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Seasonal flows of economic benefits in small-scale fisheries in Liberia: A value chain analysis

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ABSTRACT

Artisanal fisheries employ small simple craft making fishers, processors and traders vulnerable to seasonal fluctuations. This study examines effects of seasonality on supply, trading relationships and benefits distribution in two small-scale fisheries in Liberia. Quantities of seafood traded in the dry season were 6 times higher than during the rainy season. Analysis of organizational structures and marketing channels of value chains; and the differences in net benefits of actors, show that market relationships promoted competition among buyers compared to captive relationships. The difference in net benefits between fishers and traders was significant but fishers net incomes were significantly reduced during the rainy season relative to fish traders. We identify key areas of possible policy interventions, such as improving quality and infrastructure, tackling power asymmetries and promoting increased competition among middlemen.

1. Introduction

Seafood is a highly traded product and seafood trade has shaped the livelihoods of millions of people [15,19,30,56]. Seasonal fluctuations in landings lead to an intermittent reduction in fish supply, benefits and related trade [26]. Understanding the impact of seasonality is essential, as the number of people involved in processing and marketing continues to grow [15,26,61].

In most cases prices of raw materials are decided by producers at the harvesting end of value chains [15,54,57]. This is expected to influence how net return among actors and between fishing seasons are distributed along the value chains [57]. Fishers typically derive a relatively low share of the overall benefits flowing from seafood trade compared to actors downstream the value chain [17,48,57].

Different types of customers [58], forms of transactions or governance (patron-client relationships) [2,4,13,20,29,35,36] and gender [21] have been found to affect benefit flow in small-scale fisheries (SSF) [17]. The effects of seasonality in seafood supply on trading relationships and distribution of benefits of SSF producers, is neither well understood nor documented. Earlier analyses investigating differences in prices of seafood products and benefits along the value chains have often neglected seasonal fluctuations in fish supply. This could partly be because SSF value chains can be complex and difficult to examine methodically [9,6,39,52].

This paper investigates seasonal flows and distribution of net benefits and relationships between actors in two SSF in Liberia; the Kru and the Fanti fisheries. To understand the characteristics of the small-scale seafood market, the following research questions are put forward. What is the value-adding role of the main actors in the value chains and how are their benefits impacted by the relationships among them and the seasonal changes in fish supply? What are the organizational structures and marketing channels of the value chains and the differences in average net benefits of actors at each node of the value chains during the dry and rainy seasons? The paper is divided into four parts. A description of the fisheries in Liberia is followed by a description of methods, results, discussion and conclusions.

1.1. Fisheries in Liberia

Libera has a coastline of 579 km and an exclusive economic zone of 246,152 km^2 harboring valuable demersal and pelagic fisheries resources, which in turn are a source of food and livelihoods for many Liberians and an important source of government revenue [44]. The fisheries resources are exploited by Industrial fisheries and SSF

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deploying multiple types of fishing craft and gear [40,42]. The estimated total coastal catch in 2014 was about 30,000 metric tons, about 86% produced by the SSF [40]. The catch is mainly consumed locally, while shortages in fish supply are complemented through imports. The fisheries contribute about 10% to the GDP of Liberia [5].

Industrial fishery is any large-scale harvesting or associated activities using vessels with an engine capacity >100bhp and >90 ft [37]. The industrial fishery comprises coastal trawl- and offshore large pelagic fisheries [38,40]. In the coastal fishery trawlers deploy mid-water and bottom trawls mainly targeting the shallow-water demersal finfish and shrimp species [40]. This fishery accounts for about 14% of the total marine catch landed in Liberia and its catch is supplied to the domestic market, although a part is also exported [38,40].

The offshore large pelagic fishery consists of large vessels that employ purse seines, longlines and pole and line gears primarily targeting tuna and tuna-like species [38]. In 2011 government revenues from the industrial fishery subsector totalled US$ 400,000. This figure increased sharply to about US$ 6.0 million in 2013 [38]. This is most probably because of the fisheries management reforms and increased enforcement introduced by the Government of Liberia in 2010 [12].

The SSF employ canoes powered by sails and paddles and open boats <60 ft motorized with engine capacity not exceeding 40 hp, where the proprietor is directly involved in the daily operations of the business [37]. The SSF are estimated to provide livelihoods for nearly 33,000 full-time participants, around 33% of whom are fishermen [12,18,40]. While Liberian participation in the SSF is about 80%, the rest are foreigners mainly from Ghana, Togo, Senegal and the Ivory Coast. Among the Liberians, 60% are females [40].

Majority of the small-scale fishers operate 5–7 m long dug-out canoes, using mostly sails and paddles for propulsion [18]. These fishers are traditionally referred to as Kru because of the type of dugout canoe they operate but in practice they may be a mix of people comprising Kru, Vai, Bassa, Grebo and other tribes [40]. The most common gears are cast-nets, beach-seines, gill nets, long lines, hooks and lines, and traps [60]. While Kru fishermen mainly target the inshore demersal stock complexes, the *Pseudotolithus* species locally known as cassava fish is a major commercial target species accounting for about 20% of the overall catch produced in the SSF according to official statistics of the National Fisheries and Aquaculture Authority. In 2013 over 2500 Kru canoes operated from 114 landing sites along the coast (Table 1).

In addition, there are over 750 larger boats (Table 1), 10–15 m long and mostly powered by 15–40 horsepower outboard engines, traditionally called Fanti boats [12]. Most deploy ring nets and principally target small pelagic *Sardinella* species locally called bonny. Some however use set nets, drift nets and hook and line targeting shallow and deep-water demersals and some larger pelagic species [12,60]. About 60% of the total catch in the SSF comes from Fanti fishery [38].

Small-scale fish trading involves multiple actors and purchasing either for processing or for distribution and consumption [19,40]. The actors involved in fish trade are generally artisanal fish traders predominantly women (98%) or large-scale Korean traders. A small-scale fish trader is typically a woman who buys up to 150 kg, on average 70 kg, of fish at a time and goes on foot or uses public transport (such as taxi, tricycle or motorbike) to bring fish to her clients. A Korean trader typically purchases more than 300 kg day^{-1} of cassava fish from Kru fishers and uses privately organized vehicles (usually mini trucks filled with chillers), to transport the fish to Monrovia, before exporting.

Seasonality greatly affects small-scale fishing in Liberia [40]. During the dry season, October-April when the weather is good the sea is calm and fishing conditions are favorable; catches can be quite high. During this season, the intermittent advent of big shoals of small pelagic fish in inshore-waters can result in large harvests and considerable increase in downstream activities. Fish traders and processors neither have the capacity nor the means to purchase and process all the landed catch, resulting in increased levels of post-harvest losses [40]. During the rainy season, in May–October, periods of strong ocean currents, heavy storms and rainfall prevent small-scale fishers from going to sea. The small-scale Kru cassava fish and the Fanti bonny fisheries are the focus of this study.

Table 1
Locations of small-scale fisheries landing sites and the number of vessels and fishers in 2013.

Coastal county	No of landing sites	No. of Kru canoes	No. of Fanti boats	No. of fishers
Grand Cape Mount	7	222	57	1155
Bomi	2	39	26	161
Montserrado	7	453	213	2151
Margibi	6	72	44	339
Grand Bassa	22	549	187	2454
River Cess	13	247	55	637
Sinoe	24	385	90	985
Grand Kru	24	330	19	798
Maryland	9	234	66	771
Total	**114**	**2531**	**757**	**9451**

Source: MRAG [40].

2. Methods

Value chain analysis [55,59] is used to evaluate the organizational structure by describing the value-addition activities in two SSF in Liberia. The concept dates back to Porter 1985 [47] and has since evolved with others making significant contributions on value chain governance and institutions [4,22,23,29,35]. In value chain analysis, governance relates to the corporation and coordination between the participants (actors) facilitating the delivery of a product from primary production to final use and involves the power some key actors manage to exercise control over others through their bargaining power, to be able to allocate the value produced within the respective value chains [3,55]. Gereffi and associates [23] identified five types of governance structure in value chains, based on the complexity and knowledge necessary for transaction, codification and effective transmission of the information between the participants and current competence related to the necessity of transaction, namely market, modular, relational, captive and hierarchy.

Market value chains are characterized by a low level of power asymmetry between producers and consumers in which no single value chain actor has control over others. Buyers typically react to specifications of products in a market exchange established by the producers because information exchange is relatively good [23]. In hierarchy value chains, the highest level of control is concentrated in one lead producer that explicitly coordinates and controls the actors and is typified by vertical integration. Modular value chain mirrors a production arrangement interaction that can effectively adjust products specifications to consumers' needs [43]. Relational value chains incorporate price, specifications, reputation, trust and mutual reliance and direct information and contact between producers and consumers [43]. Captive value chains emerge when the producers' abilities are low, resulting in a greater level of involvement of the buyers on whom the producers become financially dependent. Gereffi and associates [23] governance framework reflects governance context in the small-scale Kru and Fanti fisheries value chains in Liberia. Their governance framework, which has been employed by researchers to analyze fisheries value chains [43,49], is adopted and used to identified types of relationships between actors in the Kru and Fanti fish value chains in Liberia.

To shed light on the distribution of net benefits flowing between fishers and traders, price analysis [6] is conducted using price and cost data from participants in each node of the respective value chains. Based on this, driving forces such as bargaining power and trading relationships, which influence inefficiencies in fishery value chains are identified. This is crucial for determining appropriate policy

recommendations, for possible interventions of participants within the value chain itself and those outside it, typically government or non-governmental organizations (NGOs), to upgrade weaker nodes [6,32].

2.1. Study sites

Primary empirical data and information were collected from boat owners (fishermen) and artisanal fish traders in November-December 2017 and May-June 2018 at three landing sites used by both Kru and Fanti, i.e. Robertsport, Point Four and Marshall beaches in Grand Cape Mount, Montserrado and Margibi counties (Fig. 1).

The selection of study areas was based on convenience [7,51]. In societies like Liberia where the road network is poor, it is difficult if not impossible to implement a more formal sampling method. Therefore, the landing sites were selected based on chance and accessibility. While the sites are samples of convenience, they are still representative of the small-scale Kru and Fanti fisheries in Liberia where fishers deploy their fishing craft and gear where artisanal fish traders and Korean wholesalers participate in seafood trade [40]. They represent a third of the nine coastal counties, with 18% of the 114 landing sites, 30% and 41% of the total number of Kru and Fanti boat operators respectively and 39% of the total number of fishers in the SSF in Liberia (Tab 1). Data were collected to identify the nature of the trading relationships and to assess the net benefits of the different actors in the respective fishery value chains examined.

2.2. Focus group discussions and survey

Data was collected through focus group discussions, personal interviews with actors including fishermen and fish traders and from key informants. Kru fishermen interviewed are local fishers who own and operate Kru type canoes and primarily target cassava fish, while a Fanti fisherman, owns and operates a Fanti type boat targeting bonny. Three focus group interviews were conducted, in November–December 2017 and January–February 2018.

Prior to the actual survey, official letters were written to the fishing communities by NaFAA informing them about the type of study, data to be collected, target respondents and researchers and study period. With support from the fishery authorities and local fishers' leadership, a list of possible interviewees for the focus groups, participating in both fisheries, was prepared before visiting the study sites. The list was prepared based on lists of members of the various fishers' groups, provided by their respective leaderships from which participants were selected for the group discussions. Following this, a systematic random sampling, where each kth participant was chosen from the lists for discussion, was employed [7].

Participants included Kru and Fanti fishermen, fishers' wives, processors, fishmongers, mini cold-room operators, representatives of local fishermen leadership and key informants. For comparison amongst interviewees and landing sites a focus group of 15 SSF actors was selected at each study site and discussions lasted for about 4 h. The open-ended structure of the questions allowed for a follow-up and conversation about initial responses.

Questions were designed to elicit information about the major types of fish products, marketing flows/links and size, actors and the importance and value of the trading relationships, value-adding roles of different actors, credit arrangements and type of repayment as well as seasonal differences in the respective value chains, using semi-structured open-ended questions. The day following the actual interview, notes recorded by hand and direct observations were typed in a Word document for analysis. This was used to check for key concepts pertinent to this analysis and trends in the literature. The information gathered was used to identify and describe the main components of the value chains, actors and their roles in value-adding, trading relationships between actors as well as drawbacks hindering the performance of the value chains.

Random sampling technique was used to choose subjects for the survey (personal interviews) [7]. The questionnaire consisted of structured questions on the details of daily operations and provided additional in-depth information on similar issues captured during the group interviews and quantitative data on prices and costs.

A total of 294 interviews were conducted; 150 in the dry season and 144 in the rainy season, representing 180 in the Kru cassava fish value chain, 60 fishermen and 120 fresh fish traders and processors and 114 in the Fanti bonny value chain including 60 fishermen and 54 processors. The fishermen and fish traders sampled, in the Kru and Fanti fisheries during the dry season, were different from those sampled during the rainy season although the methodology employed was the same. Prices of fish purchased and traded as well as mean quantity of fish sold on a typical day were collected from actors in each node of the value chain.

Korean wholesalers and local cold room operators were not willing to participate in personal interviews. So, in this present investigation, actors are restricted to fishermen (i.e. Kru and Fanti), fresh fish traders and fish processors, that directly purchase seafood from these fishermen and wholesalers[1] (middlemen) and trade at various locations-either to local consumers, hoteliers, eateries or other traders, in Monrovia and its hinterlands. Information was analyzed separately for the dry and rainy seasons.

In addition to the focus group discussion and personal interviews, three key informants were selected based on their specific roles and experience in the value chains examined. This was regarded necessary to overcome the lack of access to the Korean wholesalers and general lack of official data in Liberian fisheries.

Focus group interviews provided additional detail on the types of fish products traded, marketing links, quantities traded, the value-adding roles of the key actors and relationships among them as well as inefficiencies in the respective value chains examined. The qualitative information such as trading links, type of fish products traded, trading relationships and value-adding roles was used to map the marketing structures and trading relationships between actors in the respective fisheries. Data on quantities of fish sold, prices and costs from personal interviews provided information on markup and benefit distribution.

2.3. Net benefits

The net benefits of fishermen and fish traders and processors are defined as the average net difference between total revenues and total costs. The total revenue for the fishermen is a product of the ex-vessel price [50] or retail price (in the case of fish traders) and the quantity of fish sold, whereas the total cost is defined as the aggregate expenditure incurred. For the Kru and Fanti fishers, typical expenses included the costs of vessel, fishing gear, fishing license, labor (crew), outboard engine and fuel/gasoline (mostly Fanti), repair and maintenance, food and bait. For the fish traders, other costs consist of transport, labor, preservation and other inputs.

It proved difficult to obtain full cost estimates from the fishers and artisanal traders interviewed. This was partly because chain actors suspected the study was done on behalf of the national authorities to levy taxes, and partly because fishers do not maintain accurate records of their operations, which is typical in SSF [9,57]. Nevertheless, it is believed that the reported expenses, captured by this work, reflect the typical daily outlays of these value chain actors.

Average net benefits were converted to USD using the average annual exchange rates for 2018, the year the survey was conducted [11]. Non-parametric tests were used for hypothesis testing. The Kruskal-Wallis test was used to test for differences in net benefits

[1] These wholesalers serve are middlemen between the fishermen and end-consumers in external markets. We; therefore, in the paper use the term wholesalers and middlemen interchangeably.

Fig. 1. Map of the study areas. https://commons.wikimedia.org/wiki/Atlas_of_Liberia. Accessed April 12, 2019.fn2

between fishing seasons and actors within each fishery [24]. Mann-Whitney *U* test was performed for further examining differences between net benefits of individual groups [41]. Because of limited official statistics, it was difficult to assess total quantities of cassava fish and bonny traded at each value chain's node in both seasons. However, this analysis estimated these as shares based on the quantities reported by all respondents interviewed.

3. Results and discussion

This section presents analysis and discussion of cassava fish and bonny trade flows, nature of the trading relationships and net benefits of actors in both value chains.

3.1. Kru cassava fish value chain

The reported average daily catch (i.e. traded quantity) was 78 kg in

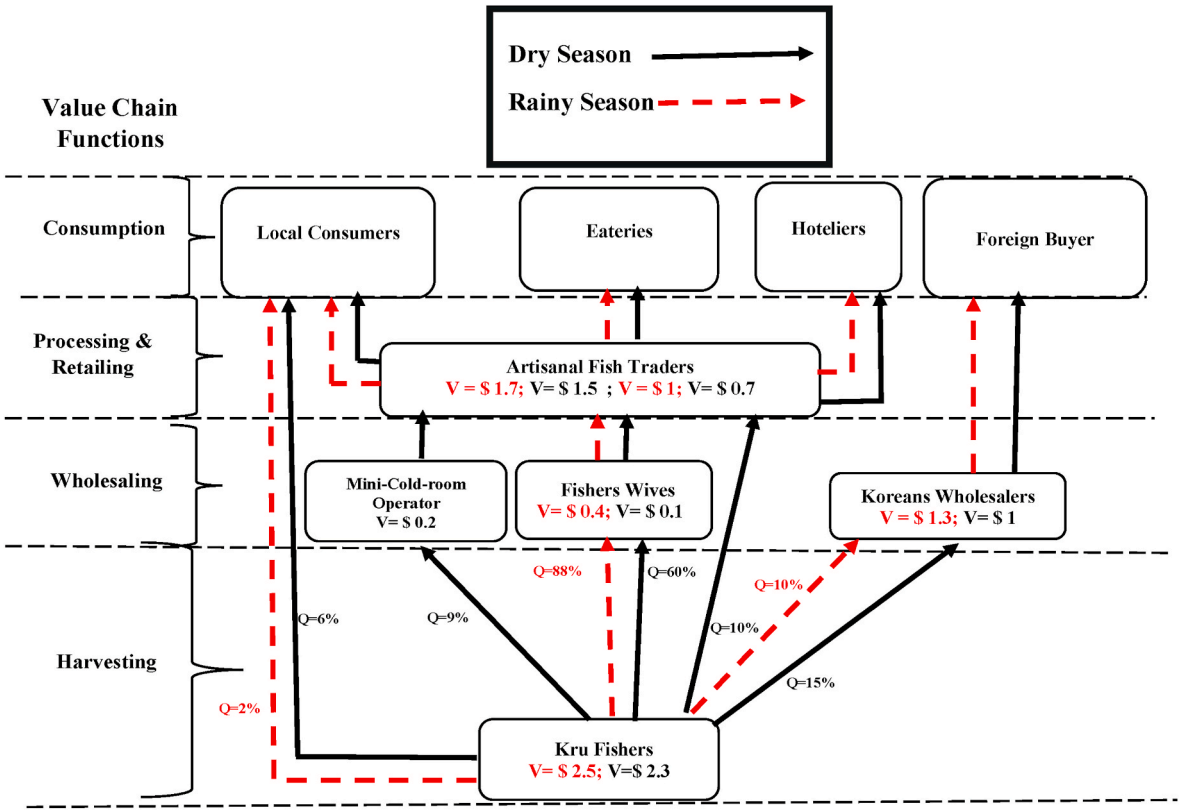

Fig. 2. Kru fishers value chain for shares (%) of cassava fish traded and value-added by each actor, based on responses from fishers and fish trader groups interviewed in the dry- and rainy seasons. Seasonal average value-added kg^{-1} "V" calculated for the different actors is based on the average prices received (Table 2).

the dry season and 32 kg, in the rainy season. Average monthly catch per vessel is estimated to be 1716 kg in the dry season and 288 kg in the rainy season, assuming fishers go out five days a week during the dry season and two days weekly during the rainy season. Average quantities traded in the dry season is nearly six times higher than in the rainy season. This refers to average quantities in a month assuming that this is mainly driven by the fact that the fishing effort in the rainy season is lower.

During the dry season the Kru fishermen sell their fish directly to their wives, Korean wholesalers, artisanal fish traders, mini cold store operators or individual consumers (Fig. 2). Due to limited supply mini cold store owners and artisanal fish traders do not buy during the rainy season (Fig. 2).

Wives buy around 60% of the total catch during the dry season and 88% during the rainy season (Fig. 2). Fishermen normally obtain informal credits from other sources primarily from their wives and other middlemen. Wives provide informal credits to buy fishing equipment such as canoes and nets or occasionally to pre-finance fishing trips. The fishermen in return repay with fish at a price typically up to 20% lower than the highest going price.

This suggests that fishers' wives are getting bargain prices in exchange for providing (through issuing informal credits) future access to gears and other operational expenses. At times, fishers' wives provide fishermen interest-free credits, pay school fees for the kids, food for the home, medication in cases of illness *etc.* Similar financial and non-refundable benefits have been reported for similar fisheries in other parts of the world [2,13,29].

Commercial banks typically require collateral, which is difficult for artisanal fishermen to provide. The lack of access to formal credit services makes participating in informal credit accords with their wives and the Koreans an appealing opportunity, according to fishermen. Crona and colleagues [13] also observed this in similar fisheries elsewhere.

Fishers conceded that "the interest-free credits provided by their wives are very important to them especially during the rainy season when due to adverse weather conditions they cannot go to sea". One fisher wife confirmed this assertion claiming "we are the men during the rainy season providing all the domestic needs for the family". Note that the intermittent operational expenses and interest-free loans provided to fishermen typically increase their debts but do not appear to alter the bargained price.

The nature of the relationship between the fishermen and their wives can be regarded as captive due to operational dependency or even hierarchical due to the family relationships. Wives pay US$ 2.4 kg^{-1} during the dry and US$ 2.6 kg^{-1} during the rainy seasons (Table 2).

If this relationship is regarded as a hierarchy-fishermen and wives can be seen to operate a vertically integrated fishing enterprise, they sell on average US$ 2.5 kg^{-1} which is essentially the same when artisanal fish traders buy directly from the fishermen. This raises questions about the value-adding role of fishermen wives and if it could be improved.

Therefore, it is somewhat difficult to clearly say whether the relationship between the fishermen and their wives is captive (middlemen) or hierarchy (i.e. part of the fishermen's enterprise) or both. This indicates the need for further research to shed more light on their relationships. If it is regarded as captive, this raises the issue of power and information asymmetries which are key obstacles in the value chain, otherwise it is difficult to say.

The second biggest buyers of cassava fish are the Korean wholesalers that buy around 15% of the total catch in the dry season and 10% during the rainy season (Table 2). According to key informants, Korean nationals who own and operate cold stores in Monrovia, commonly finance the purchase fishing canoes and gear, outboard engines and sometimes even provide operational expenses. In return, the fishermen repay the Koreans with cassava fish, usually up to 50% of a predetermined price that remains constant until the loan is paid up. The current bargained price is US$ 3 kg^{-1}. Due to this financial dependency between Korean wholesalers and fishermen the relationship is considered to be a captive one (Table 2).

However, it was difficult to estimate the actual value of the inputs supplied by the Koreans and the interest associated because fishers may not have access to fishing inputs at the same price as the Koreans who are well connected to the Asian market. This indicates a lack of transparency in the value chain. While informal credit agreements between fishers and middlemen are common in SSF, powerful middlemen typically exploit the vulnerability of fishers who are normally positioned in a low-income situation [20,48,52]. In some instances, though, small-scale fishers in rural and remote fishing communities prefer these kinds of informal credit arrangements [2,13,29]. This is partly because they offer security of critical fishing assets which include monetary and non-mandatory benefits that facilitate small-scale fishermen value chain functions [2,13,29] and partly because middlemen also provide connection to outside markets thus lowering the effort and time required by fishers to sell their fish [1,13]. Due to this financial dependency

Table 2
Kru cassava fish value chain quantity traded, average selling prices and relationships in the dry and rainy seasons.

Actors/Buyers	Dry Season			Rainy Season		
	Quantity Traded (%)	Ave. Selling Price (US $/kg)	Type of Relationships	Quantity Traded (%)	Ave. Selling Price (US $/kg)	Type of Relationships
Harvesting node						
Fishers wives	60	2.4	Captive & Hierarchy	88	2.6	Captive & Hierarchy
Korean wholesalers	15	1.5 (3.0)	Captive	10	1.5 (3.0)	Captive
Artisanal fish traders	10	2.5	Market	–	–	–
Mini cold-room operators	9	2.5	Market	–	–	–
Local consumers	6	2.8	Market	2	3.3	Market
Average		**2.3**			**2.5**	
Wholesaling node						
Fishers wives	–	2.5	Market	–	3	Market
Korean wholesalers	–	4	Market	–	4.3	Market
Mini cold-room operators	–	2.7	Market	–	–	–
Average		**3.1**			**3.7**	
Processing & Retailing node						
Local consumers (fresh fish)	–	3.3	Market	–	4.2	Market
Eateries (smoked fish)	–	5.2 (3.4)	Market	–	6 (3.7)	Market
Local consumers (smoked fish)	–	5 (3.1)	Market	–	5.5 (3.4)	Market
Eateries (fresh fish)	–	3.8	Market	–	4.5	Market
Hoteliers (fresh fish)	–	5.2	Market	–	5.4	Market

Authors' Note: 1 kg wet fish = 0.62 kg smoked fish. It was not possible to calculate weighted averages for wholesale and retail nodes due to the lack of official statistics. Average prices in parenthesis correspond to yield equivalent (see text).

between Korean wholesalers and fishermen, the relationship can be regarded as captive.

The third biggest buyers are the artisanal fish traders who buy around 10% directly from the fishermen during the dry season (Table 2). There is no dependency in this relationship, and it is based on demand and supply as evidenced by the fact that they do not buy directly from fishers during the rainy season when there is limited fish supply. The average price they pay is US$ 2.5 kg^{-1} (Table 2). The smallest buyers are the local consumers that approach the fishermen at the landing site to buy fish for their own consumption. The exchange is purely market-based as there is no dependency on either side. Around 6% of the total quantity is exchanged in this way. The weighted average price is US$ 2.3 kg^{-1} during the dry season and US$ 2.5 kg^{-1} during the rainy season (Table 2). While the weighted average prices for market relationships are US$ 2.6 kg^{-1} in the dry season and US$ 3.3 kg^{-1} in the rainy season, they are US$ 2.5 kg^{-1} and US$ 2.6 kg^{-1} for captive relationships assuming the Koreans pay US$ 3 kg^{-1} (Table 2).

In the next node of the value chains fishers' wives, usually without any value-addition service, wholesale their fish to artisanal traders through market sales. Mini cold-room operators, who are usually located at the landing sites, wash and preserve their fish in chillers before wholesaling to artisanal fish traders through market trade. The value-added generated by fishers' wives averaged around US$ 0.1 kg^{-1} in the dry- and US$ 0.4 kg^{-1} in the rainy season, whereas for the mini cold-room operators it was about US$ 0.2 kg^{-1} in the dry season (Fig. 2).

Domestic middlemen thus add value of US$ 0.2 kg^{-1} in the dry season and US$ 0.4 kg^{-1} in the rainy season for services such as washing, chilling to maintain freshness and transport. The value addition services performed by cold-room operators may explain the relatively higher average price kg^{-1} they receive compared to fishers' wives (Table 2). This suggests the role of Kru fishers' wives, in the dry season, is most likely related to assisting in fish sales for the family when supply is relatively high.

The average price received by domestic wholesalers was around US$ 2.6 kg^{-1} in the dry season and US$ 3 kg^{-1} in the rainy season (Table 2). Korean wholesalers, on the other hand, add the greatest value. They clean, sort and package the fish in plastic crates and store in chill boxes, before transporting to Monrovia for export, adding on average about US $ 1.0 kg^{-1} in the dry season and US$ 1.3 kg^{-1} in the rainy season, according to key informants (Fig. 2).

Artisanal fish traders wash the fish and preserve with ice (chillers) or sometimes no ice before transporting and retailing through market relationships to local consumers, eateries and hotels in Monrovia and other parts of Liberia. Fish processors remove scales, gut and cut the head off the fish and in the case of large fish, cut the fish into pieces before smoking and retailing (Fig. 2). This suggests retailers add value by performing services such as washing, icing, traditional smoking and transporting. Given that yield of smoked fish is around 62% [53], this indicates processors sell 38% less quantities. Although the study on yield from the Torry Research Laboratory [53] is rather old the yield is used for this study as there have not been any major changes in smoking technologies and product development since it was conducted.

Traders supplying hoteliers received the highest average price of nearly US$ 5.2 kg^{-1} in the dry season and US$ 5.4 kg^{-1} in the rainy season relative to those targeting other customers. Processors retailing smoked fish to eateries received average prices of around US$ 5.2 kg^{-1} and US$ 6 kg^{-1}, which when yield is considered correspond to US$ 3.4 kg^{-1} and US$ 3.7 kg^{-1} of fresh fish (Table 2). Hoteliers pay by far the highest price which is most probably linked to the quality of the fish they buy. This indicates that improved quality attracts higher prices in the value chains in both seasons. On average fresh fish retailers received around US$ 4.1 kg^{-1} in the dry season and US$ 4.7 kg^{-1} in the rainy season, while processors obtained around US$ 3.3 kg^{-1} and US$ 4 kg^{-1} for smoking. Value-added produced by fresh fish retailers averaged around US$ 1.5 kg^{-1} in the dry season and US$ 1.7 kg^{-1} in the rainy seasons, whereas processors added about US$ 0.7 kg^{-1} and US$ 0.6 kg^{-1} (Fig. 2).

The relatively low value produced by processors can most likely be attributed to the quality of fish they smoke and sell. Since cassava fish normally attracts better price when marketed fresh, retailers usually first attempt fresh sales and smoke what fish they cannot sell fresh. It would be worthwhile for the Government and NGOs to provide support, such as training in early decision-making regarding processing options and quality management, to the SSF subsector.

Kru fishers exchanged roughly 75% and 98% of the total traded quantities of cassava fish based on captive relationships in the dry- and rainy seasons (Table 3). In the rainy season, fishers usually sell directly to their wives who reap increased benefits from higher prices created by the excess fish demand (Fig. 2).

The prices fishers received did not differ noticeably between seasons and were primarily based on the type of customers and relationships, which has also been reported elsewhere [20]. While fishers realized on average roughly US$ 2.6 kg^{-1} in the dry season and US$ 3.3 kg^{-1} in the rainy season from market sales, they obtained about US$ 2.5 kg^{-1} and US$ 2.6 kg^{-1} from captive trades assuming the Koreans pay US$ 3 kg^{-1}.

Value-added services performed by middlemen were limited and indicative of low service value chains [14]. Because of the credits provided to Kru fishers and family connections, fishers' wives and Korean middlemen wielded higher control in the value chain which was reflected in their bargaining power. To address the challenges of financial dependencies and power asymmetries, the national government could implement policy to provide access to microloans to the small-scale fishermen to relieve them from transactional dependencies and increase benefits derived by fishers. Microloans might help to improve healthy competition, when there is an alternative source of finance rather than depending on traders in the value chains for finance, boats and equipment, and the value adding role of fishermen's wives as reported by Bjorndal and associates [6].

Hoteliers pay more than double the average price fishermen received, in both seasons. The difference in market prices paid by end-market buyers, is primarily based on freshness. There is a quality incentive in the market that fishers are not receiving perhaps because of the lack of information flow along the value chain.

Kru fishers earn significantly (p-value < 0.05) less benefits in the dry- and rainy seasons (US$ 584 and US$ 107 $month^{-1}$) than to artisanal fish traders (Fig. 3). Fresh fish traders made the most benefits (US$ 1458 and US$ 919 $month^{-1}$) followed by processors in both seasons. Other studies on SSF have found similar differences between fishermen and fish traders [17,33,45,48,57]. Fresh fish traders derived significantly higher benefits than processors who operated in similar node (p-value < 0.05), which was also observed by Wamukota et al. [57].

3.2. Fanti bonny value chain

The 30 fishers sampled reported daily traded quantities of 706 kg in the dry and 292 kg, in the rainy seasons. Because fishermen fish on average five and two days weekly in the dry and rainy seasons, this suggests average monthly quantities of 15,532 kg in the dry season and 2,628 kg in the rainy season. In the rainy season small pelagics are not typically found in inshore waters in Liberia, and Fanti fishermen are less active [40]. During the dry season Fanti fishermen market their bonny, directly to their wives, artisanal fish traders and local consumers (Fig. 4). Because of reduced supply, fishers sell only to their wives and local consumers during the rainy season.

Wives purchase roughly 85% and 90% of the total quantities traded during the dry and rainy seasons (Table 3). They smoke the bonny and sell on to artisanal fish traders through market interactions. Wives also offer similar informal credits, as observed in the Kru value chain. Fishers in return repay with fish at up to 10% lower than the maximum price at the landing sites. The business relationship between the fishermen and their wives is the same as described for the Kru. The wives pay on average US$ 1.1 kg^{-1} during the dry season and US$ 1.3 kg^{-1} during the

Table 3
Fanti bonny value chain quantity traded, average selling prices and relationships in the dry and rainy seasons.

Buyers	Dry Season			Rainy Season		
	Quantity Traded (%)	Ave. Selling Price (US $/kg)	Type of Relationships	Quantity Traded (%)	Ave. Selling Price (US $/kg)	Type of Relationships
Harvesting node						
Fishers wives	85	1.1	Captive & Hierarchy	90	1.3	Captive & Hierarchy
Artisanal fish traders	10	1	Market	–	–	–
Local consumers	5	1.2	Market	10	1.4	Market
Weighted Average		**1.1**			**1.3**	
Wholesaling node						
Fishers wives	–	2 (1.4)	Market	–	2.5(1.7)	Market
Processing & Retailing node						
Local consumers	–	2.3(1.5)	Market	–	2.8 (1.9)	Market
Eateries	–	2.6 (1.7)	Market	–	2.9 (1.9)	Market
Average		**2.5 (1.7)**			**2.9 (1.9)**	

Authors', note 3 kg fresh bonny produce 2 kg of smoked fish. It was not possible to calculate weighted averages for wholesale and retail nodes due to the lack of official statistics. Average prices in parenthesis correspond to yield equivalent (see text).

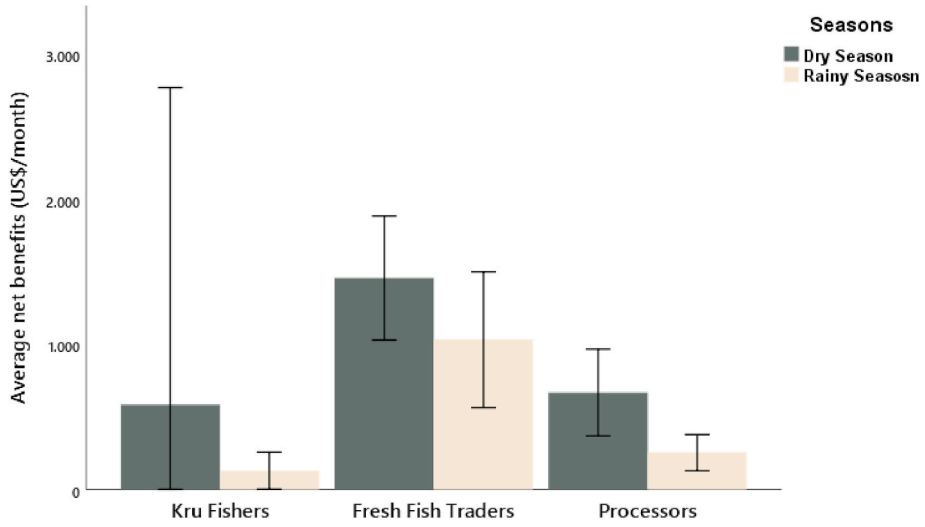

Fig. 3. Net benefits month^{-1} of Kru fishermen and fish traders in the dry and rainy seasons. Bars indicate two standard errors.

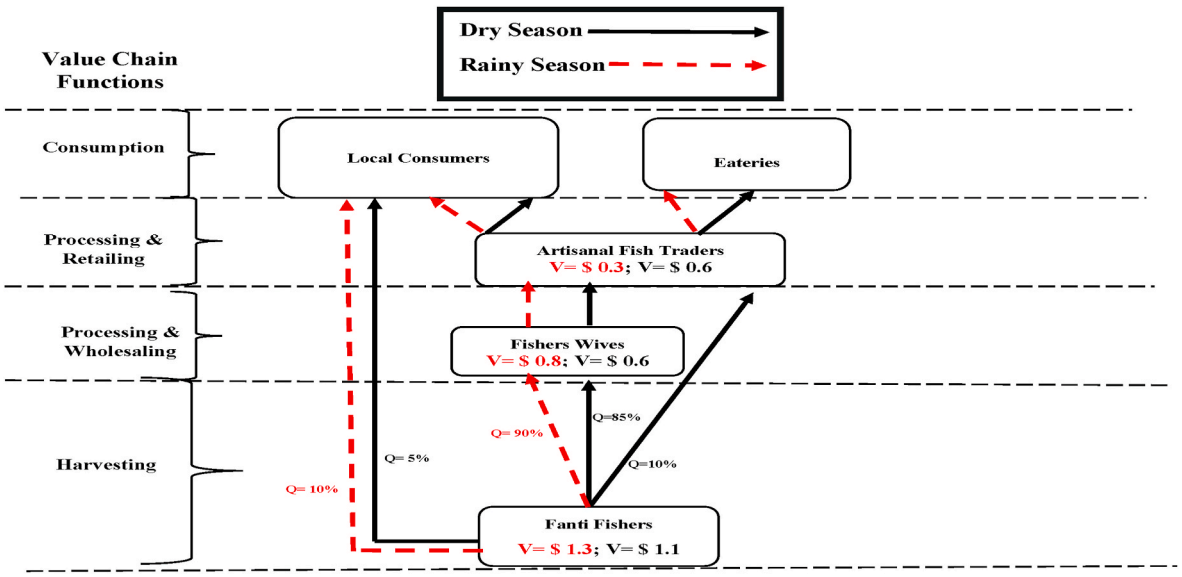

Fig. 4. Fanti fishers value chain for shares (%) of bonny quantity traded and value-added by each actor, based on responses from fishers and fish trader groups interviewed in the dry and rainy seasons. Seasonal average value-added kg^{-1} "V" calculated for the different actors is based on the average prices received (Table 3).

rainy season (Table 3) and they are the sole middlemen wholesaling bonny in both seasons, which indicates a complete lack of competition. The features of the credit arrangements in the Kru and Fanti fisheries are comparable to those described for similar SSF elsewhere [2,13,29,36].

Artisanal fish traders are the second most important buyers who purchase directly from the fishermen about 10% of the total quantity traded during the dry season but nothing directly during the rainy season. There appears to be no operational reliance in this bond, and it is based on supply and demand and thus a market relationship. They pay on average around US$ 1 kg^{-1} of bonny, during the dry season (Table 3). The relatively low price paid by artisanal fish traders in market transactions during the dry season can be attributed to market gluts, when fishers typically sell to anyone at any price to obtain some value from their catch [40]. This is because their wives do not have the capacity to smoke the whole catch. Local consumers, who purchase bonny from the fishermen, are the smallest customers (Fig. 4). The trade is market-based. About 2% and 10% of the total quantities traded are sold in this way, in the dry- and rainy seasons (Table 3). They pay average prices of US$ 1.2 kg^{-1} and US$ 1.4 kg^{-1} during the dry- and rainy seasons.

In the subsequent node of the value chain, fishers' wives wash and smoke the bonny and wholesale to artisanal fish traders (Table 3). There seems to be no transactional dependency in this trade, which is based on market relationships. Because yield of smoked bonny is roughly 67% [53] of its wet weight, it is assumed that bonny wholesalers exchange 33% less quantities. Average prices received by bonny wholesalers were around US$ 2 kg^{-1} in the dry season and US$ 2.5 kg^{-1} in the rainy season (Table 3) corresponding to US$ 1.4 kg^{-1} in the dry season and US $ 1.7 kg^{-1} in the rainy season kg^{-1} for fresh fish . The value-added produced by bonny wholesalers averaged around US$ 0.6 kg^{-1} in the dry season and US$ 0.8 kg^{-1} in the rainy season (Fig. 4). Bonny wholesalers generate higher value in comparison to the cassava fish domestic wholesalers. The lack of competition in the wholesaling node and the value-added by smoking may explain the higher value added by bonny middlemen.

Artisanal fish traders normally transport and retail their products to local consumers and eateries in Monrovia and other places in Liberia (Fig. 4). The exchange between the parties is market-based, because there is no transactional reliance and it depends on demand for and supply of fish. Retailers targeting eateries received better average prices of roughly US$ 2.6 kg^{-1} in the dry season and 2.9 kg^{-1} in the rainy season compared to those aiming for local consumers who receive on average US$ 2.3 kg^{-1} and US$ 2.8 kg^{-1}. The average prices received by retailers were roughly US$ 1.7 kg^{-1} in the dry season and US$ 2 kg^{-1} in the rainy season (Table 3). The value-added created by retailers averaged approximately US$ 0.6 kg^{-1} in the dry season and US$ 0.3 kg^{-1} in the rainy season. While the average mark-ups by bonny retailers were about 20% in the dry season and 12% in the rainy season, they were 55% and 62% for bonny middlemen indicating retailers added less value in both seasons.

Fanti fishers in the dry- and rainy seasons sold around 95% and 90% of the total quantities of bonny to their wives, while roughly 2% and 10% were sold through market interactions (Table 3). As observed in the Kru value chain, during the rainy season, when there is excess fish demand and prices are high, Fanti fishers typically sell to their wives to increase overall family benefits.

Prices received depended on the type of relationships and did not differ much. Fishers realized average prices of roughly US$ 1.2 kg^{-1} in the dry season and US$ 1.4 kg^{-1} in the rainy season from market arrangements, whereas they received around US$ 1.1 kg^{-1} and US$ 1.3 kg^{-1} from captive and hierarchy sales.

There seem to be indications that if Kru fishers were financially independent of middlemen informal credit arrangements and sold all cassava fish at market price (i.e. US$ 2.6 kg^{-1} in the dry and US$ 3.3 kg^{-1} in the rainy seasons), average monthly revenues could increase to $\leq$ US$ 4500 in the dry and US$ 950 in the rainy season for them compared to about US$ 4300 in the dry and US$ 750 in the rainy season from captive or hierarchy sales. This may be unlikely in rural and remote SSF. Captive or hierarchy relationships are apparently commonplace elsewhere [see, 2, 13, 29]. The Fantis (at US$1.1 kg^{-1} in the dry- and US $ 1.4 kg^{-1} in the rainy reasons) indicate average monthly revenues of $\leq$ US$ 17,085 and US$ 3700 compared to US$ 17,085 and US$ 3420 from captive or hierarchy sales in both seasons.

However, this does not take into full account the benefits that may be included in the informal credits agreements with the middlemen which according to fishermen and their financiers are quite substantial and essential for their daily operations. There are no indications that all fish produced by small-scale fishermen in both value chains could be sold at market price. There is a need to further assess the probable benefits small-scale fishermen in Liberia derive from the informal credits schemes with middlemen.

In this case, market sales appear to be economically beneficial for Kru fishers relative to captive or even hierarchy, whereas it represents $\leq$8% increase in monthly revenues for Fanti fishers during the rainy season.

As observed in the Kru value chain, the differences in price paid by end-market buyers are based on the type of smoked bonny. The price paid by eateries nearly doubles in both seasons, suggesting a market incentive for quality improvement.

In both seasons, Fanti fishermen realize on average significantly lower monthly net benefits (US$ 1940 and US$ 114 $month^{-1}$) relative to processors (US$ 2154 and US$ 540 $month^{-1}$) (p-value < 0.05) (Fig. 5). The current analysis of net benefits flows between fishers and traders in the bonny value chain follow similar pattern reported elsewhere [17,33,45,48,57], as was also observed in the Kru chain.

4. Conclusion and policy recommendations

This study set out to understand the value-adding roles of the main actors in the Kru and the Fanti fish value chains and how their net benefits are impacted by the relationships among them and the seasonal variations in fish supply. Primarily the cassava fish value chain consists of Kru fishers, middlemen and retailers in both seasons. Middlemen were mainly engaged in the buying of cassava fish, cleaning and cooling it before wholesale, whereas retailers were involved in purchasing, processing and retailing in end-markets. There are fewer actors in the value chains associated with the Fanti boats, such as the bonny, compared to the Kru value chains.

Fishers' wives and Korean buyers occupy central roles as fishers' main financiers in the cassava fish value chain and therefore wield higher power and handle the major share of the total quantities traded in both seasons. This represents a captive or hierarchy relationship with Kru fishers and is caused by financial dependency between the parties.

Mini cold-room operators buy cassava fish from Kru fishers in an operation based on demand and supply. Mini cold-room operators and the Koreans increase value by washing, packing and chilling, whereas fishers' wives appear not to add any value to the fish. Retailers buy cassava fish through market relationship with Kru fishers, and add value by washing, chilling and smoking before selling to consumers.

Fishers wives and retailers were identified as the main actors in the Fanti value chain. These actors perform different roles in the Fanti value chain as compared to the Kru. The Fanti fishers are the main suppliers of bonny selling to middlemen, retailers and individual consumers in both seasons. Their wives were the sole middlemen and main sponsors exercising greater power in the bonny value chain in both seasons than in the cassava value chain. Wives handled major shares of the total quantities of bonny and bought through captive or even hierarchy relationships with Fanti fishers, as was also observed in the Kru. Bonny middlemen increased value more by smoking compared to Kru fishers' wives, who added little or no value. Bonny retailers purchased bonny based on demand and supply and increased value through smoking. The role of fishers' wives in the Kru value chain is somewhat unclear as they

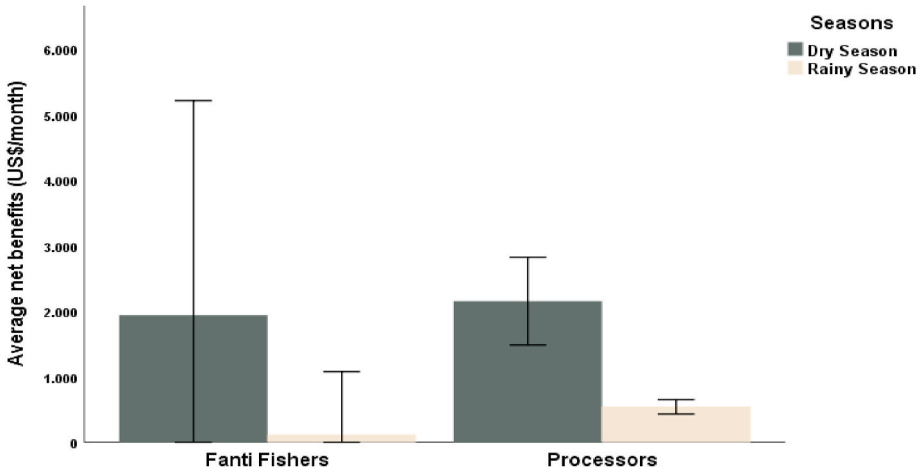

Fig. 5. Net monthly benefits of Fanti fishers and fish processors in the dy and rainy seasons. Bars indicate two standard error.

do not appear to add value. There is a need to better understand the involvement of fishermen's wives and how to improve their role in adding value to the catch.

Average mark-ups of Kru fish processors were 27% in the dry season and 33% in the rainy season in the Kru value chain, whereas they were 58% and 57% for fresh fish traders. This means, in both chains and seasons, bonny retailers generated the lowest value kg^{-1}, while most value was added by fresh fish retailers. The price kg^{-1} received by fishers, in both value chains examined, were based on the type of relationships and did not differ much. The average price kg^{-1} fishermen received between seasons in both value chains may be higher, if the full benefits of the informal agreements were considered.

Generally, market-based relationships encourage competition among buyers, offer better prices and appear to be more profitable for fishermen compared to captive or hierarchy relationships. There are indications that if all catches were to be sold at market price the average Kru fisherman's monthly revenues would increase by up to US$ 115 and US$ 186 during the dry- and rainy seasons and the Fanti fisherman's monthly earnings could increase by up to US$ 1630 and US$ 237 during the dry and rainy seasons compared to current revenues. There is no evidence that this scenario might occur because the informal credits accords with middlemen are invaluable to the small-scale fishermen in both value chains. Establishing a well-functioning market is difficult due to the nature of these fisheries and the existing infrastructure.

The quantities of fish traded in the dry season were roughly six times greater than the rainy season, assuming this is mainly driven by the fact that effort applied by fishermen in the rainy season is lower. The average prices of fish peak during the rainy season. Because of the reduced supply, fishers in both value chains mostly exchange through their wives, during the rainy season. Competition was weak or even lacking because of the bargaining power of fishers' financiers. Both value chains were typified by low value-addition services and poorly developed in comparison to high services seafood value chains in more affluent countries [31,46].

End-market prices indicate opportunities for interventions to increase returns of fishers. Marketing signals linked to quality were reflected in the average prices paid by hoteliers and eateries in both value chains and seasons. While more extensive market trade would be beneficial for fishers, financially dependent relationships and the lack of information generate obstacles for this to happen [20,48]. This means, although it is possible to enhance value for fishers in both seasons, power asymmetries and the information externality in both value chains would need to be tackled through policy interventions.

Kru fishers were not able to estimate the actual costs of the inputs supplied to them by the Koreans who are using their bargaining position to generate more profits by supplying fishermen with inputs on credit. This lack of transparency in the value chain makes it difficult to establish the real price fishermen receive. The same applies to the fishermen's wives that provide funding for the fisherman and pay lower prices than in market relationships. This raises questions about fishermen's access to other funds and puts pressure on the government to provide access to financial services to rescue small-scale fishers from predatory behavior of powerful traders.

Fanti fishers on average realize higher monthly net benefits in both seasons than Kru fishers but the net benefits are relatively higher in the dry rather than the rainy season. Whereas bonny retailers made the most monthly net benefits in the dry season, fresh fish retailers in the Kru value chain realized the greatest benefits in the rainy season. Fresh fish traders earned about US$ 874 more per month in the dry season and US$ 812 more per month during the rainy season than the Kru fishers, whereas processors realized US$ 84 monthly and US$ 148 monthly more. Bonny traders received around US$ 213 per month during the dry season and US$ 426 per month during the rainy more net benefits relative to Fanti fishers. Thus, in both value chains and seasons, fishers earn less benefits in comparison to traders. The net benefits of all actors in both value chains significantly decreased during the rainy season particularly for fishermen.

Given the results of this study, the following policy recommendations emerge. In order to raise fishers' benefits and increase overall efficiency in the value chains, we suggest that:

(i) basic fisheries infrastructures and trainings to improve quality and handling in the value chains should be provided; and
(ii) a microloan facility should be instituted, providing an alternative source of finance and thus increasing competition among middlemen. This might improve fishermen ability to sell their fish at market price in response to market signals.

For this to be possible, the government and or NGOs should provide support through establishing essential fisheries infrastructure such as ice and chill facilities, suitable sanitary facilities and hands-on training to improve quality handling and processing in the value chain. Ideally infrastructure should be established close to the landing sites, equipped and functioning, where fishermen and traders will have direct access to the facilities to add value to the fish. The government needs to provide less demanding and restrictive microloans to the SSF subsector as an alternative source of finance. While this would give fishermen access to the needed investment finance, it would also serve to break their financial dependencies on dominant middlemen and consolidate their ability to sell their fish at market price. If the relationship between the fishermen and their wives is regarded as hierarchy-single fishing enterprise, external microloans might be helpful in improving the handling

of the catch i.e. fishers's wives could improve their value adding role which has implications for the price they receive. The value adding role of fishers' wives is unclear and limited.

Increasing competition among middlemen, enabling fishermen to sell 100% of the catch in both seasons at market price, is a policy option that could augment fishers' benefits. This has been observed as a strategy to rescue fishers from powerful traders who want to secure regular supply of fish [58]. However, for increased competition to result in higher market price for fishers, they must be organized as collectives to establish better bargaining position. Further analysis should be undertaken to quantify other economic benefits of the informal credit arrangements provided fishermen in the SSF before implementing this policy measure.

Fishers should be able to respond to quality signals from the high end of the market by taking portable ice containers onboard their canoes to maintain fish quality, which would then lead to a better price for them. Fishers can now sell their fish at market price, to increase their benefits, because they have other source of finance to operate. Cassava fish main middlemen, on the other hand, who before added no value to the fish would then increase value by performing services such as cleaning, icing or smoking before wholesale.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.marpol.2020.104042.

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