

Sustainable Livelihood and Market Chain Analysis of Giant Freshwater Prawn Culture-Based Systems in Two Selected Reservoirs in Puttalam District, Sri Lanka

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Received: 28.07.2019 Revised: 05.03.2020 Accepted: 06.03.2020 Published online: 21.03.2020

Abstract The Sustainable Livelihoods Framework, which identifies capital assets in five specific forms, including: (1) Human; (2) Social; (3) Physical; (4) Natural, and (5) Financial was applied to investigate the effects of production and marketing of giant freshwater prawn (*Macrobrachium rosenbergii*) from two reservoirs (Mahausswewa and Siyambalankattuwa) in the Puttalam district in Sri Lanka on the livelihood of adjacent culture-based fishing (CBF) communities. Eighty different market actors selected through stratified random sampling techniques were subjected to a face-to-face interview with the help of a pre-tested structured questionnaire to collect primary information. The Livelihood Pentagons derived for each community suggest that, overall, the highest percentage (95.2%) is acquired by social capital followed by those of natural (74.5%); human (64.4%); physical (64.3%) and financial (58.2%). It was found that the potential of freshwater prawn markets to uplift rural livelihoods is not utilized commendably, because there are lack of information and poor coordination between and amongst the actors in market chains starting from fishermen to collectors and also with those traders involved in international/local markets.

Keywords: Culture based fisheries, Giant freshwater prawn, Market chain, Sustainable Livelihood Framework

INTRODUCTION

Culture based fisheries (CBF) are a fishing practice, which is categorized into fisheries enhancement and aquaculture practice with the involvement of rural communities (FAO 1994; De Silva et al. 2006). The CBF is practiced as a secondary use of waterbodies, which were built for irrigation, power generation or other purposes meanwhile CBF are recognized as a mean of increasing fish production in Asia. This strategy is used to enhance the rural economy and as a mechanism to increase animal protein supply in rural agricultural farming communities (De Silva 2003; Wijenayake et al. 2005; Nguyen et al. 2005; De Silva 2006; Pushpalatha and Chandrasoma 2010). According to Amarasinghe and Wijenayake (2015), the extensive availability of inland reservoirs in the country, primarily constructed for irrigation for agriculture since ancient times, favors CBF development, which is

essentially a development since late 1990s. Given the fact that water retention period in most small village irrigation systems in the country is seasonal and lasts for six to nine months in the year, CBF development in these reservoirs requires fast growing species. Further, it clarifies that the CBF in village reservoirs of Sri Lanka is a combination of communal activity involving fishers, agricultural farmers those do not have prior experience in fisheries and the biological productivity of water bodies and socio-economic conditions of rural communities. The degree of the combinations found to vary from reservoir to reservoir. The CBF is used as a main fisheries enhancement strategy in Sri Lanka by stocking major Indian and Chinese carps, Nile tilapia, Common carp and Giant freshwater prawn (GFWP) in reservoirs. The CBF mainly depends on the hatchery reared fingerlings and post larvae creating new employments in the sector of fish seed production. Also marketing network of CBF



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is expanding with new employment opportunities and currently GFWP produced in CBF is catering for the export markets. As total number of active fishers in inland fisheries sector were reported to be 61,590 in 2018 (Ministry of Fisheries and Aquatic Resources Development 2019) therefore, CBF is an important component for rural employability.

From the point of view of socio-economic, a livelihood is considered to be “sustainable” if it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, but at the same time not undermining the natural resource base (Scoones 1998). The sustainability of livelihood can, therefore, be assessed by exploring extent to which various types of capital assets have an impact on the livelihood of a given household directly and indirectly as well as short to long run. Those capital assets affecting the livelihood will be in the form of financial, human, natural, physical and social (see below). The presence or absence, combination and the contribution of those capitals decide the enhancement, hinder, success or failure of the livelihoods, in turn. In this context, the giant freshwater prawn (GFP) (*Macrobrachium rosenbergii*) has been emerging as a promising alternative CBF activity to uplift the livelihood of rural culture-based fisheries (CBF) in Sri Lanka. Stocking of GFP post larvae in selected reservoirs has been practiced recently by National Aquaculture Development Authority (NAQDA). The GFP has, thus, become an emerging money-making commodity in CBF, holding relatively high local and export prices. The demand for GFWP grows continuously, but still there is a shortage of supply to the markets. But there is a knowledge gap to be filled in order to strengthen the GFP production and marketing, which may ultimately cause positive changes in livelihoods. It is essential to study the role of various actors in the market chain and different types of capital play in this respect.

The reasons for considering CBF as an aquaculture practice and the need to develop that compared to conventional aquaculture practices, like pond culture, have various aspects such as developing aquatic food supplies, increasing consumption of aquatic food, decreasing wild catches, and the decreasing rate of growth of conventional aquaculture but interestingly these aspects are evaluated from various viewpoints of different countries (De Silva 2003; Phomsouvanh et al. 2015). One such study carried out with regard to GFWP industry in Bangladesh pointed

out that the traders and associated groups have access to a secure source of income by involved with production and marketing of which and their level of poverty has been reduced and that result in the improvement of livelihoods to a significant extent (Ahmed et al. 2009).

Although the importance of such, to date, a relatively few studies have been conducted in Sri Lanka to assess the sustainability of the livelihoods which depend on the fisheries and aquaculture, and in the case of GFP, such studies are highly scarce. Kularathna et al. (2009) made an attempt to identify the socioeconomic characteristics of a community that influence the development and management of culture-based fisheries in village reservoirs of Sri Lanka by collecting socioeconomic data from 46 agricultural farming communities associated with 47 village reservoirs in Sri Lanka. Principal component analysis indicated that scores of the first principal component were positively influenced by socioeconomic characteristics that are favorable for making collective decisions. These included leadership of the officers, age of the group, percentage active members in the group, percentage of kinship of the group, percentage of common interest of the group, and percentage of participation of the group. In a recent study conducted by Keerthana et al. (2017) in the context of fishing communities in the Mannar district of Sri Lanka, emphasized the need of assistance to improve physical and financial capital over the other assets. In this shed of light, two significant fishing communities in Puttalam district were subjected to the analysis. The paper proceeds by analyzing the livelihoods of fishing communities and the contribution of GFP fishing to their livelihoods while concluding the existing livelihood patterns under five principle capital assets. Further, it explored the perceptions of fisherman towards introduction of new freshwater prawn systems to the area and ways and means to improve GFP systems, and in turn, to uplift the livelihoods of those involved with the industry. Moreover, Jutagate and Kwangkhang (2015) have reported that GFP have given significantly higher economic return in CBF in Thailand.

This paper uses the framework similar to the approach by Ahmed et al. (2009) to understand the role of freshwater prawn (*Macrobrachium rosenbergii*) marketing systems based on those activities associated with two reservoirs in the Puttalam district in Sri Lanka.

MATERIALS AND METHODS

Conceptual Framework

This study uses the Sustainable Livelihood Framework (Ashley and Carney 1999; DFID 1999) (Figure 1), which explores how and extent to which different types of livelihood assets combine and contribute to different livelihood strategies in order to achieve livelihood outcomes.

It proceeds by focusing on each component of this framework and with special reference to Livelihood Assets, and relate them to production and marketing of GFP by the CBF related communities in concern.

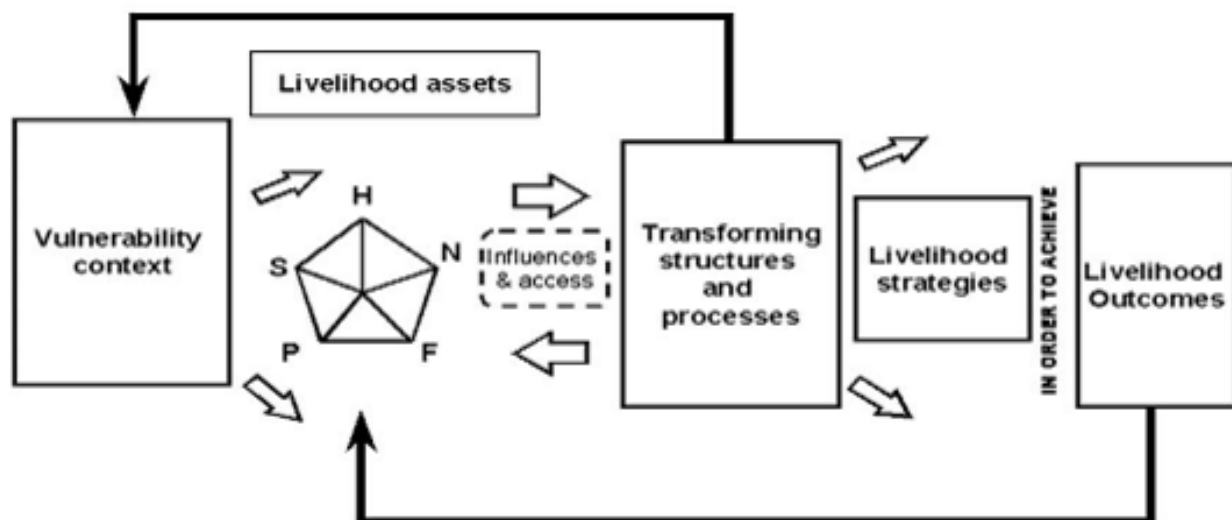


Figure 1 The sustainable livelihoods framework (Ashley and Carney 1999)

Note; H: Human capital, N: Natural capital, F: Financial capital, P: Physical capital, S: Social capital

Central to the framework is the analysis of the range of formal and informal organizational and institutional factors that influence sustainable livelihood outcomes (see: Scoones, 1998 for full description on the framework). The livelihood assets explained in this framework are, in turn, classified into five major categories, including: (1) Human capital; (2) Natural capital; (3) Financial capital; (4) Physical capital, and (5) Social capital.

Study Area and Data

Two fishing communities associated with Mahauswewa and Siyambalankattuwa reservoirs of Puttalam district, Sri Lanka (Figure 2), which were having the well-organized fisher community participation for GFWP stocking, were selected to conduct the analysis.

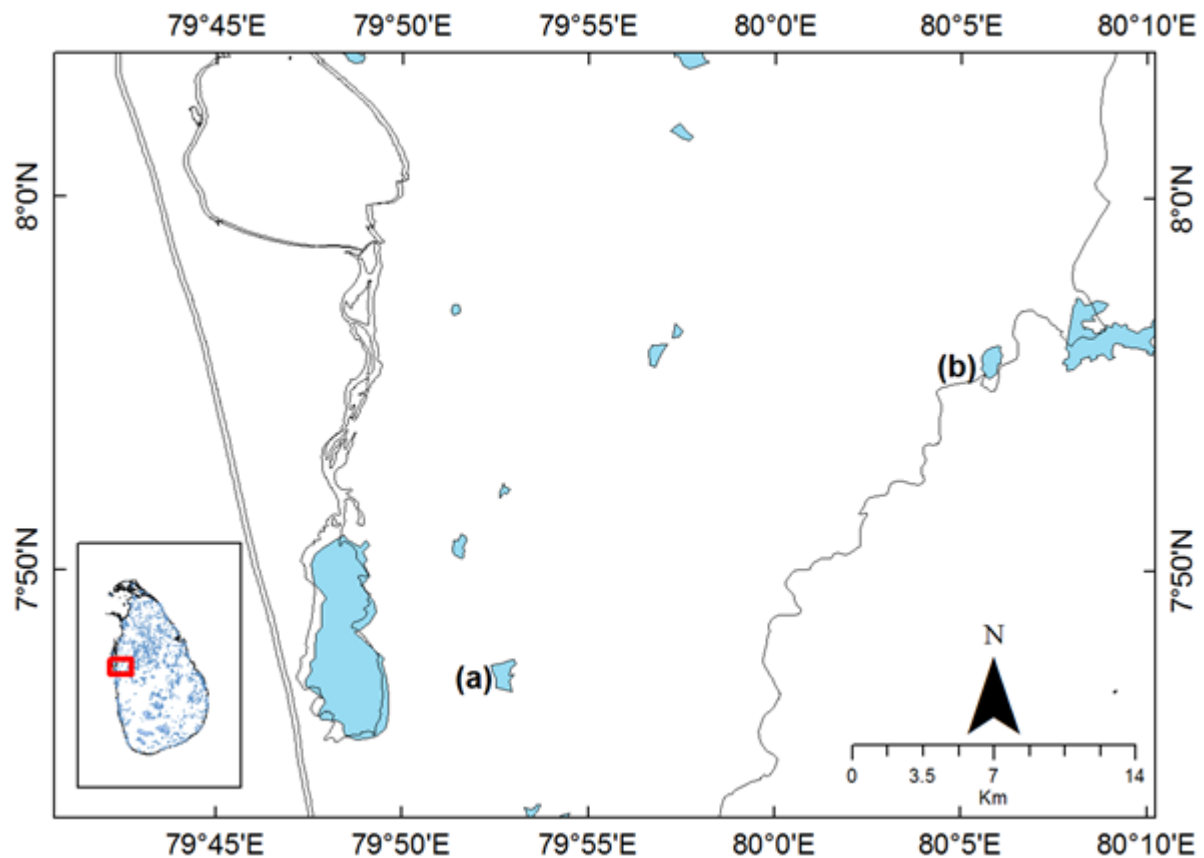


Figure 2 Locations of the two reservoirs: Siyambalankattuwa Reservoir (a) and Mahauswewa Reservoir (b) in the Puttalam District.

Table 1 Forty Criteria used in Livelihood Analysis

Human Capital	Financial Capital	Natural capital	Physical Capital	Social Capital
Age	Income from major source of income	Water resources	House with permanent shelter	Labour associations
Health condition	Income from other sources of income	Access to clean drinking water	Sanitary facilities	Reciprocity
Education	Financial Savings	Forest resources	Furniture	Mutual help
Household size	Other forms of savings	Land availability	Other household assets	Mutual trust and relationships
Experience	Credits	Nature of Soil	Communication devices	Social organizations/ Societies
Skills	Insurance	Climate	Vehicles/transport facilities	Community functions
Labor availability	Subsidies	Occurrence of disasters	Fishing vessels	Community rules and ethics
Training	Other financial inflows	Wildlife	Other properties	Conflicts, theft/robbery incidents

Data were collected from July to August 2017. The two study areas were divided into strata on geographical basis and respondents were randomly selected from each stratum.

Personal interviews carried out at the household level from a randomly selected samples $n=80$ (76 fishermen and 4 collectors were included). A pre-tested structured questionnaire was developed to

record the responses of respondents and personal interviews were conducted with different actors along the market chains of these two reservoirs. Each interview with fisher households focused specifically on the patterns on prawn distribution and marketing systems, marketing costs and margins, number of market intermediaries, pricing mechanisms, marketing bottlenecks and

opportunities, and socioeconomic conditions of actors in the market chain etc. The information gathered were used to develop a Livelihood Pentagon that illustrates the percentage contribution of respective capital assets, including human, natural, financial, physical and social collectively under 40 different criteria indicated in Table 1.

RESULTS and DISCUSSION

Socio-demographic Characteristics of Fisherman

All communities are shaped by their socio demographic characteristics, and as such, it is vital to look into those holistically. Table 1 illustrates the socio-demographic characteristics of the target population of this study.

Of the respondents, 68.75% were middle aged (45-65 years old). Average age of the respondents was 43 years followed by a range from 26 to 70 years. Of that 61.25% of the respondents were educated formally up to secondary level, and 97.5% of the respondents

owned houses with permanent shelter and 97.5% have electricity supply. However, 20% have the issue of not having proper sanitary facilities. In addition, 98.8% owns at least one mobile phone.

Table 2 Socio demographic characteristics of two fishing Communities

Category	Sub category	Percentage
Gender	Male	52.00
	Female	48.00
Age	20-30	6.25
	31-40	10.00
	41-50	36.25
	Above 50	47.50
Household size	1-2	12.50
	3-4	36.25
	5-6	42.50
	7-8	8.75
Race	Sinhala	100.00
Education	Illiterate	1.25
	Primary	36.25
	Secondary	61.25
	Tertiary	1.25
Civil status	Single	1.25
	Married	90.00
	Divorced/Widower	8.75

Freshwater Prawn Marketing Systems

It was observed that fishers get GFP together with other types of fish in their harvest. The number of GFP caught is, however, considerably less compared to the other types of fish species.

A single GFP can reach up to 0.2 to 1 kg in weight under natural conditions in a local reservoir. It was estimated that the daily harvestable quantity of GFP per farmer ranges from 0 to 25 kg. However, fishermen are financially benefited even with a small quantity of harvest. The low production has mainly been

attributed to the facts that inappropriate fishing device used in fishing and gillnet or less number of post larvae stocked in the reservoirs. The loss of stock immediately after stoking may be a severe issue which results in reduction in harvest. Currently, fishers follow conventional methods like placing tree branches during stocking, as larvae are secured within shoots until they are

adapted to the reservoir. While there is an ample room to improve the effectiveness and efficiency of those traditional practices in place, it is vital to introduce new and more productive techniques such as cages to protect larvae and specific harvesting equipment. Figure 3 illustrates the flow of GFP harvest along the market chain from fishermen to final consumer.

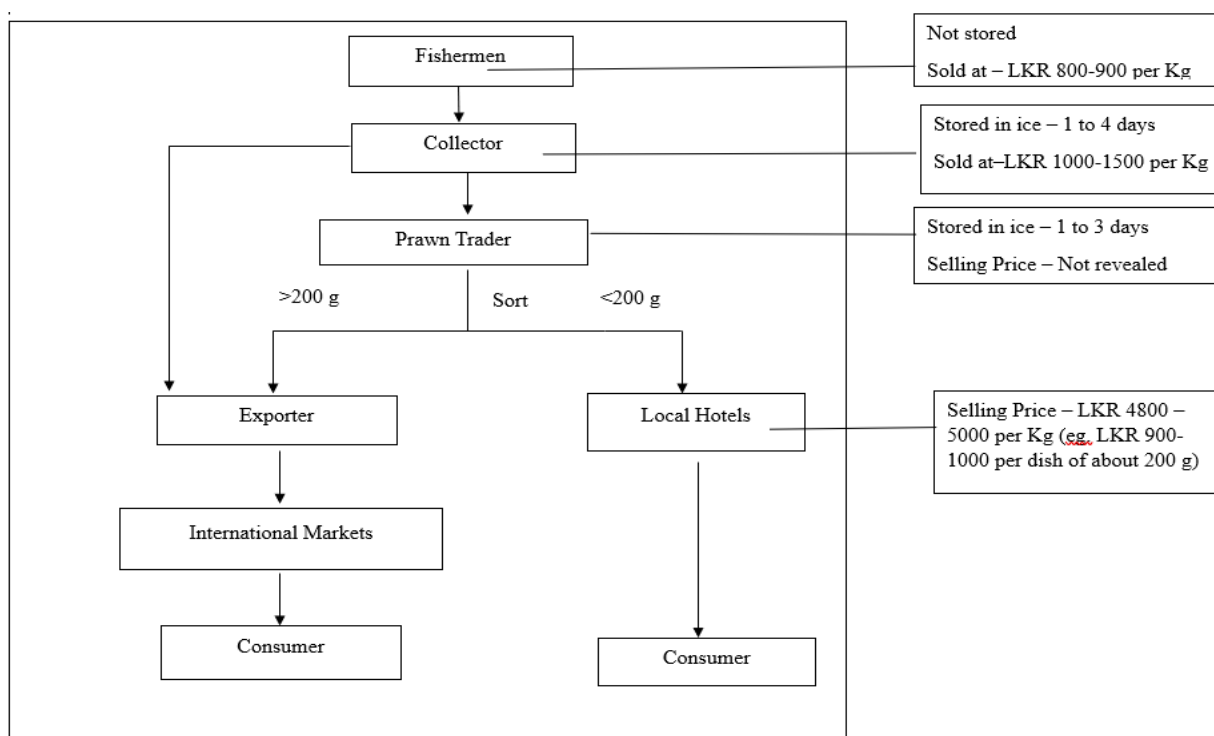


Figure 3 The market chain of GFP in two reservoirs

It was found that the entire GFP marketing system has been controlled by powerful market intermediaries. The collectors used to buy GFP from fishermen at a price ranging from LKR 800 to 900 and store in deep freezers or in ice for one to four days. This delay depends on the export mechanism. The entire stock of Mahauswewa reservoir has been sold to a prawn trader by collector at a price ranging from LKR 1,000 to 1,500. The trader then sort GFP according to the weight and those having the weight of more than 200g per head are carried to the exporter for international marketing. The rest is sold to local tourist hotels in Negombo area. Given the fluctuating nature of production and various size of prawn, it is difficult to estimate the ratios of export to local markets; but, a high percentage of production has been directed to export markets for the most part. Exporter packs the prawns in

ice and exports those 'high quality' prawns to Saudi Arabia, Japan and Holland. The whole of GFP harvest in Siyambalankattuwa reservoir which has been collected by the collector is sold to an exporting company. The company sorts GFP according to weight and appearance. Good quality prawns are packed in ice and exported to Thailand and Malaysia. The rest is delivered to hotels in Colombo, Ja-ela and southern part of Sri Lanka.

A monopoly of collectors has been apparent in both reservoirs. As a result, competitive market structure is not established for the most part and market information is "hidden" to other parties to a larger extent. The collectors experience less competition throughout the market chain, and in consequently, the active players in the marketing channel have less desire to develop proper mechanism for production to marketing of GFP. The existing market margin appears to be very high, indicating the

exploitation of prawn farmers and consumers by middlemen. For an example, sorted GFP (>200g) are exported, while the rest is delivered to local hotels. The price of those GFP at local hotels was LKR 900 – LKR 1000 per 200g dish at the study period. The export prices were not even revealed indicating a higher state of hidden market information. Therefore, there exists a heavy need to create a market channel characterized by equitable profit distribution.

The focal point of GFP marketing system is the export market. But the markets have the potential to expand by entering into tourism, hotel industry and invading local consumer's attention by making it available at retail level with affordable prices. Collectors and traders have less access to quality ice at an affordable price. Therefore, it can be used as an opportunity by others to generate additional employment opportunities in this industry and to help development various other service marketing components.

Livelihood Analysis

A summary of findings with respect to each capital asset considered under the sustainable livelihood framework is presented below.

Financial Capital: There is no any systematic mechanism in place to harvest GFP in both study areas. However, even with the relatively small quantity of prawns they harvest at a given point of time, the fishers and traders earn a considerable portion of income. For an example, out of these two groups, GFP collectors and traders get high income (LKR 100,000 – 150,000 per month in peak fishing periods) levels compared to the fishers. In light of this, receiving of even a few kilograms of prawns a day made the fishers happy as they can easily pass them to the traders without much issue. It was noted that most of the fishers (86.25%) do not save a part of their income on regular basis although they have the ability to do so through local financial institutions and at least in small amounts. Further, a large number of fishers are addicted to borrow money from local money lenders at high interest rates even above 15%.

Human Capital: It was noted that fishermen, in general, are healthy (do not have chronic or severe diseases and disabilities. It was recorded that very few suffer from heart or kidney diseases) and their capacity to work is at a

relatively high level except in few situations. However, discussions with them revealed that their service in terms of GFP harvest is underutilized. According to the analysis, over 60% of respondents possess skills in several other fields in addition to the fishing. A portion of 87.5% of fishermen in the sample have been engaged in fishing for more than 10 years, where their level of experience in this connection is heavily considerable. But a wide gap in knowledge with regard to the technologies, management, and lack of access to markets and marketing information have become key barriers for ensuring sustainability in livelihoods with respect to their potentials.

Natural Capital: In the case of production of GFP in these reservoirs, it does not require to support it with any inputs externally, or in other words, GFP are grown by utilizing the naturally available food, including parts of aquatic plants, dissolved organic particles, plant debris and on farm by-products. It was reported that the available stock of prawns is threatened by eel attacks that results a severe drop of catches observed when compared with the amount stocked. Further, climatic issues pertaining to the study areas, especially lack of rainfall to the catchment of these reservoirs over the period of study had result in a drastic drop i.e., 25-30 Kg in peak production dropped to 0 Kg during dry seasons of GFP harvest. Consequent to these, as noted above, most of the fishermen and traders depend on other sources of income to overcome income shortfalls. The soil type of this region is suitable for cultivation of certain commercial types of crops such as coconut, paddy, few selected vegetables and fruits. Further, people in the area are used to engage in brick production to earn extra income. The households from Mahauswewa are facing the problem of pure drinking water because most of the wells contain saline water. It was also noted that the livelihoods of many households are highly benefitted from provisionary services from adjacent forest ecosystems, including the food, firewood and medicine etc.

Physical Capital: The physical infrastructure required to operate this industry efficiently and more profitably is lacking in both regions. It was reported that a considerable portion of stock harvested with great effort is wasted because the stock is not protected inside the reservoir (i.e. until reaches to the trader) due to lack of access

to protective equipment and techniques during the process of harvesting and stocking. Fishermen do not use specific nets or equipment to harvest GFP, from one hand, and the GFP traders do not have proper storage facilities and access to quality ice with affordable prices, on the other. The poor and damaged roads create limitations with respect to accessibility of traders to the collecting point on time and that result unwanted bargains.

Social Capital: this reflects the way in which people interact and work together within household and in the community, in general. The estimates on selected criteria obtained the highest overall percentage of 95.2 percent for this criterion, which can, in turn, be considered as a key indicator of potential to develop these

communities. The communities still hold the reciprocity concept and the conflicts, theft and robbery sort of incidents are rarely reported. It was noted that the decisions regarding whole community have been made collectively for the most part along the guidance of relevant community institutions established by them. The outcome of analysis further suggests that almost all (i.e. 98.8%) of the respondents have positive attitudes towards introduction of more updated and fisherman friendly production and marketing system for GFP that would function for the betterment of their livelihoods in future.

The livelihood pentagons obtained to reflect the performance of two fishing communities with regard to these five capital assets is depicted in Figure 4. It can be seen that it is not symmetrical and not up to the levels of sustainability.

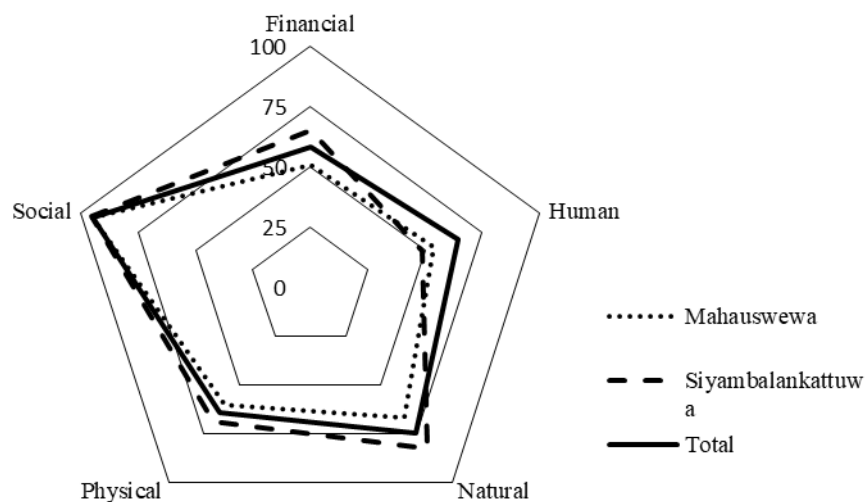


Figure 4 The livelihood pentagon of two fishing communities

It was learnt that both communities were very rich with regard to social capital by reaching the estimated value of which generally up to 95.2%. This indicates the existence of strong social bonds and social security within the community. The natural capital was highlighted as next highest valuable capital (74.5%) due to high soil fertility, access to forest eco-system services and seldom occurrence of natural disasters. Human capital was placed in a relatively average position (64.4%). Having a good physical health and multiple skills of fishermen other than fishing made this value to this level, but lack of access to technology,

training and poor education levels etc. act as constraints to have a much higher value. The value pertaining to the physical capital was relatively low (64.3%) due to poor infrastructure and other physical properties. Financial capital showed the lowest percentage (58.2%) indicating the less capital asset utilization and lack of knowledge regarding financial management. With regard to the key livelihood strategy of respondents in these areas, in general, they do not fully depend on GFP harvesting or trading, but on overall fishing. Most of the people are multi-skilled, and therefore, they are prone to engage in more than one source of income. Fishing

communities have the access to nutritional food and a relatively better living standard as achievements of livelihood strategies. However, the livelihood outcomes are not reached their best when compared to the opportunities they meet in their day today life as livelihood strategies.

Ministry of Fisheries and Aquatic Resources Development, Ministry of Agriculture, North Western Provincial Council and NAQDA are the key institutions which have a direct influence to the livelihood activities of fishing communities. Additionally, there are well functioning fishing societies operating with the guidance of above-mentioned institutions. Certain rules and regulations were established, although not perfect, those help to shape the behavior of fishing communities and protect them from external threats. People who fail to obey the rules have to pay fines to the society or in serious issues, legal actions are taken by NAQDA by bringing accused to the courts. In addition to the rules and regulations laid by the responsible institutions, livelihoods of these communities are shaped by their own community ethics too.

The external factors that cause direct impacts on livelihood assets of people, or in other words, vulnerability context, are in the form of three, including shocks, trends and seasonality, and is discussed below.

Shocks: GFP systems in Puttalam district are vulnerable to droughts and heavy rains. Droughts reduce the harvest and it causes shortages in supply. Heavy rains and winds interfere with fishing activities which cause hardships to fishermen within very short time. Price shocks occur in markets as well as those related to health of prawn act as major shocks to the fishermen and other market participants.

Trends: GFP marketing system in study area depends more on international prawn markets. Trends in international markets like emerging competitors, substitutes and international economic trends may cause significant effects on GFP marketing. Fishers are rarely benefitted by the positive price trends in international markets and exporters grab the benefit from those trends. The consumer behavior is unpredictable and new trends in food consumption patterns emerge day-by-day based on health concerns, environmental and religious aspects.

Seasonality: the income of fishermen is threatened by seasonality because its peak

production lasts for three months (November to January). The harvest is relatively low in rest of the months. Though they experience a relatively high harvest in August to October period, the harvest in April and May is extremely low. Therefore, fishermen have to engage in other employment (part time) in order to stabilize the household cash inflows.

CONCLUSION

The outcomes of both market chain and livelihood analysis highlight that GFP industry possesses a great potential to expand the employment opportunities and increase the level of income of those involve directly, and of the rural poor in the respective areas in general. However, the inefficiencies of information on production, various behaviours of market actors, and issues relating to profit distribution along the market chain create barriers to improve the GFP production and marketing system pertaining to these reservoirs.

It further suggests that the commercial stability of GFP production and marketing depends more on the international markets, and having permanent access to prominent local markets. However, there exists a lack of coordination and information flow from those markets to the production level through the

It was seen that social capital is prominent within the CBF communities, which helps upkeep the sustainability of the system. Human capital is the most important asset of a community because the whole of livelihood assets can be improved indirectly by improving it by way of proper education and training sharp the skills of those involved with GFP production and trading. Community participation in decision making for implementing development programs is crucial because they have empirical knowledge on how the mechanisms are taken place.

Responsible authorities should focus on socio-economically desirable advancements of technologies and to increase research output also. As it is necessary to improve secure sources of income which have potential to uplift lifestyles of fishing communities, a detail investigation on market chain covering small to medium scale different geographical regions including the Northern and Eastern part of the nation is warranted. In light of this, corporation of private and public sector is essential to come up with productive plans to improve GFP marketing systems, where each and every market participant

and authority has the responsibility to look into potentials for carrying the current system to a better change.

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