and unregistered work in areas such as processing or marketing as part of their contribution to the family business, highlights that much work needs to be done to mainstream the role of women in the sector (Horsford 2021). Social norms are defined here as informal (often unspoken) rules governing the behaviour of a group, emerging out of interactions with others and sanctioned by social networks (Cialdini and Trost 1998). These norms often reinforce gender stereotypes making societal and cultural changes difficult. Despite the numerical gains by females, for the most part the fisheries sector of Antigua and Barbuda continues to be male dominated. Of the 13 females captured in the survey 84.6% were involved in capture production as investor, captain, or crew whilst the remaining 15.4% were involved in secondary activities such as processing and marketing. Investor was the most common role for female fishers as owners of fishing vessels. A follow-up survey of female respondents indicated family history, experience in fishing or processing (via apprenticeship) and inheritance of assets (e.g., fishing vessel) were the main points of entry for females into the sector. This highlights the urgent need for a national centre for fisheries professional development or some other formal mechanism, if we intend to scale-up the proportion of females and youth participation in the fisheries sector. Note under Caribbean Association of National Training Authorities (CANTA), the implementation arm of the CARICOM Regional Coordinating Mechanism for Technical and Vocational Education and Training, various regional occupational standards have been approved for the sector in areas such as aquaculture, fish handling and processing, boating operations and safety of fishers operating vessels of 12 m or less, and fishing vessel operations (CANTA 2023).

The recently developed Caribbean Regional Fisheries Mechanism (CRFM) five-year *Gender Analysis and Action Plan on Gender Mainstreaming in Fisheries*, provides direction for strategic priorities and activities on gender mainstreaming throughout the region (CRFM 2020). These priority areas include: 1) enhancing collection and analysis of comprehensive sex-disaggregated socioeconomic data in fisheries; 2) increasing understanding of the differentiated social and cultural factors impacting labour and poverty of women, men, and youth in fisheries, and gender-responsive approaches to address these issues; 3) enhancing cross-sectoral collaboration and knowledge generation on gender equality and youth engagement in fisheries; and 4) strengthening engagement with fisherfolk organisations and local level stakeholders on implementing gender-responsive approaches in fisheries. Antigua and Barbuda as a CRFM member state is actively participating in the process and has designated a Fisheries Gender Focal Point that will support capacity building sessions, access to resources, and development of a National Gender and Fisheries Action Plan. Notwithstanding the difficulties of changing social norms, gender equality is possible since ironically women had a much great role in fisheries in the post-emancipation period (the decades after 1834) than the period after gaining independence in 1981 – "… the new lifestyle that the free people were forced to live, breed a whole tun (lots of) of fisherman and fisherwoman than any other kind of people in the first

twenty or so years after freedom" … "I deliberately say fisherwoman" since "back then, the women make their own fish pots" (Smith and Smith 2003).

Of the 219 active fishers sampled, 51.6% (113) had another source of income and / or occupation. Occupational pluralism was common with fishers having more than one job or multiple sources of income from various occupations or enterprises within or outside the fisheries sector (Figure 4). In addition to occupational pluralism, vertical integration of businesses was also observed, where individuals establish additional enterprises either upstream or downstream in the product or service value chain. For example, a fishing operation and a seafood restaurant or a fish processing facility, or a marine chandlery and a fishing operation. Vertical integration can potentially increase economies of scale, lower variable production costs and address quality concerns – thereby enhancing competitive advantage and profitability. Based on the strategy of occupational pluralism and in some cases vertical integration of businesses, most fishers (roughly half) have a somewhat robust degree of financial resilience and economic security. Economic security is defined here as "the ability of individuals, households, or communities to cover their essential needs sustainably and with dignity" considering individuals' physical needs, the environment, and prevailing cultural standards (International Committee of the Red Cross 2015). These needs include food, basic shelter, clothing, etc., as well as the essential assets needed to earn a living, and the costs associated with health care and education. With respect to the two latter essential needs, Universal Health Coverage Index for Antigua and Barbuda in 2019 was 72 out of 100 (World Health Organization 2022), indicating a "high level" of universal health coverage for the residents, complemented by a suite of social benefits in the event of sickness, injury, invalidity, maternity, retirement, or death. Since 1973, education has been free and compulsory for children 5 to 16 years old, in accordance with the Education Act. While the livelihood strategies and social metrics suggest a somewhat robust degree of financial resilience and economic security, the picture changes when one looks at securing the essential assets to earn a living – securing insurance for fishing vessels. In 2010, 11.1% of the active fishing fleet had vessel insurance coverage, whilst in 2017, only 5.9% of the owners reported that they had vessel insurance (Horsford 2020). High premiums, inadequate coverage (e.g., the maritime limits of the policy normally did not cover the extent of fishing operations) and high deductible were cited as the main reasons for opting for a voluntary saving strategy to cover emergencies. The Caribbean Ocean and Aquaculture Sustainability Facility (COAST) provided by the Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company (CCRIF SPC) offers a unique opportunity to address the issue of fishing vessel insurance. COAST is a parametric insurance product at a level relevant to fishing communities that supports governments' efforts to provide rapid economic relief to fishers affected by extreme events, whilst promoting a culture of building back better to enhance fishing community resilience. The COAST product is unique in that it incorporates a livelihood protection component (analogous to micro-insurance) and a tropical cyclone component (like sovereign insurance). Currently, the COAST product is available in two pilot countries – Grenada and Saint Lucia. Antigua and Barbuda hopes to utilise this product once the pilot phase has been completed.

Regarding formal education, 77.2% (169) of the 219 active fishers sampled had attained a secondary school education or higher. In contrast, research done in selected fishing communities in 1999 and 2005 (Horsford 1999, Horsford 2005), indicated that at most 43.3% had attained a secondary school or higher. This achievement in human capital with respect to formal education enhances occupational mobility (i.e., the capacity to change occupation) and adaptive capacity (i.e., the potential as individuals to respond to economic stress) in the fisheries sector. Female fishers were more formally educated than their male counterparts at the secondary school level or higher (84.6% versus 76.7%) (Figure 5). This is consistent with similar trends observed in the general population and throughout much of the other Organisation of Eastern Caribbean States (OECS) member states over the past decades. There has been a declining participation of males at the upper secondary and tertiary levels; in 2010,

approximately 65% of entries for the Caribbean Secondary Education Certificate examination and for the Caribbean Advanced Proficiency Examination were female (OECS 2016). On average, the enrolment rate of males attending tertiary education in OECS member states was about 35% for the same period. While females led for formal education, males had more practical skills via apprenticeship in fishing and ancillary services (e.g., gear construction and repairs, outboard engine troubleshooting, fibreglass repairs) or from another trade (carpentry, welding, electrical installation, etc.). With respect to fishing, generally male fishers were proficient in two fishing methods whilst female fishers were only proficient in one fishing method. These differences are most likely due to social norms and gender stereotypes mentioned in the earlier sections. The promotion and advancement of technical and vocational training is one mechanism whereby female fishers can acquire the necessary practical skills traditionally acquired via apprenticeship. Many educators in technical and vocational training favour the integration of academic and technical / technological curricula because learning sophisticated technical or technological concepts requires a sound foundation in Mathematics, Science and Communications (OECS 2016).

Regarding significant relationships between the socio-economic metrics, there was a significant relationship between marital status and ownership ($p < .001$), with a significantly greater proportion of married fishers owning vessels or processing facilities (79.0%) as opposed to those who did not (21.0%) ($p \leq .05$). Conversely, a significantly greater proportion of single fishers did not own vessels or processing facilities (59.8%) as opposed to those who owned (40.2%) ($p \leq .05$). This was possibly related to the fact that marriage typically allows for the pooling of financial resources thereby allowing for greater investment as well as better access to financing provided both individuals have a good credit history and sufficient collateral. For divorced fishers, there was no significant difference ($p > .05$) between the proportion that owned (53.8%) and those that did not own (46.2%); this may be related to the liabilities that comes with divorce (e.g., spousal support, or alimony). The marital status of the 219 fishers sampled was broken down as follows: married (47.9%), single (42.0%), divorced (5.9%), common law (3.2%), and widowed (0.9%). The proportional distribution was more reflective of the "traditional" or the nuclear family structure in Antigua and Barbuda in the 1970s and earlier; this was related to the middle-aged structure of the active fishers – mean and median age was 50 years respectively. In 1960, 35.0% of the population 15 years and older was married (United Nations Statistics Division 2023) whilst in 2011 the proportion declined to 27.2% of the population (Statistics Division 2014). If being married is one of the societal structures that supports ownership (investment) in the fisheries sector and single-parent households and unmarried adults are becoming the norm, then the approach to promoting investment in the sector will have to change if we intend to maintain the high level of "grassroot" ownership (58.4%) and micro-entrepreneurship in the sector. Note common law fishers (n = 7) and widowed fishers (n = 2) had to be excluded from the relationship analysis since there were too few samples and inclusion would have violated one of the assumptions of the Chi-square test concerning minimum expected cell frequency (0 cells having expected count less than 5).

There was a significant relationship between work status and occupational pluralism ($p < .001$). For full time fishers, a significantly greater proportion ($p \leq .05$) had a single occupation (70.6%) as opposed to multiple occupations (29.4%). Conversely, a significantly greater proportion ($p \leq .05$) of part-time fishers had multiple occupations (71.1%) as opposed to single occupation (28.9%). One can argue that by applying "division of labour", the economic concept which states that dividing the production process into different stages enables workers (in this case mainly self-employed fishers) to focus on specific tasks thereby increasing overall efficiency, could benefit small-scale fisheries. This concept popularised by Adam Smith in the 1776 book entitled *An Inquiry into the Nature and Causes of the Wealth of Nations* is geared towards industrialisation where workers are "cogs" as opposed to independent actors in the production

line. Hence applying this concept to small-scale fisheries is difficult since they are not homogenous units but are units with widely differing organisational levels ranging from self-employed single operators through informal micro-enterprises to formal sector businesses (Food and Agriculture Organization of the United Nations [FAO] 2004). One way in which division of labour may be applied to small-scale fisheries is the use of cooperatives to handle the marketing of catch; hence seagoing fishers can preserve their sense of "individualism" or self-reliance by focusing on fishing whilst using "collectivism", in the structure of a cooperative body to outsource the marketing aspects of their operations. This is a "win-win" situation since individualism is preserved as well as the benefits of occupational pluralism (e.g., greater economic security and financial resilience) while at the same time economies of scale and efficiency in the value chain have increased. Note there were no significant association between sex and ownership, and sex and occupational pluralism ($p > .05$ respectively); hence there was no evidence for gender inequality regarding these factors. Future studies should focus on surveying a larger sample size of active fishers such that the various predictor variables can be disaggregated to allow for more complex analysis such as logistic regression; this method can be used to describe and test hypotheses about relationships between a categorical dependent variable and a set of categorical or continuous predictor variables or a mixture of both. It allows for the testing of models to predict categorical outcomes as well as provide an indication of the relative importance of each predictor variable as opposed to the limitations of the Chi-square test for independence in this study (i.e., limited to whether two categorical variables are related). A greater understanding of the relative importance of each predictor variable will allow the Fisheries Division to be more strategic in the formulation of fisheries development plans or initiatives to address the various issues (sexual equality, youth participation and empowerment, etc.).

Livelihood strategy such as occupational pluralism allows small-scale fisheries to serve as a "safety net" in times of economic crisis. For example, during the coronavirus (COVID-19) pandemic, the number of persons renewing their fisher licence or registering and licensing for the first time increased by 262% when compared to the mean number of fisher licences issued in the pre-pandemic years (Figure 6). Much of the increase in the number of individuals obtaining a fisher licence was due to laid-off workers entering fisheries following the collapse of tourism and tourism related sectors (e.g., transportation) due to the closure of international borders. Given that economic crises tended to result in "spikes" in fishing effort, future studies should focus on understanding the labour market dynamics of fisheries and other related sectors, including recruitment and retention, to ensure the long-term sustainability of fishery resources. While the shift from an "open access" to a "limited entry" management regime in 2013 allowed for greater control of fishing effort, further steps will have to be taken at the national level to ensure that the necessary social protections are in place to deal with large scale displacement or unemployment due to exogenous economic shocks (e.g., Global Financial Crisis, Great Recession, COVID-19 recession associated with the lockdown). The pandemic highlighted the need for strengthening of social safety nets by expanding coverage to include unemployment benefits and universal healthcare (Horsford 2021). Under the current system individuals requesting to be entered into the record as a licensed local fisher are required to first register under the Social Security Act 1972, and any other labour requirements for Antigua and Barbuda (e.g., Medical Benefits Scheme). This provision was incorporated into the Fisheries Regulations 2013 to ensure fisheries policies where consistency with overall social protection policies as well as to support the process of "formalising" and "professionalising" the fisheries sector. Hence fishers are entitled to a suite of social benefits in the event of sickness, injury, invalidity, maternity, retirement, or death as well as medical benefits (refunds for prescription drugs, and services such as laboratory tests, X-rays, surgery, etc.) once they meet the contribution requirements. Further collaboration between fisheries and social protection authorities will ensure that fishers and fishing communities are better able to face the challenges posed by exogenous economic shocks and climate change. This is critical given that the Global Climate Risk Index 2021, ranked Antigua and Barbuda seventh out of 180 countries, in terms

of economic losses from extreme weather events based on average losses per unit GDP in percentage from 2000 to 2019 (Germanwatch 2021).

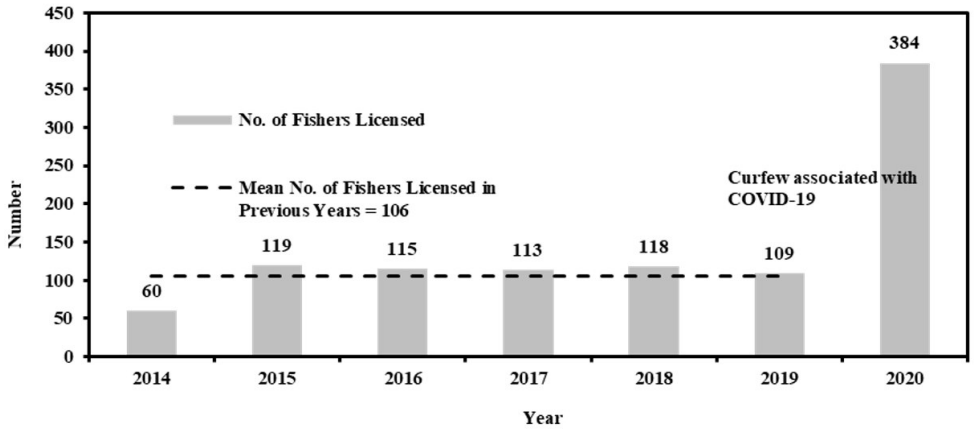

Figure 6. Number of fishers registering and licensing for the first time or renewing their licence during the first six months of the year in Antigua.

LITERATURE CITED

Caribbean Association of National Training Authorities (CANTA). 2023. Occupational standards. Retrieved August 15, 2023, from the CANTA website: https://cantaonline.org/os/

Caribbean Regional Fisheries Mechanism. 2020. *Gender Analysis, Strategy and Action Plan on Gender Mainstreaming in Fisheries of Member States of the Caribbean Regional Fisheries Mechanism*. Technical & Advisory Document, No. 2020/ 06. CRFM. Belize and St. Vincent and the Grenadines. 69 pp.

Caribbean Regional Fisheries Mechanism. 2021. *Third Caribbean Regional Fisheries Mechanism Strategic Plan 2022-2030, CRFM Administrative Report*. 24 pp.

Cialdini, R., and M. Trost. 1998. Social influence: social norms, conformity and compliance. Pages 151-192 in D. Gilbert, S. Fiske, and G. Lindzey, (eds.) The Handbook of Social Psychology. McGraw-Hill, New York.

Cohen, J. 1988. *Statistical power analysis for the behavioural sciences (2nd ed.)*. Lawrence Erlbaum, New Jersey.

Food and Agriculture Organization of the United Nations (FAO). 2004. Advisory Committee on Fisheries Research: Report of the second session of the Working Party on Small-scale Fisheries. Bangkok, Thailand, 18-21 November 2003. *FAO Fisheries Report No. 735*. FAO, Rome. 21 pp.

Garcia, S. M., and A. T. Charles. 2007. Fishery systems and linkages: from clockworks to soft watches. *ICES Journal of Marine Science* 64:580-587.

Germanwatch. 2021. Global Climate Risk Index 2021. Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2019 and 2000-2019. Retrieved August 14, 2023, from Germanwatch website: https://www.germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf

Horsford, I. 2000. Fisheries management – a holistic approach. Pages 40-43 in OECS Fishers. Organisation of Eastern Caribbean States Natural Resources Management Unit. St. Lucia.

Horsford, I. 2004. *Antigua and Barbuda vessel frame survey 2001*. Fisheries Division, Ministry of Agriculture, Lands, Marine Resources and Agro-Industries, St. John's, Antigua. 37 pp.

Horsford, I. 2005, 20 February. Fishing industry vital – the experiences of Point-Villa and Grays-Green. *The Sunday Scoop, The Family Newspaper of the OECS*, St. John's, Antigua. p. 10.

Horsford, I. 2020. *Tropical disturbance AL98 and associated troughs – preliminary damage assessment for Antigua and Barbuda's fisheries sector*. Fisheries Division, Ministry of Agriculture, Fisheries and Barbuda Affairs. Antigua. 17 pp.

Horsford, I. 2021. *Social development and sustainable fisheries: Antigua and Barbuda*. The International Collective in Support of Fishworkers Publication. India. 62 pp.

International Committee of the Red Cross (ICRC). 2015. *What is Economic Security?* Retrieved August 15, 2023, from the ICRC website:
https://www.icrc.org/en/document/introduction-economic-security

Mahon, R. 1997. Does fisheries science serve the needs of managers of small stocks in developing countries? *Canadian Journal of Fisheries and Aquatic Sciences* **54**:2207-2213.

Organisation of Eastern Caribbean States (OECS). 2016. *OECS Education Sector Strategy: 2012 – 2026*. Retrieved August 30, 2023, from the OECS website:
https://www.oecs.org/en/our-work/knowledge/library/oecs-education-strategy/download

Smith, A. 1776. *An inquiry into the nature and causes of the wealth of nations, Volume 1*. Strahan. 534 pp. Retrieved September 15, 2023, from Google Books:
https://books.google.com.ag/books/about/An_Inquiry_Into_the_Nature_and_Causes_of.html?id=C5dNAAAAcAAJ&redir_esc=y

Smith, K.B., and F.C. Smith. 2003. *To shoot hard labour 2: the life and times of Samuel Smith, an Antiguan workingman, 1877-1982*. Edan's Publishers. Ontario.

Statistics Division. 2014. *Antigua and Barbuda 2011 Population and Housing census: Book of Statistical Tables I.* Statistics Division, Ministry of Finance, the Economy, Public Administration, Public Broadcasting and Information, Antigua.

Statistics Division. 2018. *Antigua and Barbuda 2015 Labour Force Survey Report*. Statistics Division, Ministry of Finance and Corporate Governance. Antigua.

Statistics Division. 2020. *Antigua and Barbuda 2018 Labour Force Survey Report*. Statistics Division, Ministry of Finance and Corporate Governance. Antigua.

United Nations Statistics Division. 2023. Population by marital status, age, sex and urban/rural residence: Antigua and Barbuda 1960. Retrieved September 15, 2023, from the United Nations Statistics Division website UNdata:
http://data.un.org/Data.aspx?d=POP&f=tableCode%3a23

World Health Organization. 2022. *World Health Statistics 2022: Monitoring health for the SDGs, Sustainable Development Goals*. Geneva.