

Project Titled: Improving Food Security, Household Nutrition, and Trade through
Sustainable Aquaculture and Aquatic Resource Management in Cambodia and
Vietnam

Food and Nutritional Consumption Survey: Women and Preschool-Age Children in Cambodia

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INVESTIGATION V:

Enhancing food security and household nutrition vulnerability of women and children focus on
nutrient dense commonly consumed fish from capture fish and aquaculture in Cambodia

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I. Introduction

This report is part of the implementation of its 2nd activity plan within Investigation 5 “Enhancing food security and household nutrition vulnerability of women and children focus on nutrient dense commonly consumed fish from capture fish and aquaculture in Cambodia” under the project Titled: Improving Food Security, Household Nutrition, and Trade through Sustainable Aquaculture and Aquatic Resource Management in Cambodia and Vietnam.

The primary purpose of this activity is to identify the commonly consumed fish species and Other Aquatic Animals (OAAs) of the sample women and preschool-age children. The secondary purpose is to evaluate the current food consumption situation; energy, and nutrient intakes of sample women and preschool children and the relative contribution made by fish and Other Aquatic Animals (OAAs) and products to total nutrient intake of studied subjects. The result will be a basic step for implementing of its 2nd activity in early 2015, in time schedule of Interstation 5, as planned.

Study Design and Scope

Stung Treng province (Upstream Mekong River); Prey Veng province (Downstream Mekong River); and Kampong Thom province (Tonle Sap Area) were selected for study sites. The data collection was conducted in rainy season from 2 to 26 June, 2014. The target of the study subjects are women and preschool children (aged 6 months to 5 years old). Three hundred (300) eligible women and 343 eligible preschool-age children were selected by using simple randomized sampling from three provinces. Dietary intake was conducted through face-to-face interview by using a single 24-hour food recall to estimate the amount of food that has been eaten in the past 24 hours. Food models were used to identify food items were eaten by the subjects. All food and beverage consumed were recorded using standard household measurement and Electronic Scale (precision to 0.1g). The names of local dishes consumed were also recorded. The amount of each food item consumed was estimated from the real food models. Mothers were asked to show the amount of food consumed by her child, which was then weighted. All food item consumption of women and preschoolers were converted to weight in grams and the nutrient content of the foods consumed were computed by using the ASEAN Food Composition Table (ASEANFCT, 2000). Included nutrients for evaluation: energy; macronutrients (Protein, Carbohydrate and fats); and key micronutrients such as Iron, Zinc, Calcium, and Vitamin A. The nutrient intake of women and preschool children was then compared to the Recommended Dietary Allowances harmonization in Southeast Asia, 2008 (Barba, 2008) to determine the level of nutritional adequacy of the food intake to estimate the amount of food that has been eaten

Training and Survey Organization

The data was collected by 4 trained field enumerators. The training was conducted aims to educate field enumerators how to conduct dietary assessment by using the 24 hour food recall questionnaire, educate the interviewers to get familiar with fish species; reinforce the recall interviewers with exercise practices and pilot testing; and educate the interviewers to be familiar

with questionnaire before data entry was employed. Pilot pretest questionnaire was conducted in order to identify the potential problems encountered in questionnaires, questions and recall form. Letter of survey objective was informed to the local authorities informing them of the conduct of the survey before the actual field work was started. Questionnaires were cross-checked by the members of the team for any missing pieces of information followed by data entry. Microsoft Excel 2013 and SPSS Statistics Version 20.0 were used for data entry and analysis. Data coding, cleaning and cross-checking were conducted. Descriptive statistic was used.

Operational Definition of Terms

Socio-demographic Characteristics - refers to the age, sex, marital status, family income, educational attainment of respondents.

Age - refers to the number of years of respondents from birth to last birthday at the time of the survey.

Educational attainment - refers to the total number of years spent by the respondent in formal.

Occupation/employment - refers to the main occupation of the respondents.

Nutrition- The science of food and the nutrient and other substances they contain, and of their actions within the body (including digestion, absorption, transport, metabolism, and excretion).

Nutrients- Chemical substances obtained from food and used in the body to provide energy, structural materials, and regulating agents to support growth, maintenance, and repair's the body's tissue. Nutrients may also reduce the risk of some diseases.

Diet- Foods and beverages a people eat and drink.

Energy-yielding food/nutrients- the nutrients that breakdown to yield energy the body can use: Carbohydrate, Fat and Protein.

As Purchased (AP) - is the form of food as sold in the market or picked from garden, and includes peelings, bones, shells and other inedible parts.

Per Capita Food/Nutrient Intake - is the average amount of food and nutrient eaten by each member of the sample population, without consideration of age, sex, and physiological status.

Estimated Average Requirement (EAR) - is used to estimate the prevalence of inadequate intake within a population group.

Recommended Dietary Allowances (RDA) - The average daily amount of a nutrient considered adequate to meet the known nutrient needs of the practically all healthy people; a goal for dietary intake by the individual.

Table 1. The Recommended Dietary Allowances per day by age group

Population Group	Weight (kg)	Energy (Kcal)	Protein (g)	Iron (mg)
Infants, months				
Birth-< 6	6	560	9	0.38
6-<12	9	720	14	10
Children, years				
1-3	13	1070	28	8
4-6	19	1410	38	9
7-9	24	1600	43	11
Males, years				
10-12	34	2140	54	13
13-15	50	2800	71	20
16-18	58	2840	73	14
19-29	59	2490	67	12
30-49	59	2442	67	12
50-64	59	2170	67	12
65+	59	1890	67	12
Females, year				
10-12	35	1920	49	19
13-15	49	2250	63	21
16-18	50	2050	59	27
19-29	51	1860	58	27
30-49	51	1810	58	27
50-64	51	1820	58	27
65+	51	1410	58	10
Pregnant women				
Trimester				
First		66		27
Second	+300	66		34
Third	+300	66		38
Lactating Women				
1 st 6 months	+500	105		27
2 nd 6 months	+500	105		30

Desirable Contribution of Carbohydrate, Fats and Protein to Total Dietary Energy

Carbohydrate 55-70%

Fats and fatty acids 30-40 for infants and 20-30% for all others

Protein 10-15 10-15 %

Dietary Evaluation- The ASEAN Food Composition Table were utilized to determine the nutrient content of food items consumed and the Recommended Dietary/Nutrient Allowance to determine the level of nutritional adequacy of food intakes. This will be computed using this formula:

$$\text{Adequacy} = \frac{\text{Total energy/nutrient intake}}{\text{RENI values for energy/nutrient}} \times 100\%$$

II. Results of the Study

2.1. Socio-Economic Characteristics

The Socio-Economic survey provides a summary of the demographic and socio-economic characteristics of the women. Data collected include type of dwelling units; household possessions; water supply and sanitation; and characteristics of the women such as age, education attainment, and occupation.

The socio-economic variables are vital in the analysis of the relationship between the nutrition and health variables, and very useful in targeting and locating specific population groups who are nutritionally vulnerability to socio-economic fluctuations and environmental degradation.

2.1.1. The Sample Women's Profile

2.1.2. Age of Sample Women

Table 2. Percentage distribution of the women by age group and number of children.

Characteristic	Percent (%)
Age Group (Year) (n=300)	
15-19	1.7
20-24	22.7
25-29	30.7
30-34	26.3
35-39	9.0
40-44	6.0
45-49	2.7
50+	1.0
Minimum	17
Maximum	53
Mean	29.6
Std. Deviation	6.6
Marriage Age Group (Year) (n=300)	
15-19	8.3
20-24	86.7
25-29	5.0
Minimum	13
Maximum	46
Mean	21.7
Std. Deviation	4.06

Number of Living Children(n=343)

1-2 children	70.7
3-4 children	23.7
5+ children	5.7
Minimum	1
Maximum	8
Mean	2.1
Std. Deviation	1.4

Nearly one-third (30.7%) of the sample women belonged to the adult age category (25 - 29 years old), followed by the age category (30-34 years old) was more than one-fourth (26.7%). A small percentage (1%) was age group more than 50 years old. The average age of sample women was 29.6 years old (by conducted survey). Regarding to the first time married age, three-third (86.7%) of sample women belonged to age category (20-24 years old), followed by small percentage of about 5% belonged to age group (25-29 years old) with an average age was 21.7 years. The average number of children of sample women were 2.1 children. More than 70 percent of the interviewed sample women had children between 1-2 kids. While respondents had children more than 5 was only 5% (table 2).

2.1.3. Educational Attainment and Literacy of Sample Women

Table 3. Percentage distribution of sample women by educational attainment and employment.

Characteristic	Percent (%)
Educational Attainment(n=300)	
No Schooling	10.3
1-6 grade	29.3
7-9 grade	45.0
10-12 grade	12.3
University	3.0
Ability to read(n=300)	
Yes	69.0
No	31.0
Employment (n=300)	
Fishing	41.5
Agricultural Farmer	62.8
Animal Husbandry	40.0
Employment has wage	13.6
Small business at home	16.3
Labor	42.5

House Wife	3.3
Other Works (28 different kinds of job items)	21.7
Number of Jobs (n=300)	
One Job	12.0
Two Jobs	49.2
Three Jobs	30.2
Four Jobs	8.6

The Cambodian educational system, grade one to six is classify as primary level, grades seven to nine is classified as secondary level, while grades 10 to 12 is classified as high school. Forty five percent (45%) of sample women completed secondary school and 29% completed primary level of education around. Only about 12 % and 3% reached high school and college/university, respectively, of which there were 69% are able to read (Table 2). More than two-fourth (62.8%) of the respondents derived income from agriculture, followed by labor force, fishing and animal husbandry were similar percentage which accounted for about 42.5%, 41.5% and 40%, respectively. Up to around 21.7% generated income from other 28 different job items. Almost half of respondents had two different jobs and only 12% had one job (Table 3).

2.1.4. The sample women's Household Possessions

Table 4. Percentage of household procession, means of transportation, agricultural land by sample women

Possession	Percent (%)
Household effects (n=300)	
TV	55.8
Radio	29.9
Mobile Telephone	77.4
Others (CD/DVD, refrigerator, generator, fans, thresher, water pump machine, air-condition, wood cutting machine, electric cooker)	15.6
Means of Transport (n=300)	
Bicycle	43.5
Motorcycle	64.1
Car	2.7
Kour Yorn	6.0
Boat	1.0
Housing Type (n=300)	
Wooden House	94.0
Concrete House	6
Ownership of agricultural land (n=300)	

Family has agricultural land (other than the piece of house land lot)	56.0
Family does not have agricultural land (other than the piece of house land lot)	44.0

The information on ownership of durable goods and other procession is presented in table 3. Among the appliances that are most acquired by women, mobile telephones owned highest more than (77%), followed by televisions owned around (56%) and other appliances such as CD/DVD, refrigerator, generator, fans, rice harvesting machine, water pump machine, air-condition, wood cutting machine, electric cooker owned more than 15%. More than half of all respondents own a motorcycle, followed by bicycle own more than 43%. The percentage owning a boat only was 1%. The type of the material used for the house is one of indicators for the impression of the wealth at the first glance. Nearly all (95.4%), table 4, of the sample women owned the wooden houses. The percentage of the sample women owned a concrete house. More than half of the sample women (56%) owned land for agriculture.

2.1.5. Water Supply and Sanitation

Table 5. Percentage distribution of drinking water and type of toilet sanitation facilities by sample women.

Characteristic	Percent (%)
Household drinking water (n=300)	
Rainwater	78.7
River	51.2
Mechanical/Hand Pump	31.6
Pipe/running water	23.9
Electric Pump	1.3
Type of toilet sanitation facilities (n=300)	
Open Air toilet	43.5
Own Toilet	43.2
Shared Toilet	13.0

The source of drinking water is an indicator of whether it is suitable for drinking. Nearly 79% of household of the sample women consumed drinking water from rainwater and more than half of the sample women utilized water from river for drinking water. Nearly one-fourth of sample women consumed drinking water from pipe or running water (Table 5). Almost half of the sample women's household had no access to toilet hygiene facility and making use of fields or bush areas. Thirteen percent reporting shared their toilet facility.

2.1.6. Child Health Care

Table 6. Percentage distribution of breastfeeding status, exclusive breastfeeding, and child health care

by sample preschool children.

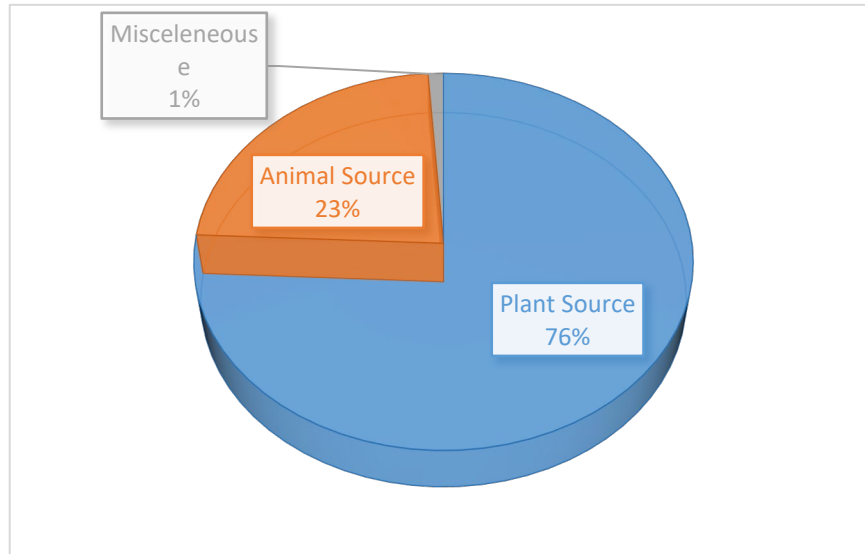
Characteristic	Percent (%)
Breastfeeding Status (n=343)	
Child has ever been breastfed	97.7
Child has not ever been breastfed	2.3
Frequency of Exclusive Breastfeeding (month) among under 6 month child (n=343)	
<=6	84.2
5-4	7.5
3-2	3.4
1-0	3.4
Child Care (n=290)	
Once in a week or more	3.0
Few times in a month	43
Once in a month	22.2
Few times in a year	22.9
Once in a year or less	5.3

Early initiation of breastfeeding is encouraged for a number of reasons. Mother benefit from early suckling because it stimulates breast milk and facilitates the release of oxytocic, which helps the uterus contract and reduces postpartum blood loss. The first breast milk constraints colostrum, which is highly nutritious and has antibodies that protect newborn from disease. UNICEF and WHO recommended that children be exclusively breastfed during the first 6 months of life and that children be given solid or semisolid complementary food in addition to continued breastfeeding from 6 months to 24 months. Exclusive breastfeeding is recommended because breast milk uncontaminated and contains all of the nutrients necessary for children in the first few months of life. Table 6 shows that the proportion of sample children ever breastfed was almost all (98%) and has not ever been breastfed only 2.3%. More than three-fourths of sample children under 6 months of age were exclusively breastfed. While only more than 3% age 0-1 month were exclusively breastfed. Table 5 shows forty three percent of sample women reporting their child get sick few time in a month and more than one-fourth (22%) get sick once in a month.

2.2. Food Consumption

2.2.1. The women's Food Consumption

Figure 1. Percent contribution of food sources of the women's mean one day capita food consumption



Food consumption in different areas of the country may be influenced by topography; religious customs; cultural relationships; trades and price (food affordability); and agricultural products (local food availability); family size; household food distribution; and among others are among the indicator influence to food consumption pattern of individuals especially women and children. Majority of foods that made up the sample women's diet comes from plants at 76%, while 23% comes from animal source, and 1% comes from food group such as condiments and spices (Figure 1).

Figure 2. Percent Distribution of the women's mean one-day per capita food consumption by particular food group.

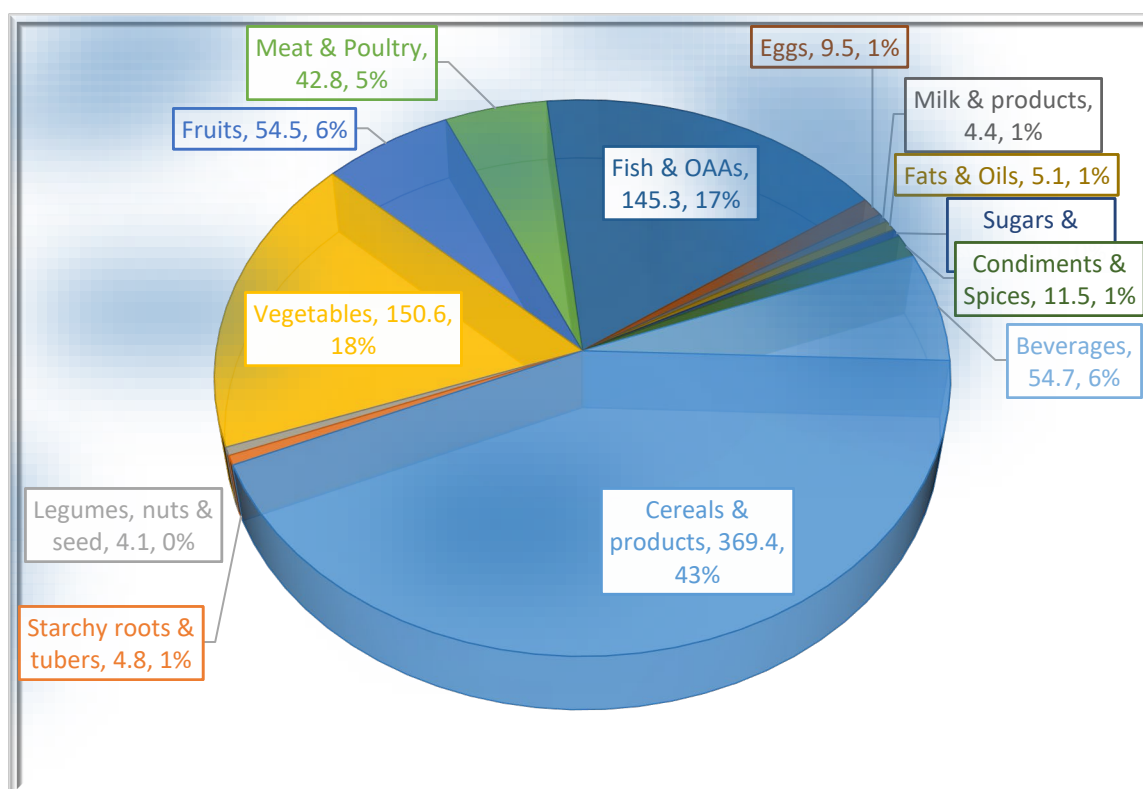


Figure 2 shows that total sample women's diet is basically rice-vegetable-fish combination. In term of weight, the total mean one day per capita food consumption is 861g per day, in raw as purchased form. The highly consumed food was cereal and cereal products at 369.4g (43% of the total food intake), contributing to more than 1/3 of the total food intake. Vegetables were the second top food group commonly consumed by sample women at around 150 g (18 % of the total food intake) per capita per day. Intake of fish, Other Aquatic Animals, and its products were the third largest consumption at 145.3 g (17% of the total food intake). There was also a high consumption of fruits and beverages at similar amount 54g (6%). The rest of the major food groups consumed in small amount by the sample women were fats and oils; egg, sugar and syrups; legumes, nuts, seeds; and starch roots and tubers.

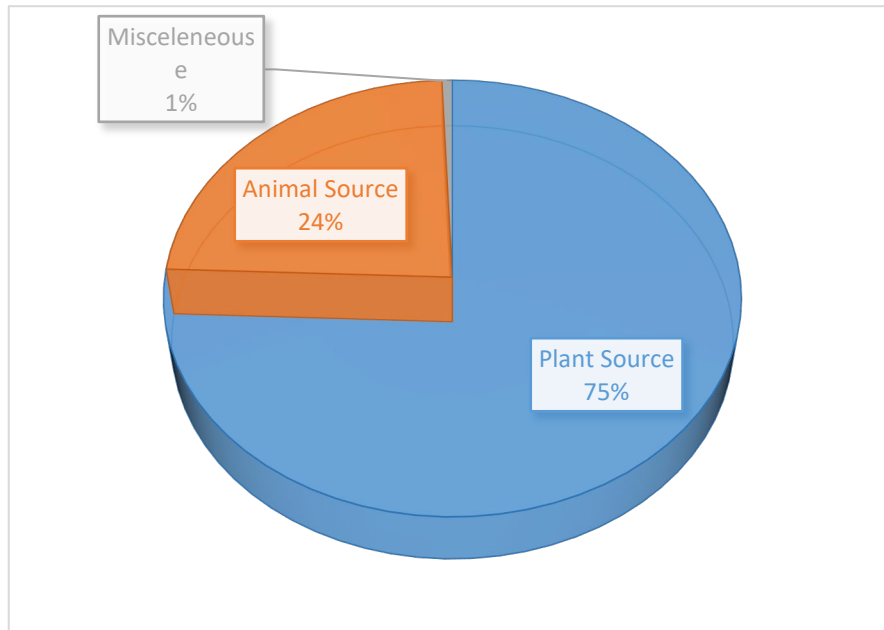
Table 7. Percent Distribution of the women's mean one-day per capita food consumption across the provinces

Food Group	All Sample Women		Stung Treng Province		Kampong Thom Province		Prey Veng Province
	Consumption Raw AP (g/day)	% of Total	Consumption Raw AP (g/day)	% of Total	Consumption Raw AP (g/day)	% of Total	Consumption Raw AP (g/day)
Energy-Giving Foods							
Cereals & products	369.38	42.91	366.05	43.42	365.23	42.71	376.86
Sugars & syrup	5.08	0.59	2.77	0.33	5.93	0.69	6.32
Starchy roots & tubers	3.99	0.46	4.55	0.54	3.75	0.44	3.67
Fats and Oils	4.76	0.55	3.14	0.37	4.67	0.55	6.46
Body-Building Foods							
Fish & OAAs	145.34	16.89	141.14	16.74	140.28	16.40	154.61
Meat & poultry	42.76	4.97	53.20	6.31	26.69	3.12	48.41
Eggs	9.53	1.11	4.86	0.58	9.42	1.10	14.33
Milk & products	4.37	0.51	2.00	0.24	6.08	0.71	5.04
Legumes, nuts & seed	4.15	0.48	3.64	0.43	4.98	0.58	3.83
Regulating Foods							
Vegetables	150.60	17.50	148.67	17.63	152.21	17.80	150.94
Fruits	54.54	6.34	51.48	6.11	70.31	8.22	41.83
Miscellaneous							
Beverages	54.68	6.35	50.78	6.02	53.43	6.25	59.83
Condiments & Spices	11.54	1.34	10.86	1.29	12.16	1.42	11.59
All Foods	861	100	843	100	855	100	884

Table 7. shows that among the studied provinces, the Prey Veng province, located in Cambodian Lower Mekong part, showed highest food intake at 884g, followed by Kampong Thom Province, Tonle Sap area, at around 855g, while Stung Treng province, located in Cambodian Upper Mekong part, was lowest consumed at around 843g. Intake of cereals and cereal products, predominantly rice, was high Prey Veng province at around 377g followed by Kampong Thom province at 365.2g per day. Stung Treng consumed at around 366g per day. Kampong Thom province consumed vegetables highest at around 152g per day followed by Prey Veng province at around 151g and Stung Treng was at around 148.6g. Fish, Other Aquatic Animals and its products were generally eaten more than either any of the body building foods such as meat or poultry or eggs in all sample provinces. Higher consumption of fish was observed in Prey Veng province at around 155g per day/capita, flowed by Stung Treng province was at around 141g and lower consumption was observed in Kampong Thom province at 140g. The other different food groups are fats and oils; egg, sugar and syrups; legumes, nuts, seeds; and starch roots and tubers were also consumed, by sample women, across the studied provinces.

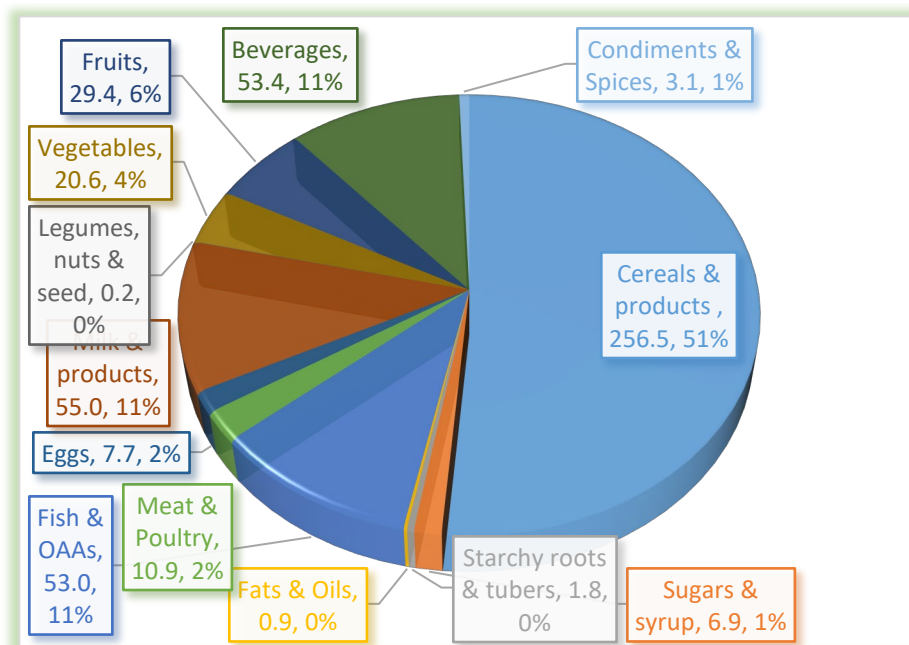
2.2.2. The Preschool-Age Children Food Consumption

Figure 3. Percent contribution of food sources of the preschool-age children's mean one day capita food consumption



Diet of sample pre-school children sharing from plant source accounting for 75%, animal source contributing 24%, and 1% coming from condiments and spices (Figure 3).

Figure 4. Percent Distribution of the preschool-age children's mean one-day per capita food consumption by particular food group.



The mean one-day total food intake of children aged 6 months to 5 years old weighed 499 g, as purchased form (figure 4) consisting largely of 256g (51%) of cereal and cereal products of which rice and rice products were the predominant forms, the second top intake of 55g (11%) of milk and milk products, the third largest consumption of 53g (11%) of fish and Other Aquatic Animals, and combination of vegetable and fruits was at around 50g (10%). Energy giving foods such as rice and body building foods such as milk, fish, meat poultry and egg are food items that are needed most importantly in preschool children's diet to support the fast rate of growth and development. Rice consumed contributed more than half of the total food intake. This age group's intake of fish and fish products was about 11% while meat and meat products at 2.4 %, poultry and eggs at 1.5 % of the total food intake. Milk and milk products were at 11% of the total food intake. Fruits and vegetables amounted to 29.3 and 20.5 g, respectively, which shared about 5.9-4% of total food intake. The intake of fats and oils, at 0.8g or %0.17% of the total food intake, although low, is important for the transport of fat soluble vitamins especially vitamin A found in animal tissues or beta-carotene, the precursor of vitamin A from the plant tissues.

Table 8. Percent Distribution of the preschool-age children's mean one-day per capita food consumption across the provinces

Food Group	All Sample Childen		Stung Treng Province		Kampong Thom Province		Prey Veng Province	
	Consumption Raw AP (g/day)	% of Total	Consumption Raw AP (g/day)	% of Total	Consumption Raw AP (g/day)	% of Total	Consumption Raw AP (g/day)	% of Total
Energy-Giving Foods								
Cereals & products	256.54	52.46	250.56	53.63	220.96	48.29	300.52	54.95
Sugars & syrup	6.89	1.41	5.23	1.12	7.47	1.63	8.02	1.47
Starchy roots & tubers	1.78	0.36	0.05	0.01	0.03	0.01	5.32	0.97
Fats and Oils	0.85	0.17	0.87	0.19	0.57	0.13	1.13	0.21
Body-Building Foods								
Fish & OAAs	52.99	10.84	51.05	10.93	50.42	11.02	57.99	10.60
Meat & poultry	10.93	2.24	11.81	2.53	7.99	1.75	13.10	2.40
Eggs	7.72	1.58	7.66	1.64	5.96	1.30	9.61	1.76
Milk & products	44.57	9.11	38.07	8.15	46.53	10.17	49.53	9.06
Legumes, nuts & seed	0.21	0.04	0.07	0.02	0.47	0.10	0.08	0.02
Regulating Foods								
Vegetables	20.57	4.21	17.18	3.68	21.37	4.67	23.33	4.27
Fruits	29.43	6.02	29.61	6.34	27.03	5.91	31.92	5.84
Miscellaneous								
Beverages	53.42	10.92	52.29	11.19	64.55	14.11	43.93	8.03
Condiments &	3.12	0.64	2.78	0.59	4.23	0.92	2.38	0.44

Spices								
All Foods	489	100	467	100	458	100	547	100

Table 8 shows that the mean one day food intake of children aged 6 months to 5 years old across the studied provinces, Prey Veng province showed highest food intake at 547g, followed by Stung Treng province at 467g, while lowest food intake was observed in Kampong Thom at 458g per day. Intake of cereals and cereal products, predominantly rice, was high in Prey Veng province at 300g followed by mountain Stung Treng province around 250.5g per day, while lowest food intake was observed in Kampong Thom at around 221g per day. Fish and beverages were the second largest consumption across the studied provinces which the combination of both items accounting for nearly one-fourth of total food intake by pre-school children. Milk and milk products was third top consumption across the studied provinces in which Prey Veng province was at 49.5g(9%), followed by Kampong Thom province was at 46.5g (10.17%) and Stung Treng is the lowest consumption of milk was 38g (8%). Food groups such as fruits, vegetables, eggs, sugar and syrup, starchy roots and tubers, legumes, nuts and seed, and beverages were consumed by this age groups.

Table 9. First 10 commonly consumed fish and percent distribution of the women's mean one day per capita fish consumption

No.	Khmer Name		Common Name	Scientific Name	Mean	%
1	Trye Riel	ត្រីវល្ល		<i>Cirrhinus sp.</i>	31.05	21.04
2	Trye Ros	ត្រីវល្ល	Striped snakehead	<i>Channa striata</i>	19.14	12.97
3	Trye Chhpin	ត្រីឆ្កែ	Mekong silver barb	<i>Hypsibarbus pierrei</i>	15.04	10.19
4	Trye Kanhchus	ត្រីកញ្ចុះ		<i>Mystus sp.</i>	12.64	8.56
5	Trey Chhlang	ត្រីឆ្កែ	Asian redbtail catfish	<i>Hemibagrus sp.(cf.nemarus)</i>	9.6	6.5
6	Trey Andeng	ត្រីអណ្តែងរឹង	Walking catfish	<i>Clarias batrachus</i>	9.17	6.21
7	Trey Deab	ត្រីដេប	Giant snakehead	<i>Channa micropeltes</i>	7.48	5.07
8	Trey Chab	ត្រីចាប	Pirapatingga	<i>Piaractus brachypomus</i>	5.41	3.66
9	Trey Kranh	ត្រីក្រាញ់	Climbing perch	<i>Anabas tastudineus</i>	4.38	2.96
10	Trey Pou	ត្រីពោ	Spotted-ear catfish	<i>Pangasius larnaudii</i>	4.34	2.94
11	Other species				27.05	19.9

The study founded that women consume 43 of fish and OAAs species with an average consumption of women consume 145.3g per capita per day. The 10 most consumed fish species in term of weight and percentage contribution of sample women consuming fish species per day is shown in Table 8. Trey Riel (*Cirrhinus sp.*) was the largest consumption at 31g (21%) of total fish intake per day. Trey Ros (*Channa striata*) and Trey Chhpin (*Hypsibarbus pierrei*) ranked 2nd and 3rd with 19.14g (13%) and 15g (10.1%) to the total fish intake per day, respectively. Other fish species, aquaculture fish, and Other Aquatic Animals were also listed (table 9).

Table 10. First 10 commonly consumed fish and percent distribution of the preschool-age children's mean one day per capita fish consumption

No.	Khmer Name		Common Name	Scientific Name	Mean (g)	%
1	Trey Riel	ត្រីវល្ល		<i>Cirrhinus sp.</i>	12.9	24.3
2	Trey Ros	ត្រីវល្ល	Striped snakehead	<i>Channa striata</i>	9.6	17.8
3	Trey Kanhchus	ត្រីកញ្ចុះ		<i>Mystus sp.</i>	5.1	9.6
4	Trey Chhpin	ត្រីឆ្កែ	Mekong silver barb	<i>Hypsibarbus pierrei</i>	4.2	8.0

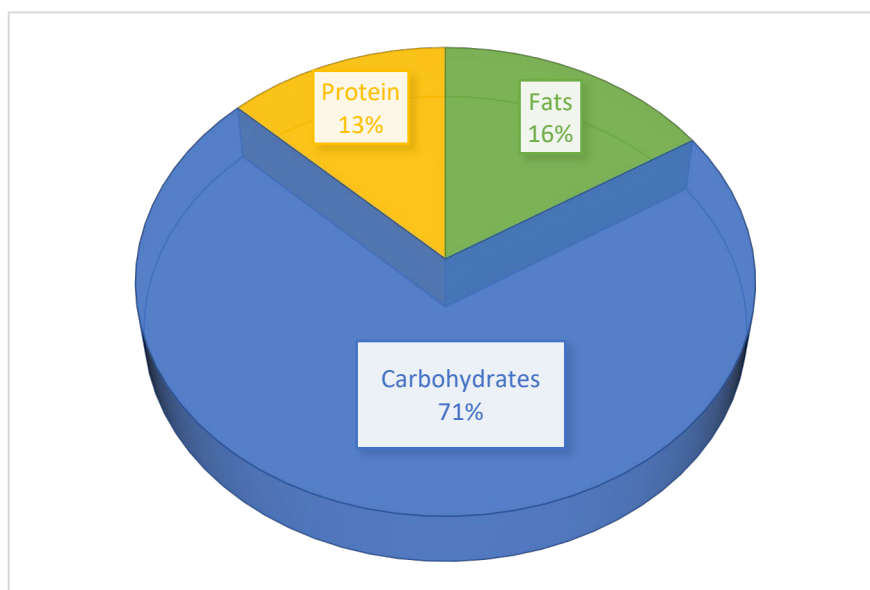
5	Trey Andeng	ត្រីអណ្តែងទឹក	Walking catfish	<i>Clarias batrachus</i>	2.8	5.2
6	Trey Chhlang	ត្រីឆ្កែ	Asian redbtail catfish	<i>Hemibagrus sp.(cf.nemarus)</i>	2.6	4.8
7	Trey Chab	ត្រីចាប	Pirapatingga	<i>Piaractus brachypomus</i>	1.4	2.7
8	Trey Chongva	ត្រីចង្វា		<i>Rasbora sp.</i>	1.4	2.6
9	Trey Deab	ត្រីដេប	Giant snakehead	<i>Channa micropeltes</i>	1.3	2.5
10	Trey Tuke	ត្រីតុក្កក		<i>Cephalophlis sp.</i>	1.0	2.0
11	Other species				10.8	20.5

Preschooler consumes 38 of fish and OAAs species with an average consumption is 53g per capita per day. The 10 most consumed fish species in term of weight and percentage contribution of children consuming fish species per day. Trey Riel (*Cirrhinus sp.*) was also the largest consumption at 12.89g (24.34%) of total fish intake per day. Trey Ros (*Channa striata*) and Trey Kanhchus (*Mystus sp.*) ranked 2nd and 3rd with 9.6g (17.8%) and 5.09g (9.6%) to the total fish intake per day, respectively. Other fish species, aquaculture fish, and Other Aquatic Animals were also listed (table 10).

2.3. Nutrient Intakes

2.3.1. The women's nutrient Intake by sample women

Figure 5. Proportion contribution of carbohydrate, fats and protein to the women's total dietary energy



All major food groups contribute to the caloric intake of individuals especially women and children therefore, adequacy in the caloric and protein intakes measured against the recommended daily allowance is a good indicator of food adequacy. An intake of 1 gram of carbohydrate-rich foods such as cereal and its products, starchy tubers and roots, sugar and syrups, fruits and vegetables will generate 4 Kcal. An intake of 1 gram of protein-rich foods such as fish, meat, milk, poultry, eggs, dried beans, nuts and seeds and their products will also generate 4 Kcal. An intake of 1 gram fats and oils including butter margarine will give 9 Kcal. The sources of calories in a diet namely, carbohydrates, proteins and fats is an indicator of the quality of the diet. Figure 5 shows that the sample women diet has a total energy of 1976 Kcal, the largest amount of energy comes from carbohydrates up to at 71 %, with desirable contribution from proteins at 13% and very low from fats and oils (16%) (Figure 5).

Table 11. Mean one-day and percent adequacy of energy and nutrient intake of the women

Energy and Nutrient	All Women	Stung Treng	Kampong Thom	Prey Veng
<i>Energy(Kcal)</i>	1976.0	2032.1	1813.3	2082.6
<i>Meeting 100% of Energy Intake (%)</i>	50.0	52.0	42.0	56.0
<i>Protein(g)</i>	65.7	67.4	61.9	67.8
<i>Meeting 80% of Protein Intake (%)</i>	71.0	75.0	66.0	72.0
<i>Iron(mg)</i>	13.0	11.7	13.9	13.2
<i>Meeting 80% of Iron Intake (%)</i>	10.7	13.0	5.0	14.0
<i>Zinc(mg)</i>	3.8	3.1	4.2	4.1
<i>Meeting 80% of Zinc Intake (%)</i>	36.3	28.0	46.0	35.0
<i>Calcium(g)</i>	545.2	478.4	537.7	619.3
<i>Meeting 80% of Calcium Intake (%)</i>	24	21.0	26.0	24.0
<i>Vitamin A(mcg RE)</i>	458.4	531.4	438.8	404.9
<i>Meeting 80% of Vitim A Intake (%)</i>	28	24.0	29.0	31.0
<i>Carbohydrate(g)</i>	355.7	346.7	349.0	371.4
<i>Fats(g)</i>	35.5	33.5	28.9	44.0

The total energy and nutrient intake among three provinces ranked from 1813.3 to 2082.6 Kcal. Prey Veng province had the highest energy intake while Kampong Thom province had the lowest (table 11). The sample women's daily protein intake ranged from 61.9 to 67.8 g, carbohydrate intake from 346.7 to 271.4g, while fats intake from 28.9 to 44g. Iron intake ranged from 11.7 to 13.9mg. Zinc intake at 3.1 to 4.1 mg, calcium intake at 478.4 to 619.4 g and vitamin A intake ranged from 404.9 to 531.4 mcg RE. In term of energy and nutrient adequacy, half of the sample women met at least 100 % of their recommended intake for *energy*. About 71% of the sample women met at least 80% of the recommended intake of protein. Less than one-fifth of the sample women met at least 80% of recommended intakes for *iron*. More than 1/3 of sample women met at least 80% of recommended intakes for zinc. Close to ¼ of sample women met the recommended intakes for calcium and more than ¼ of sample women met the recommended intakes for Vitamin A.

2.3.2. Nutrient Intake by preschoolers

Figure 6. Proportion contribution of carbohydrate, fats and protein to the preschool-age children's total dietary energy

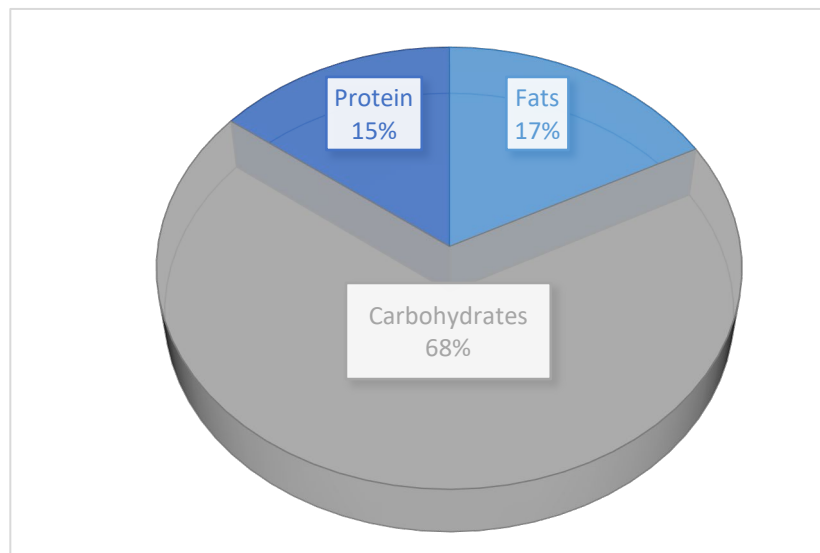


Table 12. Mean one-day and percent adequacy of energy and nutrient intake of the preschool-age children

Energy and Nutrient	All Children	Stung Treng	Kampong Thom	Prey Veng
<i>Energy(Kcal)</i>	844.94	775.94	830.54	922.90
<i>Meeting 100% of Energy Intake (%)</i>	29.58	22.22	28.57	37.38
<i>Protein(g)</i>	28.72	26.72	26.36	32.90
<i>Meeting 80% of Protein Intake (%)</i>	53.37	46.66	48.57	61.68
<i>Iron(mg)</i>	5.09	4.83	4.75	5.67
<i>Meeting 80% of Iron Intake (%)</i>	24.11	15.28	22.85	32.71
<i>Zinc(mg)</i>	1.68	1.26	1.60	2.14
<i>Meeting 80% of Zinc Intake (%)</i>	8.03	2.85	5.71	14.95
<i>Calcium(g)</i>	277.77	207.56	287.95	332.73
<i>Meeting 80% of Calcium Intake (%)</i>	23.79	15.23	18.09	27.10
<i>Vitamin A(mcg RE)</i>	241.03	233.41	268.03	221.59
<i>Meeting 80% of Vitim A Intake (%)</i>	18.64	13.33	22.85	18.69
<i>Carbohydrate(g)</i>	133.72	119.51	127.52	152.95
<i>Fats(g)</i>	15.10	13.08	13.13	18.90

The total energy intake of sample pre-school children among three provinces ranked from 775.9 to 922.9 Kcal. Prey Veng province had the highest energy intake, while the Kampong Thom province had the lowest (table 12). The sample preschool children's daily protein intake ranged from 26.7 to 32.9 g, carbohydrate intake from 119.5 to 152.9g, while fats intake from 13.08 to 18.9g. Iron intake ranged from 4.75 to 5.56mg. Zinc intake at 1.26 to 2.14 mg, calcium intake at 207.5 to 332.7g and vitamin A intake ranged from 221.5 to 268mcg RE. Among the preschool children, only about 30% met the recommended dietary intake for *energy*; more than half of them met at least 80% of *protein* requirements; close to ¼ of the preschool children met at least 80% of recommended intakes for *iron*. Less than 1/10 of the preschool children met at least 80% of recommended intakes for zinc; about 24% of the preschool children met the recommended intakes for calcium and more than 18% of the preschool children met the recommended intakes for Vitamin A.

Table 13. Percentage contribution of particular food groups to the women's total energy and nutrient intakes

Food Group (%)	Energy	Protein	Fats	Cars	Iron	Zinc	Calcium	Vit A
<i>Cereals & products</i>	60.93	30.91	14.84	77.14	43.08	17.35	22.08	7.83
<i>Starchy roots & tubers</i>	0.09	0.03	0.01	0.13	0.11	0.02	0.08	0.00
<i>Legumes, nuts & seed</i>	0.13	0.18	0.51	0.03	0.32	0.27	0.05	0.00
<i>Vegetables</i>	2.05	4.15	1.22	6.38	14.11	15.60	16.12	26.63
<i>Fruits</i>	1.45	0.82	0.43	1.76	3.06	2.54	1.45	29.96
<i>Meat & poultry</i>	3.57	11.04	17.01	0.04	7.17	33.37	3.85	0.26
<i>Fish & OAAs</i>	9.73	48.91	28.47	12.51	25.82	27.83	39.65	24.93
<i>Eggs</i>	0.64	1.43	7.20	0.03	1.65	1.14	4.29	3.31
<i>Milk & products</i>	0.14	0.11	4.77	0.13	0.08	0.16	3.71	0.15
<i>Fats & Oils</i>	1.15	0.00	13.78	0.00	0.00	0.06	0.10	0.10
<i>Sugars & syrup</i>	0.18	0.08	0.31	0.16	0.03	0.00	0.42	0.10
<i>Condiments and Spices</i>	0.33	1.09	0.55	0.12	4.29	1.03	6.88	2.87
<i>Beverages</i>	19.60	1.25	10.89	1.56	0.27	0.60	1.32	0.86

The contribution of particular food groups to total energy and nutrients intake as shows in table 13, cereal and cereal products are top energy contributors in the sample women diet contributing at 60.9 %. Because of the large bulk that this food group was eaten, it is also the major contributor of carbohydrates more than 77%. It is also the second contributor of protein at 31%, fats at 14.8%, iron at 43%, calcium 22% and Vitamin A 7.8%. Fish and fish products are the major contributors of protein at 48.9%, fats at 28.4 %, Iron at 25.8 %. Meat and meat products follows fish and fish products in their contribution to the total nutrient intake. Vegetables, on the other hand, are the second contributor of carbohydrate at 12.5%, and the major contributors of

Iron, Zinc, Calcium and Vitamin A. Fruits was the top contractor to total Vitamin A intake, while beverage was the second largest contributor to total energy intake by the sample women.

Table 14. Percentage contribution of particular food groups to the preschool-age children's total energy and nutrient intakes

Food Group (%)	Energy	Protein	Fats	Cars	Iro n	Zin c	Calciu m	Vit A
<i>Cereals</i>	57.47	34.57	21.50	73.46	44.4 6	4.44	12.10	2.07
<i>Starchy roots and tubers</i>	0.32	0.06	0.08	0.48	0.40	0.29	0.21	0.00
<i>Legumes, nuts and seed</i>	0.15	0.16	0.71	0.04	0.37	0.38	0.04	0.00
<i>Vegetables</i>	0.82	1.46	0.48	5.70	6.60	6.92	5.44	11.73
<i>Fruits</i>	3.79	1.34	1.25	4.82	7.25	5.91	2.05	38.06
<i>Meat & poultry</i>	2.60	7.63	9.32	0.10	19.4 5.32	7	0.41	0.71
<i>Fish & OAAs</i>	12.12	40.86	28.41	0.90	14.5 5	18.2 1	34.93	16.61
<i>Eggs</i>	2.08	3.84	9.55	0.15	5.58	3.62	2.29	12.12
<i>Milk and products</i>	7.77	7.42	11.99	7.38	11.5 3	39.7 1	36.32	16.67
<i>Fats and Oils</i>	1.14	0.00	7.89	0.00	0.00	0.00	0.00	0.00
<i>Sugars and syrup</i>	2.19	0.64	3.18	2.12	0.24	0.00	1.82	0.00
<i>Condiments and Spices</i>	0.28	0.84	0.40	0.13	3.11	1.01	2.94	1.20
<i>Beverages</i>	9.27	1.16	5.24	4.72	0.60	0.05	1.45	0.82

The contribution of different food groups to total energy and nutrients intake as shows in table 14, cereal and cereal products are the largest contributors in the sample pre-school children's diet to energy, carbohydrates, iron at about 57.4%, 73.4%, and 44.4%, respectively. It is also the second contributor to protein, fats at about 34.5% and 21.5%, respectively. Fish and fish products are top contributors to protein and fats with 40.8% and 28.4%, respectively. Milk and products was the largest contributor to zinc and calcium at around 39.7% and 36.3%, respectively. Fruits and vegetables, on the other hand, are the major contributor to vitamin A, while the other food groups such as starchy roots and tubers; legumes, nuts and seed; sugars and syrup; beverages; condiments and spices were less contributors to energy and nutrient intake by pre-school children.

2.4. Role of Fish in Nutrition Security in women and preschool children

Table 15. Percentage contribution of fish to the women's total animal energy and nutrient intakes

Animal Food Source (%)	Energy	Protein	Fat	Cars	Iron	Zinc	Calcium	Vit A
<i>Meat & poultry</i>	25.60	17.99	32.29	0.34	20.70	53.5 3	8.06	0.90
<i>Fish & OAAs</i>	69.78	79.68	54.04	99.39	74.54	44.6 4	82.97	87.48
<i>Eggs</i>	4.62	2.33	13.67	0.27	4.76	1.83	8.97	11.62

Fish plays the greater role in meeting adequacy for diet in terms of energy is the fact that when energy need by the body cannot be supplied by rice and other carbohydrate-rich foods, the body metabolizes the protein from fish to sustain the caloric need of the human body for the proper functioning of the various physiological and biochemical processes such as digestion and metabolism of foods to sustain life. Fish is also the source of fats. The fats and the protein contributed by fish significantly played in mitigating caloric deficiency in women and preschool children diet and perhaps the protein-energy malnutrition which is the form of malnutrition that exists in developing countries like Cambodia.

Fish contribute some fat but overall intake of fat was low, it is far lower than the desirable contribution of fats to total dietary energy recommended for 30-40% for infants and 20-30% for all others. The low fat intake is the reason for low calorie intake. Fish provides protein, which the body uses for optimal growth, but in the context of low calorie intake the body must turn to protein to satisfy energy needs. This is the form of protein-calories malnutrition (Marasmus) and the major reason for stunted growth and development in Cambodia. Another form of protein-calorie malnutrition (Kwashiorkor) is simple protein deficiency. This type is not common in Cambodia and rarity can be attributed to availability of protein from fish. It can be noted that the contribution of dietary energy from 13% (Figure 5) and 15% (Figure 6) to total dietary energy per capita is the desirable contribution of protein recommended 10-15%.

Aside from contributing to the total energy intake, fat of fish contains essential fatty acids namely, linoleic acid (omega 6), the precursor of arachidonic acid (ARA) and linoleic acid (omega 3), the precursor of DHA. These nutrients are not synthesized by the body. It must be obtained from food and it is known to be benefit to health. DHA is a key component of the phospholipids membranes of the eyes and brain. It is essential for brain and eye development infants and children; reduce the risks of heart disease and stroke- prevents blood clots, lowers blood pressure, protects against irregular heartbeats, reduces inflammation; strengthens the immune system; and essential for normal growth and development -for healthy skin, normal growth and reproduction. A diet that is deficient in DHA is associated with poor growth skin lesions, reproductive failure and fatty liver.

Beside its key role of contribution in meeting primarily protein and energy adequacy, fish plays a significant role in meeting adequacy in iron, zinc and vitamin A in women and preschool children. Iron has function as part of hemoglobin, which transports oxygen in blood to cells to produce energy and part of myoglobin in muscles, which makes oxygen available for muscle contraction. Iron is part of an enzyme in the immune system helps protect against infections and involved in making amino acids, collagen, hormones or normal brain functions-for synthesis of neurotransmitters & brain growth in human.

Table 15 shows that fish, OAAs and products was the major contributor of energy and nutrients to animal source, providing more than three-fourths (80%) to the total animal protein intake. Meat and poultry, and eggs contributed less than one-fourth to the total animal protein intake accounting about 18 % and 2 %, respectively. Fish, OAAs and products was also the major contributor to energy, fats, carbohydrate, iron, zinc, calcium, and vitamin A contributed at 69.7%, 54%, 99%, 74.5%, 44.6%, 83% and 87.4%, respectively.

Table 16. Percentage contribution of fish to the preschool-age children's total animal energy and nutrient intakes

Animal Food Source (%)	Energy	Protein	Fat	Cars	Iron	Zinc	Calci um	Vit A
<i>Meat & poultry</i>	15.49	14.59	19.72	11.46	20.89	47.14	1.08	2.42
<i>Fish & OAAs</i>	72.14	78.08	60.08	93.75	57.19	44.10	92.83	56.41
<i>Eggs</i>	12.37	7.33	20.20	4.49	21.92	8.77	6.09	41.17

Again fish, OAAs and products was the largest contributor to the total daily energy and nutrient intake from animal food source which sharing around 80% to the total animal protein intake (Table 16). Meat, and poultry; and eggs contributed to the total animal protein intake which accounting for about 14.5 and 7.3%, respectively. Fish, OAAs and products was also the major contributor to energy, fats, carbohydrate, iron, zinc, calcium, and vitamin A contributed at 72.1%, 60%, 93%, 57.2%, 44.1%, 92.8% and 56.4%, respectively.

III. Summary of the Survey Finding

Three hundred of the eligible women and 343 eligible preschool children were randomly selected for study and analysis. By conducted survey, nearly 1/3 of the sample women belonged to the adult age category (25-29 years old). Three-third (86.7%) of sample women, married age, belonged to age category (20-24 years old). The average of number living children was 2.1 children with the highest proportion of having children between 2-4 children, accounting for 23%. The survey found that sample women was able to read only about 69%. Employment opportunity of the sample women are the agricultural farmer, fishing, and animal husbandry ranked 1st, 2nd and 3rd, accounting for 62.2%, 41.5% and 40%, respectively. Nearly 79% of the sample women consumed drinking water from rainwater and almost half of them had no access

to toilet facility and making fields or brush areas. Overall, the proportion of sample preschool children ever breastfed was almost all (98%). More than three-fourths of them under 6 months of age were exclusively breastfed.

The sample women and preschool children diet are basically rice-vegetable-fish combination. Diet of sample women and preschool children were similar proportion, which 76% comes from plant source, 23% comes from animal source, and 1% comes from food group such as condiments and spices. The overall mean one day per capita food consumption of women and preschool children are 861 g/p/day and 489 g/p/day, in raw as purchased form, respectively. The cereal and cereal products (predominantly rice) was the highly consumed in both women and preschool children at 369.3g/p/day and 256.5 g/p/day, accounting for 42.9% and 52.4%, respectively. Vegetables are the second largest consumption by women and preschool children at 150.6g/p/day and 20.5g/p/day, accounting for 17.5% and 4.2% to total diet intake, respectively.

Forty three (43) and 38 of fish species including OAAs (frog, rice field shrimp, etc.) and its products consumed by sample women and preschool children, respectively, in which Trey Riel (*Cirrhinus sp.*), Trey Ros (*Channa striata*) and Trey Chhpin (*Hypsibarbus pierrei*)/Trey Kanhchus (*Mystus sp.*) were the 1st, 2nd and 3rd commonly consumed. . Fish and OAAs was the largest top 3 consumption by women and preschool children, which estimated at 145.3 g/p/day and 52.9g/p/day, sharing nearly at 17% and 11% to total diet intake, respectively. The other major food groups such as meat and poultry; fruits; eggs; milks and products; beverage; sugar and syrup; legumes and nuts; starchy roots; and condiments and spices were also consumed by the studied subjects.

The sample women diet has a total energy of 1976 Kcal, the largest amount of energy comes from carbohydrates up to 71 %, with desirable contribution from proteins at 13% and low from fats and oils 16%, while the sample preschool children diet has a total energy of 844.9Kcal, of which carbohydrate generates the largest amount accounting for 68%, protein for 15% and very low from fats and oils for 17%.

Food groups such as cereals and products; vegetable; and fish, OAAs and products are the largest contributor to energy and key nutrient intake of the sample women and preschool children. Overall, for the sample women, cereals and products was a key contributor to energy at 60.9%, protein at 30.9%, carbohydrate at 77.1% and iron at 43.08%. Vegetables was a major contributor to vitamin A. Fish, OAAs and products was a key contributor to protein at 48.9%, fats at 28.4%, iron at 25%, zinc at 27.8%, calcium at 39.6% and vitamin A at 24.9%. Fish, OAAs and products providing about $\frac{3}{4}$ (80%) to the total animal protein intake. The rest of the other major food groups namely meat and poultry; eggs; fruits, starchy roots and tubers; legumes and nuts; milk and products; fats and oils; sugar and syrup; and beverages were also contributor to the energy and nutrient intake of the sample women. At the same time, for preschool children, cereals and products; fish, OAAs and product; and vegetable were also a key contributor to energy and key nutrient intake of the sample preschool children, and the rest of the other food groups such as meat and poultry; eggs; fruits, starchy roots and tubers; legumes and nuts; milk and products; fats and oils; sugar and syrup; and beverages were minor contributor to the energy and nutrient intake of the age group.

Overall, half (1/2) of the sample women met the recommended intake for energy. More than 2/3 of the sample women met at least 80% of the recommended intake for protein; 1/10 of the sample women met at least 80% of the recommended intake of iron intake; nearly ¼ of the sample women met at least 80% of the recommended intake of calcium; and more than ¼ of the sample women met at least 80% of the recommended intake of vitamin A.

On the other hand, nearly 1/3 of the sample preschool children met the recommended intake for energy. More than 1/2 of the sample preschool children met at least 80% of the recommended intake for protein; less than 1/10 of the sample preschool children met at least 80% of the recommended intake of iron intake; nearly ¼ of the sample preschool children met at least 80% of the recommended intake of calcium; and less than ¼ of the sample preschool children met at least 80% of the recommended intake of vitamin A.

IV. Conclusion and Recommendation

Cambodia's natural resources provide a foundation for food security; income and employment for their livelihood. Most of the rural people rely on rice cultivation, harvesting of fish and OAAs, and forest products.

Rice and fish are the traditional staple foods playing the important role in the diets of women and children. Rice is the main source of energy and fish is the main source of animal protein. Fish is the major contributor of key micronutrients such as iron, zinc, calcium and vitamin A in women and children.

Nutritional status of the rural poor women and children was low. The low intake of micronutrients in comparison to the recommended daily intake put them in the risk of micronutrient deficiencies.

Cambodia should take up an independent programme to mitigate micronutrient deficiencies in women and children. Fish should be used to combat micronutrient deficiencies in rural poor women and children in Cambodia.

Research should be conducted to develop technologies for the sustainable production of fish and OAAs in the open waters, lake and rice fields as well as to improve handling, preservation and processing methods.

Research should be done to identify fish species and processed fish products rich in micronutrients. Since, rice-field fisheries are the major source of micronutrients for the rural poor women and children in Cambodia, micronutrient dense fish species should be incorporation in the cultural practices.

Fish is nutritionally important animal food source contributing in the daily diets of the women and children in poor rural households. Promotion of the availability and accessibility of nutrient dense commonly consumed species are important for ensuring food and nutrition security in Cambodia.

Data on fish consumption at the species level and analyses of nutrients in commonly consumed fish species are needed to quantify the present and potential contribution of fish to key micronutrient requirements.

Awareness of the importance of nutrient-dense fish species to combat vitamin A and mineral deficiencies should be raised at the household level as well as all levels in the agriculture, health, and nutrition sectors.

Programme on nutritional education among women and mother, and hygiene and sanitation facility should be educated and promoted.

The inclusion of suitable nutrient-dense fish species in aquaculture in Cambodia should be promoted. Access to these fish, through management of fisheries resources, including open water fisheries should be protected and enhanced. These steps can lead to nutrient-dense fish being used in food-based strategies to combat vitamin A and mineral deficiencies.

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