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Assessing the Household Food Security of Marine Fisheries Sector in Sri Lanka: Case of Muslim Fishing Community in the Beruwala Divisional Secretariat Division

M.M.F. MUKARRAMA[1], J.M.M. UDUGAMA[2], U.K. JAYASINGHE-MUDALIGAE[2], S.M.M. IKRAM[2] and S.N. DISSANAYAKE[1]

[1] *Department of Agricultural Systems, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura*

[2] *Department of Agribusiness Management, Faculty of Agriculture & Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), 60170*

Abstract

The purpose of this study was to assess the status of household food security of Muslim community belonging to the marine fisheries sector in the Beruwala Divisional Secretariat Division (DSD) in Sri Lanka. The data were collected from 494 individuals from 80 households located in 5 Fishing Inspection Divisions in the DSD using the Proportionate Random Sampling techniques. The data collection process was characterized by a number of techniques, including verbal communication; anthropometric measurements; secondary data obtained by means of various reports, records and bills etc., and direct observation of the housing environment. The Aggregate Household Food Security Index (AHFSI) developed by the FAO was used to evaluate the status of food security. The results revealed that the AHFSI of the Muslim community, in general, was 84.6 (i.e. at a "sufficient" level. The outcome of analysis also highlights that the household expenditure, access to loans, the fishing effort, gender, age and education possess a varying effect on their level of food security.

Introduction

In the twenty-first century, the pursuit of food problem remains as one of the greatest critical challenges for the entire world. According to the Food and Agriculture Organization (FAO), Sri Lanka has been identified as one of the 14 countries facing 'food emergencies' and about 23 percent of the total population of the country is reported "undernourished" (Fisheries statistics Sri Lanka 2009). An average poor in Sri Lanka receives nearly 1700 kcal per day, while which is for a non-poor is about 2200 kcal per day. The official poverty line in Sri Lanka is fixed at a welfare level of a person who meets a certain minimal nutritional intake (2030 kcal per day) in 2002. According to the Food Balance Sheet prepared for the year 2006, the National Average Calorie Intake is 2389. However, it was reported that

about 51 percent of the population receives less dietary energy than that what is set as the minimum level required (Department of Census and Statistics 2007).

The above records, hence, suggest that food security, both at the national and household level, becomes an indispensable factor that needs special care and immediate attention of the respective stakeholders. Food security is defined, in broad, as "the physical and economic access to sufficient, safe and nutritious food for all the people at all times to meet their dietary needs and food preferences for and active and healthy lifestyle". Food security is, in general, described under three essential elements, namely: (1) *availability* of food, i.e. the amount and the quantity of food available globally, nationally and locally and which can be affected temporarily or long-term by many factors including climate, disasters, war, civil unrest, population, agricultural practices, environment, social status and trade etc; (2) *accessibility* to food, i.e. whether households have the purchasing power or other entitlements to buy food, which can have an effect from the person's ability to access and afford sufficient food and is associated with the age, social status, gender, income, geographic location and the ethnicity etc., and (3) *utilization* of food, which is, at the household level, sufficient and varied food needs to be prepared safely for people to grow and develop, meet their energy needs and to prevent diseases. At the household level, food security is, in turn, defined as the "ability of the household to secure enough food to ensure adequate dietary intake for all of its members" (Malkanthi et al. 2007, 2010).

Sri Lanka being an island, the fisheries sector has a very high potential for an immense contribution to the food security of the country. Fish directly influence the food security as being a crucial part of the daily diet of Sri Lankans and as one of the main sources of calorie intake, dietary protein, micronutrients and essential fatty acids, so enhances the working power, and thereby, productivity. It influences food security indirectly by generating income through local and export markets, and as a result, the purchasing power of food (Hotta 2000).

The fisheries sector of Sri Lanka, which is generally divided into three broad categories, namely (1) *marine* (further, sub-divided into coastal and offshore fisheries); (2) *inland*, and (3) *aquaculture*, plays a key role in Sri Lanka's social and economic life. It contributes about 1.1 percent to the Gross Domestic Product (GDP) and the total fish production in year 2009 was 339 metric tons (Central Bank of Sri Lanka 2009). In addition, the fisheries sector employs nearly 250,000 active fishers and another 100,000 in various support services and this workforce represents a population of almost one million people of the country. Out of the total fish production in 2008 and 2009 almost 90 percent has contributed by marine fisheries, while the contribution of inland fisheries and aquaculture was approximately 11 percent and approximately 1 percent in 2008 and 2009 respectively (Fishery and Aquaculture Country Profiles 2009).

From an economic point of view, there is significant scope for increasing the level of contribution from this very important sector to the national economy not only through an increased output, but also by means of exploiting the potential for value addition and import substitution etc. From the social point of view, marine fishery sector, however, comprises most of the poor marine fishermen in Sri Lanka which involves several parties, including: those who directly involved in fishing,

dependents of those involved directly with fishing, those who buy fish for human consumption, those who are benefited from related income and employment, and those who are benefited indirectly as a result of national export revenues from fisheries and re-distributive taxation and other macro level mechanisms. An investigation that focuses on the potential links between the status of food security, especially at the level of household, and the fishing sector of the country can, therefore, be justified as malnutrition and food insecurity of fishing households, which represents a very important part of the Sri Lankan population, have a big impact on national development through its direct and indirect involvements on the all parties aforesaid.

Where the fishing sector of Sri Lanka is of concern, there is a significant contribution by the Muslim community of the country, especially those who reside in the coastal areas and involves with marine fishery as one of the main employment, towards the development of fisheries sector in Sri Lanka. Given that the food consumption and behavioral patterns of the Muslim communities are unique, it is of interest and also has risen as a need of the day to assess the status of food security of these communities separately from other ethnic groups. Moreover, marine fishermen of the nation are, in general, considered "poor" compared to others of the country, and as a result, may not have continuous access to quality food secure both food and nutritional security with an appropriate level of safety.

The aim of this study was, therefore, to assess the status of household food security of the marine fishing sector in Sri Lanka, where that of the Muslim community is of special interest. It will contribute to the literature as one of the innovative studies in this area and the information gathered through which may be used to formulate appropriate policies to promote development of human resources in this very important sector of Sri Lankan economy.

Methodology

Development of Aggregate Household Food Security Index

Different methodological approaches are in use to analyze the status of food insecurity (and famines) that lead from general explanations in terms of drought, war, land degradation etc. to scientific causes of which as well as eclectic approaches that combines both. However, general explanations cannot be considered precise and more specifically be used in quantifying the problems related to food security; thus, are not helpful in leading to accurate predictions and specific policy interventions cannot be made based on these approaches. As a result, the specific models were developed in the literature based on demand and supply and theories on market failure. The Supply and Demand side analyses, which are popularly known as Food Availability Decline (FDA) models and Food Entitlement Decline (FED) models, respectively, however, do not elaborate how food security causation may be explained at the household level.

The issues related to food insecurity such as the stages of coping, exposure, capacity and capability, transitory, chronic and acute vulnerability etc. have received much attention in modeling the status of food security. In addition, a number of outcome-based measures of household and individual food security such

as the Individual Food Intake Data, Household Caloric Acquisition, Dietary Diversity and Indices of Household Coping Strategies were used to assess it (Hoddinott 1999; Malkanthi et al. 2007, 2010; Maxwell 1995, 1999). We use the *Aggregate Household Food Security Index* (AHFSI) for the purpose of this empirical analysis, which takes into consideration of both the extent and the depth of undernourishment and the variance of food supplies during a specific period of time (a year), and can be used effectively to assess the household food security status of a specific community (see, for example Ahamed et al. 2004; Ramakrishna and Demek 2002). AHFSI can also be considered as an indicator of per capita food availability in a household for consumption and incorporates all three elements of the availability, accessibility and utilization of the FAO's concepts of the food security explained above more comprehensively. The AHFSI can be specified as follows:

$$AHFSI = 100 - [H \{G + (1 - G)\, I^P\} + 0.5\, \sigma \{1 - H [G - (1 - G)\, I^P]\}]\, 100$$

Where, H = Head count of the proportion of the sample population undernourished; G = Measure of the extent of food gap of the average undernourished; I^P = Measure of inequity in the distribution of the individual food gap of the undernourished (based on the Gini coefficient derived through the Lorenz Curve developed by M. O. Lorenz in 1905), and σ = Coefficient of Variation (CV) in dietary energy supply that gives the probability of facing a food shortage. The steps used to develop respective variables in the AHFSI are explained, in turn.

The value of "*Head Count of the Proportion of the Sample Population Undernourished*" (H) can be estimated by calculating the Body Mass Index (BMI) of both the adults and children to which the Weight (in kilograms) and Height (in meters) of each and every individual above 2 years of age in the sample is taken. The BMI was calculated by using the formula: BMI = Weight (kg) / $[\text{Height (m)}]^2$. The "Online Calculators" is used commonly to estimate the BMI, where the "Adult BMI Calculator" and "Child and Teens BMI Calculator" are freely available to be used for this purpose. For the adults (>20 years), BMI can be interpreted using the Standard Weight Status categories that are the same for all ages and irrespective of the gender. Any adult having the BMI value below 18.5 is considered generally as "undernourished". For children and teens, however, the interpretation of BMI should be based on both age and sex-specific methods. The sum of undernourished adults, children and teens are then taken to derive the H. Accordingly, the value of H in the AHFSI can be obtained through the equation: Number of undernourished individuals in the sample / Total individuals in the sample.

The "*Measure of the Extent of Food Gap of the Average Undernourished*" (G) is evaluated through a food consumption survey, where the individual food consumption data for 24 hour period are recalled (i.e. 24-hour food recall). The calorie intake by the individual person per day is then estimated by using the "Food Base Software" developed by the Wayamba University of Sri Lanka. Then the calorie intake of the undernourished people is taken separately and the Arithmetic Mean of their calorie intake is calculated. Using The National Average Calorie Intake per day defined in the Food Balance Sheet prepared by the Department of

Census and Statistics, the Food Gap is defined as: G = (National Average Calorie Intake – Undernourished Average Calorie Intake) / National Average Calorie Intake.

The "*Inequity in the Distribution of the Individual Food Gap of the Undernourished*" (I^P) is assessed by plotting a Lorenz Curve and deriving the Gini Coefficient with the use of free online calculator. The "*Coefficient of Variation in Dietary Energy Supply*" (σ) gives the probability of facing a temporary food shortage. It is estimated by using the formula: σ = SD / X, where SD = Standard Deviation of calorie intake of all individuals, and X = Mean of calorie intake of all the individuals.

The value of the AHFSI ranges from "zero" (i.e. total famine) to "100" (i.e. risk free food security). Therefore, any household and/or community whose value of AHFSI is less than 65 it is deemed to have a "Critical" level of food security. Consequently, it is the value of AHFSI is between 65 and 75; it is categorized as "Low"; 75 and 85 as "Sufficient", and the above 85 as having a "High" level of food security.

Collection and Analysis of Data

The Muslim marine fishing communities adjacent to the coastal lines belonging to the Beruwala Divisional Secretariat Division (DSD) were selected to collect data. The Proportional Random Sampling techniques were employed to select the households into the sample, where the sample was proportional to the spread of Muslim Fishing Families (MFF) in the five Fishing Inspection Divisions (FID) in this DSD (n_{mff} = 1581), including: (a) Maggona (215); (b) Payagala (406); (c) Beruwala South (300), (d) Beruwala North (177), and (e) Aluthgama (483). Given the comprehensiveness of study in terms of taking numerous data from a given household members to assess the AHFSI, the sample was restricted to 80 Muslim households selected randomly to represent 5 percent of the total MFF.

The primary data were collected by means of a personal discussion carried out with all the potential members in the household. A structured interview schedule was prepared to make the discussion straightforward and to collect all the information required and which was piloted using 10 households (2 each from 5 FIDs) to test its validity and reliability. The data collection process was, thus, characterized by a number of techniques, including verbal communication (e.g. 24hour –recall method); physical measurements (e.g. weight, height); secondary data obtained by means of various reports, records and bills etc., and direct observation of the housing environment.

Further, the following information was gathered, amongst the others, from each household. The data on household expenditure was gathered by asking each member in the household to report their monthly expenditure on the categories of food, education, transport, clothing, construction, electricity, fuel, medicine, water, communication, ceremonial events, expenditure on repair of the fishing craft and miscellaneous. Based on these values, the total average annual expenditure of a household was estimated and attention was paid to minimize the errors in reporting and calculations and certain adjustments were made to reflect the actual expenses unreported. The data gathered were used, in turn, to plot a graph showing the

expenditure per year of the household against the household numbers. As this graph shows more or less a Normal Distribution, the data set was divided into two based on the households having expenditure "above average" and "below average" and the AHFSI was calculated for these two groups separately.

To derive the total fishing effort of the household, the respondents were asked about the type of fishing craft used to catch fish and whether they use their own fishing craft or work as laborer of another person's fishing craft. The fishing effort used per year was then computed by multiplying the share of the fishing craft with the number of days utilized for fishing such that: Fishing Effort = $Y_i * Z_i$. Once the share of the fishing craft was obtained, the fishing effort was plotted in a graph against the household numbers. Again, the households in the sample were divided into two groups based on this distribution and the AHFSI was calculated for these two groups separately.

A similar procedure was adopted to plot graphs showing relationships representing several other variables of interest and the number of people in the household which included: (a) Household expenditure; (b) Access to loans (to counterbalance their daily expenses in the case of income shortage); (c) Fishing effort; (d) Gender (males and females); (e) Age (children/teens and adults); (f) Literacy rate (ability of read and write by the head of the household); (g) Family size, and (h) Dependency ratio. Both household expenditure and Loan taken [(a) and (b) above] are considered the entitlement factors which are having negative influence on food insecurity. Literacy rate and Fishing effort [(c) and (f) above] were used as proxy variables for the attitudes of the households and expected to influence food security positively. Gender and Age [(d) and (e) above] are also another proxy variable that was expected to influence the food security positively, where in the case of gender it was by the male. Family size and Dependency ratio [(g) and (h) above] are demand factors that can have an influence on food security positively. Once the graphs were plotted, the sample was divided into two distinct groups based on its distribution (e.g. with regard to the Literacy Rate, two groups were "literate" and "illiterate") and the AHFSI was calculated for each group separately as mentioned above.

Results and Discussion

Descriptive Statistics of the Sample

The sample with 80 households consists of 494 individuals of which 50.8 percent were "Males" and 49.2 percent were "Females". About 66 percent of individuals in it were "Adults" and the rest were "Teens and Children". With regard to the education, nearly 71.7 percent of individuals were grouped as "Literate" and the rest (28.3%) were "Illiterate". In terms of number of people in a family, the average household size was 6.2 and a majority of households contain from 5 to 9. The minimum household size selected for analysis was 3 (controlled) and the maximum household size was 13.

Descriptive Statistics of the Variables Used to Develop AHFSI

The BMI calculated for each individual in the sample helped to identify "undernourished" people in it, which was 121 out of 494 individuals. As a result, the head count of the proportion of the total sample population undernourished (H) was 0.245. The average calorie intake of food of the undernourished population (n_{un} = 121) was 1445 kcal per day. The National Average Calorie Intake of Sri Lanka reported in the Food Balance Sheet prepared for the year 2006 was 2389 kcal per day. Thus, the food gap of the undernourished population was 944 kcal per day, and thereby, the measure of the extent of the food gap of the average undernourished (G) was 0.395. This tells us that the gap between the "average requirement" and the "average availability" was 39.5 percent, or in other words, if the average requirement was equal to 100 percent, the availability of food for the households was 65 percent.

The calorie intake of food of the 494 individuals in 80 households was estimated using the Food Composition Data Base. Next, these calorie intakes were fed into Gini-coefficient online Calculator, which was based on the Lorenz Curve constructed for this purpose of which the X-axis contains the cumulative percentage of the calorie intake of the sample and Y-axis contains cumulative percentage of the sample population who shares those calorie intake (Wessa 2008). The value of Gini coefficient[1] obtained through which, i.e. 0.168, can be considered as a measure of the inequity in the distribution of the individual food gap of the undernourished population (I^P). We can infer that the distribution of food among the households did not show a severe inequality as the Gini Coefficient was less than 0.5, and in fact it is close to zero (i.e. 0.168). Thus, the distribution of food amongst the households in this community is more or less equitable, or in other words, there was an acceptable level of accessibility to food by all households, in general (Figure 1).

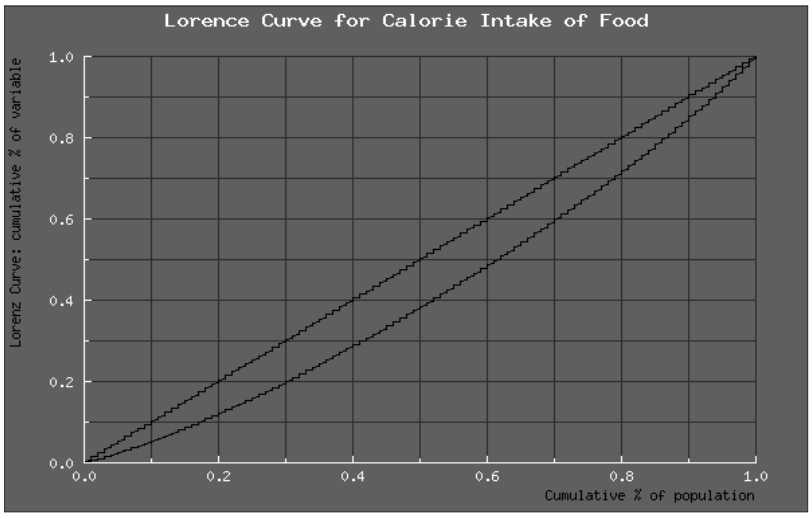


Figure 1: Lorenz Curve for the calorie intake

[1] The Gini coefficient is equal to the ratio between the area between line of equality and Lorenz Curve and total area under the line of the equality (a triangle area).

The Standard Deviation of the dietary energy supply (σ) of all the individuals in the sample was 444.0 and the Arithmetic Mean of the calorie intake of the sample population was 1512.7. The Coefficient of Variation (CV) in dietary energy supply was, therefore, 0.294.

Table 1. Descriptive statistics of the variables used to develop AHFSI:

Criteria Used	H	G	I^P	σ	AHFSI
Total Sample (n = 494)	**0.245**	**0.395**	**0.168**	**0.294**	**84.6**
Calorie Intake					
Above Average	0.305	0.224	0.082	0.149	**90.4**
Below Average	0.269	0.515	0.119	0.212	**81.0**
Household Expenditure					
Above Average	0.257	0.569	0.174	0.309	**77.8**
Below Average	0.235	0.545	0.147	0.268	**80.7**
Fishing Effort					
Above Average	0.289	0.387	0.184	0.343	**82.2**
Below Average	0.214	0.398	0.154	0.274	**86.2**
Gender					
Male	0.262	0.395	0.169	0.337	**83.3**
Female	0.226	0.357	0.166	0.292	**86.7**
Age					
Adults	0.197	0.357	0.107	0.271	**88.5**
Teens / Children	0.304	0.407	0.172	0.302	**81.3**
Education					
Literate	0.273	0.395	0.169	0.297	**83.2**
Illiterate	0.171	0.395	0.164	0.29	**88.0**
Household Size					
Above Average	0.246	0.389	0.165	0.29	**84.8**
Below Average	0.210	0.379	0.167	0.297	**86.6**
Dependency Ratio					
Above Average	0.231	0.404	0.173	0.304	**84.7**
Below Average	0.269	0.395	0.157	0.279	**83.7**

Estimates of the AHFSI

The values of variables of the AHFSI estimated above were, in turn, used with the equation such that AHFSI = $100 - [H \{G + (1 - G) I^P\} + 0.5 \sigma \{1 - H [G - (1 - G) I^P]\}]$ $100 = 100 - [0.245 \{0.395 + (1 - 0.395) 0.168\} + 0.5 * 0.294 \{1 - 0.245 [0.395 - (1 - 0.395) 0.168]\}]$ 100 = 84.6. Given that AHFSI was in between 75 and 85 (i.e. 84.5%), we can infer that, according to the classification of FAO, the household food security of the Muslim community considered in this

study was at a "Sufficient" level (or, almost in the lower boundary of category "High")[2]. To explore the results further, the entire sample (n = 494) was divided into two groups based on a number of criteria explained above, and the estimate of AHFSI obtained for each criterion is reported in Table 1 and is briefed, in turn.

The estimate of AHFSI for the "undernourished" individuals in the sample (n_{un} = 121; 24.5%) was 50.8. This portrays that the level of food security of undernourished fisherman was "critical". Further, it figures out that out of 75.5 percent of other fisherman in good condition, about 78 and 16.6 percent can be classified as "healthy" and "overweight" individuals. The results show that about 85.7 percent of individuals in the total sample received a calorie intake less than 2030 kcal per day (i.e. the official poverty line expressing the minimum calorie requirement of the average Sri Lankan). Further, it explains that nearly 97.2 percent of individuals in the total sample were having a calorie intake less than 2389 kcal per day (i.e. the average calorie intake of the Sri Lankan people in year 2006, according to the Food Balance Sheet). The average calorie intake of the entire sample was 1515 kcal per day, and nearly 52.4 percent of individuals received calorie intake less than this level. In fact, the value of AHFSI of this particular group was 81.0 indicating a "sufficient" level of household food security. However, the value of AHFSI of the people who intake a calorie level above average was as high as 90.4 indicating a "high" level of food security (Figure 2).

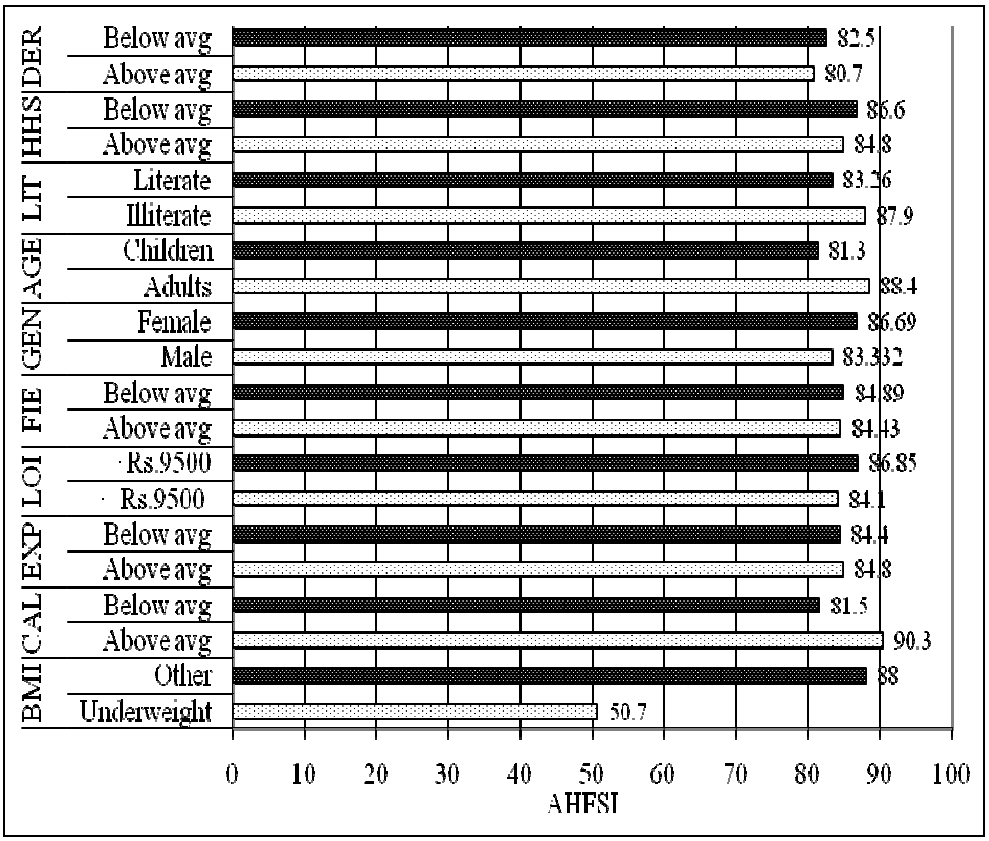
According to the findings of study, there was no significant difference with respect to the values of AHFSI of the two groups of fisherman whose average annual expenditure was "above the average" and "below the average". The Mean AHFSI of these two groups was 84.7 with the Standard Deviation of 0.321. This tells us that household expenditure, as a whole, has no considerable effect on the household food security. Irrespective of the facts that income of more than 75 percent of fishing families included in the sample was not stable and they stay out by not going for fishing for, on an average, 3 to 4 months per year, we recognized through the discussions that they were continued to have a good demand on food irrespective of their day-to-day expenditure patterns stemmed by their income levels.

We found that a vast majority of households have an access to loans to in order to fulfill their food and other needs, which was ranging from Rs. 3,500 and Rs. 9,500 for nearly 55 percent of households. The Mean intake of loan was Rs. 7,876. The results show that the value of AHFSI of the households whose loans were "above Rs. 9,500" is higher than the households who took loans "below Rs. 9,500" (Mean = 85.5; SD = 1.94). This means these fishermen use loans to cover up their day-to-day expenses and people who have an access to higher loans were having a higher food security.

As we consider about the fishing effort of these households, there were only 2 households own and operate a multi-day boat and other 18 and 3 households possess small boat/s and outrigger canoe/s, respectively. All others were working as laborers in a fishing craft belong second or third party. We found that the AHFSI of

[2] However, this does not mean that each and every household in the sample hold a sufficient level of food security, since the AHFSI is an index which addresses the level of food security in an aggregated manner.

the households having a fishing effort "above 1000 units" was greater than those having a fishing effort "below 1000 units" indicating that households with higher fishing effort are food secure (Mean = 85.8; SD = 3.17).



Note: BMI - Body Mass Index; CAI - Calorie Intake; EXP – Expenditure; LOT - Loan Intake; FIE - Fishing Effort; AGE – Age; LIT-Literacy Rate; HHS - Household Size; DER - Dependency Ratio

Figure 2. Estimates of AHFSI for various socio-economic variables

The results also highlight that the food gap for the female undernourished was less than that of the undernourished males. Further, the inequality in the distribution of calorie intake for the males was higher than female undernourished. Moreover, the Coefficient of Variation (CV) of the male is higher than that of the females. All these suggest that AHFSI of "females" was higher than that of the "males" suggesting that the gender has a significant impact on overall household food security (Mean 85.0; SD = 2.37). Further, the value of AHFSI for "adults" was greater than that of the "children and teens" (Mean = 84.9; SD = 5.06). The "illiterate heads" in the sample was having a higher food security level than the "literate heads" though, theoretically, it may be come in other way (Mean = 85.7; SD = 3.34).

The Muslim households included in the sample are characterized by both the extended and nuclear family, but the percentage of the former is higher than the latter. We found that the AHFSI of the households with "extended families" (large) was higher than that of the "nuclear households" (small) (Mean = 85.7; SD = 1.29). Household food security also depends on the number of working heads along with the household size. As a result, the dependency ratio should also have an impact in this respect. It was found that the dependency ratio of a large number of households was in between 0.30 to 0.39. However, the overall impact of the dependency ratio on the level of food security is relatively low (Mean = 84.3; SD = 0.71).

In addition to the above, we have examined the common survival mechanisms used by Muslim fishing communities in the area. It was revealed that about 76 percent of households were involved with less than 200 days fishing days per year. The food ratio of the sample was nearly 63 percent suggesting that nearly one third of their revenues were expensed on day-to-day food items. In addition, a considerable amount of money was expensed on education of their children, to pay bills, especially for mobile phones (sample average was Rs. 466 per month). The main source of money during severe income shortage period was loan intake by the households. Even though their income was almost zero during certain period of the year, the households in this community were continued to consume food sufficiently by taking loans from the nearby groceries and from the neighborhood. During the days which they were not going for fishing, some of the households were looking for another employment, for example casual laborers in construction works and going to harbor for weaving net and so on. But the percentage of people doing extra jobs outside the marine life was very much low. Most of the time, they were just staying at home without doing any income generating activities incessantly.

Conclusions

Food security is one of the prime important factors to be considered in the process of economic and social development of a country, thereby, a scientific assessment of the status of food security at the national and household as well as at an individual level has become a must. Based on the Aggregate Household Food Security Index (AHFSI), this study evaluated the food security status of Muslim fishing communities in Sri Lanka using the special case of marine fishing households in the Beruwala DSD. It points out that the status of food security of these families were at a satisfactory level. The outcome of analysis suggests that the household expenditure has no significant impact on their status of food security, in general, but their capacity to access to the loans from various sources in order cover up their day-to-day expenses had a considerable effect in this respect. Further, the literacy rate and household size does not show a positive impact on the level of the food security as expected and the female population has relatively higher food security compared to their counterpart. Although the value of AHFSI obtained in this analysis indicates that the household food security is sufficient, we may not go into the wrong assumptions that every household in this community receives it equally. As a result, it is needed to come up with more extensive analysis covering a

wider population and advanced methodologies to address the level of food security at the individual level. In fact, the AHFSI covers just a few facets of the issue of household food security, thus, there is a need to develop composite index for this purposes.

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