Identifying Socio - Economic Inequality by Food Consumption Patterns in Jaffna Peninsula - A Multivariate Statistical Approach

C. Elankumaran

Abstract

Socio- Economic indicators of developing countries vary depending on their Economic structure. However, food consumption pattern has been a common indicator of socio - economic status in almost all the societies. Food consumption patterns are undergoing substantial change in many countries as economic development proceeds. Food insecurity, food deprivation and famine are also some common phenomena in some under developed countries. But, in the Jaffna peninsula of Sri Lanka the food consumption patterns have been terribly affected due to the ethnic conflicts and civil war during the last two decades. This is more severe during the last decade, end of the last century. A cross sectional study named "Jaffna Scio- Economic Health Study" conducted in early 1999 reveals that there is much variation in the food consumption patterns among the society. Altogether 1172 families, throughout the peninsula drawn by a two stage sampling technique, were subjected to study.

The data collected by a pre-designed questionnaire include information of a demographic nature, characteristics of parents, monetary status, and food consumption patterns of families. Exploratory data analysis and Multivariate techniques such as Principal components analysis, Factor analysis and Canonical correlation analysis were employed to extract the common factors causing the variation in food consumption patterns. A notable demographic variation was observed among the families. Broad variation in income and expenditure distribution was also detected. An important factor namely " Effective income as controlled by non - health expenditures and food subsidy" was identified to cause the changes. The variations in individual food items in different zones were observed according to the domestic features of the zones.

A cluster analysis on the food consumption patterns of the families was performed on the basis of seventeen important food items mostly consumed by the Jaffna society. Cluster analysis was also performed on the basis of three important nutrients 'energy', 'protein', and 'fat' data transformed from the food consumption data. The analysis revealed that three are three major groups of similar food consumption patterns in the society. Canonical discriminant analysis was used to strengthen the results. The demographic structure or family composition showed the most positive effect followed by moderate effects by characteristic of parents and monetary status of the families on discriminating food consumption patterns. The three distinct clusters of families with varying food consumption patterns and the variation in the monetary status of the families in the corresponding clusters give a different dimension in socio - economic inequality in the war affected Jaffna peninsula of Sri Lanka.

1. INTRODUCTION

The problems accounted with food are usually approached by economists through two dimension, 'food supply' and 'food demand'. Food production and food consumption are the practical events directly connected to these two economic terms, respectively. We concentrate on food demand, i.e. Food consumption, in this paper. Although monetary expenditure on food consumption is not a good indicator, it is well known that the family budget includes highest priority on food expenditure. Actual physical quantity of food intake will be an appropriate indicator for the analysis of food consumption of a family (JSA, 1993).

Different food items contain varying quantities of different nutrients or nourishing matter, needed by the body for its growth, and well being. The nutrients needed differ, according to the physiological functioning and process ; more being needed at times of rapid growth, as infancy, early childhood, adolescent period and stress situations such as pregnancy, lactation, sickness, recovery and work. The Jaffna society, which traditionally is a vegetarian society, today gives more emphasis to non-vegetarian diet, without considering quantity of the items included in the food. The infants and preschool children of the Jaffna society suffer lack of nutrition due to lack of knowledge amongst mothers and grand mothers and the wrong dietary habits adopted (Nachahinarkiniyan, 1993).

Rae (1998) examined the effect of expenditure and urbanization growth on the demand for animal based products through time in a number of Asian countries, and found that urbanization often had a significant positive effect on consumption of such products. Huang and Bouis (1996) , using 1991 Chinese cross sectional data shown that, moving a consumer from a rural area to an urban area, would produce an increase in consumption of meat and fish. Chernichovsky and meesook (1982), based on the National Socio- Economic survey of Indonesia 1978 (Susenas) , found that increasing household size was associated with decreased consumption of animal products and fruits, and that increased educational status of the spouse was associated with increased consumption of the more expensive foods. Telku and Johnson (1988) found that household size lead to a reallocation of expenditure on foods.

We move closely with the current study. Ariyawardana, et.al (1999) studied the varying food consumption patterns of Sri Lanka . The study reveals that the Sri Lankan food consumption pattern has certain similarities with the developed as well as other fast developing countries. This study also highlights that the cereal consumption is at higher level, rice consumption exhibits a declining trend, and wheat consumption shows an increase which is registering a consistency with other countries. The data used in this Sri Lankan latest study is the data published by the Department of Census and Statistics of the Government of Sri Lanka covering the period 1986 to 1996. Unfortunately, this database does not include the data for Jaffna district as the function of Government departments on this type of field activities is not in operation due to the war and conflict in the region. Hence, the present study with primary data collected in 1999 will be meaningful for national as well as international comparison and conclusions.

The Jaffna peninsula of Sri Lanka faced a series of armed conflicts, military battles and economic blockades during the last two decades. People of Jaffna peninsula have been dynamic since 1983.The degree of displacement of population has increased specifically in 1987, 1990 and 1995. People have been Socially, Economically, Physically, and even Mentally affected due to these continuous military battles and displacements. These conflicts and displacements have caused significant effects on food supply and food distribution to the people at village level within the peninsula. The vulnerable groups of people such as pregnant and lactating mothers, preschool children and infants had to face a dangerous situation and some of them have died due to lack of food supplies. The consequence of war includes, reduced and erratic supply of food and nutritional supplements (Sivarajah, 1993). The food situation in Jaffna peninsula has been unstable throughout the last decade. The war and related economic embargo affected the farmers and their crop production and hence the food supply from the local market was irregular and unstable. Hence, the traditional food habit practised by the people prior to 1990 has been substantially changed.

The custom and tradition of food intake style of Jaffna people could be characterized as follows. Lunch is taken as the main meal and most of the people have rice and curry. Some men have rice

and curry for both lunch and dinner. many people prefer flour-based meals for dinner, locally called 'palakaram' . This palakaram includes pittu, hoppers, string hoppers, thosai, idli, roddy, etc. The breakfast may also be of palakaram for some people, but many consume bread and supplements. These supplements include jam and butter or sampal or curry. Hence, the meals of Jaffna people can be categorized into three groups which are (1) 'rice and curry', (2) 'palakaram and curry', (3) 'bread and supplements' . The war in the Jaffna peninsula affected the occupation and income, hence the people had to change their life style and food intake patterns. This was also depended on the issue 'Nivaranam' which is the assistance given by the Government to the displaced, affected and economically poor families (Elankumaran, 2001). The 'Nivaranam' is defined as an indirect payment or 'food subsidy' by the Government to its village food supplier, called Multi-Purpose Co-operative Society (MPCS).

Three issues motivate the current study. The first is to find any common factors, which cause the food consumption pattern of the society. The second motivation is aimed at classifying the families of Jaffna peninsula into a suitable number of clusters that reflect different food consumption patterns. Third is to determine which, if any, of a set of socioeconomic variables can be used to classify the families at various stages of dietary transformation. Hence to show the socio-economic inequality among the families with new variables which include 'family food subsidy' an incidental war related variable.

2.Survey Methodology

2.1 Jaffna socio- Economic Health study 1999

A cross- sectional study named 'Jaffna socio - Economic Health study 1999' (JSEHS 1999) was conducted by the author during March to June 1999. The study area includes six adminisrative divisions, called Divisional Secretariat's Divisions (DS Divisions) of the Jaffna peninsula. These six DS divisions constitute the valikamam sector of the Jaffna peninsula, experienced the major displacement , called 'Exodus 1995'. A two stage stratified random sample of 1172 families was drawn from 34 Grama Servaka (GS) divisions, which represent 34 villages of the Area. A GS division is the smallest administrative division in Sri Lanka. Every administrative district

is divided up into number of DS divisions and they in turn are further divided into GS divisions.

`The preliminary investigation carried out in December 1998 and January, 1999 prior to commence this survey revealed that a total of 256,791 persons belonging to 73,302 families were registered and living in the study area which constitutes six DS divisions. The survey information on these six DS divisions, i.e. six zones, are given in Table 1. Teams of data collectors, headed by the author, conducted the data collection process. Direct and Indirect investigation methods were adopted to gather information and statistics from the families sampled.

A fifteen page questionnaire, consisting different headings on Social, Economic, and Health concepts, was used in this survey. The data collectors recorded the information from the families while the author conducted the direct oral investigation with the respondents. The response rate of the survey was 95.82%. The collected data set is named as 'JAFFNA DATA' . Four sections of the questionnaire, namely, **'Family composition', 'Food intake pattern', 'Family expenditure'**, and **'Occupation and Income'** are considered in the present study.

2.2 Variables and Data

Several studies have examined aspects of food consumption patterns with suitable data relevant to the region and its people. the primary focus of some Indonesian studies using 'Susenas National Household survey data' has been 'the influence of changing prices, incomes , and expenditures on food consumption'

Table 1: Details of population, sample and period of Jaffna Socio - Economic Health study 1999

Zone Code	Population (No of Families)	Second Stage Sample (No of Families)	Period of Survey (Dates 1999)	Not - Responded (No of Families)
JAFF	12,303	173	16/05 to 09/06	6
NALL	16,102	238	13/05 to 14/06	14
VASW	10,691	164	16/03 to 01/06	7
VAWE	9,131	172	18/03 to 12/05	4
VASO	9,859	193	24/03 to 09/05	8
VAEA	15,216	232	24/03 to 13/05	10
Total	73,302	1,172		49

and 'the nutritional status of house holds' Only one or two studies reported the impacts of variables that accounted for demographic and household characteristics. The explanatory variables used by Timmer and Alderman (1979) were expenditure and prices. Household characteristics such as size, age and sex distribution or educational status were not included.

In the present study **JSEHS,** four sections of the questionnaire, namely, **Family Composition' , Food Intake pattern', 'Family Expenditure',** and **Occupation and Income** are mainly considered. The variables and data selected for this study are as follows. From the 'Family composition' section of the questionnaire , Family size , Age and Educational levels of husband and wife were directly obtained. The educational level defined for this study is the total number of years spent on **Schooling** and **Higher education,** which were two different variables in the questionnaire **'Number of pre school children and Infants' , Number of School/college /University students', Number of Unemployed Adults and Youths',** and **Number of Elders and Disabled persons'** were counted by using the occupational codes and the **proportions** of these numbers related to family size are defined as variables.

From 'family expenditure' section, the details of monthly budget on various expenditure categories were obtained. The expenditure on **Food, Health,** and **Education** were directly used. But expenditure on eight other categories in the original questionnaire were combined into two new expenditure categories which are named as Expenditure on Household management and other Expenditures. Various types of savings were also combined and expressed as Total saving. From 'Occupation and Income' section, the occupational status of husband and wife, their monthly income, income of others in the family were obtained. The occupational codes of them were transformed in to the scores of Occupational levels on a 50-point scale*. Monthly income of husband and wife are added together and the Monthly income of others are added separately to use two different income variables. The variable Household revenue due to Agricultural and Livestock production was defined by accumulating eight such revenue categories. Household revenue from other sources was obtained by three different sources of revenue on the

*C.Elankumaran, Ph.D thesis, Volume II, University of Jaffna (Unpublished).

original questionnaire. The seasonal revenues or incomes given by the respondents for the year were converted into monthly basis.

From 'Food Intake Pattern' section, Type and number of meals per day, and weekly consumption (Quantities) of seventeen different food items to the family were directly obtained. In addition to the variables on the above seventeen food items, three nutrient content variables, namely, Energy, Protein, and Fat are also defined. The food consumption data, collected by the quantities of seventeen food items were converted into energy, protein and fat. This is done on the basis of the conversions due to Nachchinarkiniyan (1993) and Wikramanayake (1987). These follow from tables of Food and Agriculture Organization (FAO) and National Institute of Nutrition, India.

The effects of war and conflict in Jaffna peninsula and a consequent event major exodus happened in 1995 in the study area, resulted loss of traditional occupations of many people. As a result of this situation the Government of Sri Lanka issued food subsidy to the families. This subsidy allowed the families to obtain essential food items required for the survival of the family (Elankumaran, 2001). The amount of this food subsidy, called 'Nivaranam', is being considered as an additional revenue data, which is relevant, as far as the food consumption pattern is concerned. Hence a list of variables, with notations under two sub sections **Socio - Economic Data** and **Food Consumption Data,** has been prepared and given in Appendix A.

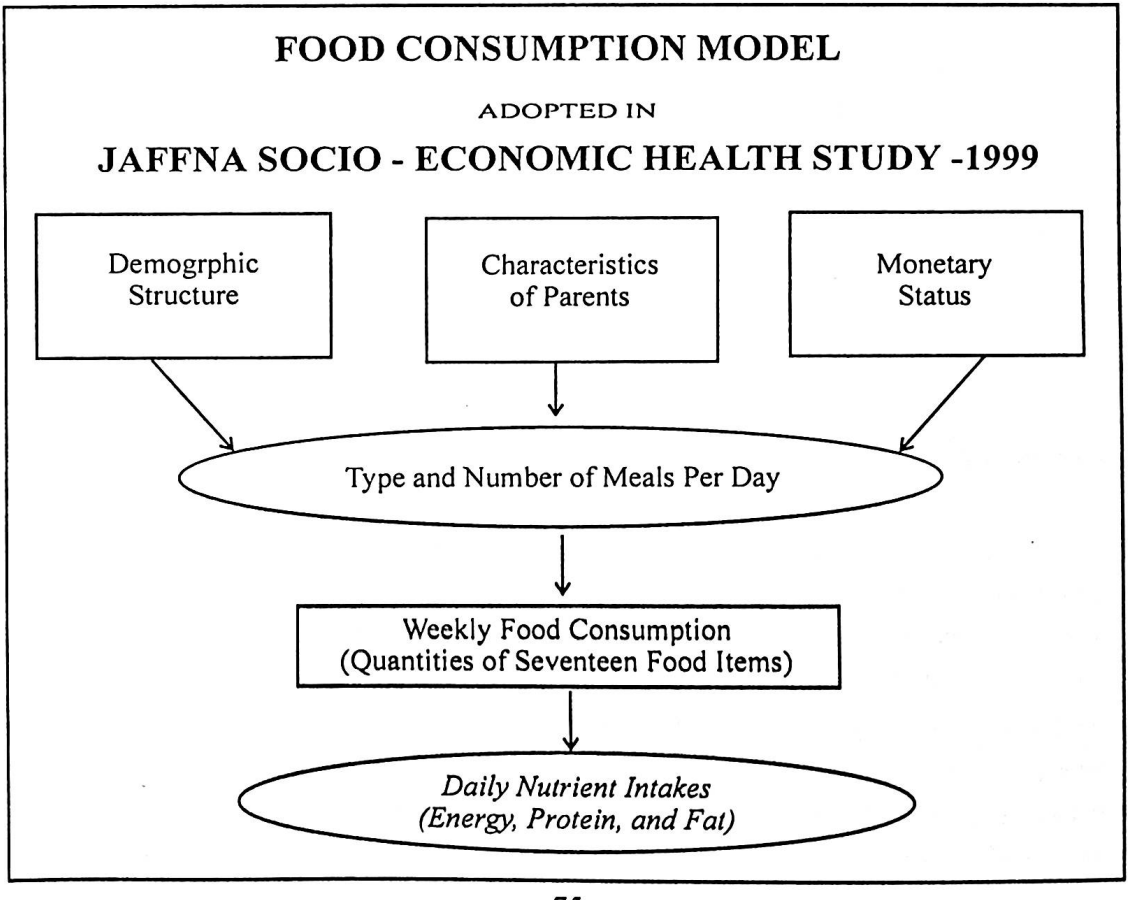
3. Food Consumption Model and Statistical Methods

In the study of 'Clustering Dietary variables and Other lifestyle factors', Karin et. Al. (1992) employed Cluster analysis to classify subjects into groups based on similarities in dietary variables. K-means Cluster analysis was used to classify individuals into a limited number of groups on the basis of similarity in nutrient intake. In the study of 'Food Consumption pattern', Rae (1999) employed Cluster analysis to identify the typical clusters of households and then applied Discriminant analysis to see the consumption pattern.

The method of analysis for the present study originates with the definition of the following Food

consumption model. It is defined on the basis of the selected sets of variables of Socio-economic data and Food consumption data. The model is given by Figure 1 and its explanation also follows. The 'type and number of meals' is considered as the general food consumption pattern which is supposed to be determined by the sicio - economic dimensions 'Family composition', 'Characteristics of Parents', and 'Family Expenditure and Household Income/Revenue'. These three dimensions are shown as independent dimensions in this model. The 'Food consumption pattern' is defined on the basis of the intermediate factor 'Type and number of meals per day' shown in the model. The 'real food consumption' could be measured by the **'seventeen food items'** or **'three nutrient contents'**, which are the depending dimensions according to this model.

Figure 1 : A model for food consumption patterns



In our study, a statistical methodology is required that allows a relationship to be established between a set of dependent variables (Food consumption pattern) and a set of independent variables (Socio- Economic status). We began with an Exploratory Data Analysis (EDA) to bring out the basic features and characteristics of the six - multivariate data sets shown in the model under investigation. The second stage of the analysis utilised Principal Component Analysis (PCA) and Factor Analysis (FA) to see whether the dimensionality of the data can be reduced and to examine the existence of any common factors. PCA was neither carried out on the family composition variables as aggregation of these variables is meaningless; nor on the seventeen food items as it is not suitable to nature of the variables. However, PCA was applied to Characteristics of parents, Family Expenditure and Revenue, and Nutrient intake.

FA was applied to the Family expenditure and Revenue data, and the entire set of seventeen food consumption variables, as it is feasible to explore the existence of underlying common factors here. A search for unusual data was done on the basis of EDA, PCA, and FA. Some 'Outliers' were detected during these first and second stages of the analysis, and were removed prior to further analyses of the various data sets. The interrelationships between sets of variables were studied during the third stage of the analysis. Only suitable pairs of sets of variables were considered for exploration. This analysis allowed to interpret the individual relationships. At the second step, structural relationship between sets was performed. The statistical technique Canonical Correlation Analysis (CCA) provides a procedure for computing correlations (called 'canonical correlations') between two sets of dimensions. CCA also gives (Canonical) coefficients for both sets of variables for possible interpretation of the interrelationships. Each of the food consumption sets of variables was interrelated with each of the three economic dimensions by means of CCA. The CCA was not carried out among the three sicio-economic dimensions as this was not a major aim in this paper.

The next stage of the analysis attempted to group the families into a suitable number of Clusters on the basis of food consumption data (separately on the seventeen food items and the three nutrient intakes). The Ward's Minimum Variance method based on the 'euclidean distances' between the observation

vectors was utilised here. Once the clusters of families were obtained, an attempt was made to see which food consumption patterns influenced the creation of family clusters. Multivariate Analysis of Variance (MANOVA) was utilised to examine the significance of the differences between the family clusters obtained and to choose an optimum number of clusters for further investigation. Cross classifications was also considered to see whether the new family clusters had any similarity with the existing administrative set up in the Jaffna peninsula.

The differences between the clusters of families (once detected by MANOVA) were highlighted using 'canonical discriminant functions' of the dimensions considered for clustering procedure. This was carried out using Canonical Discriminant Analysis (CDA), applied on the clustered data. The canonical functions were used to verify the discriminatory power of sicio - economic variables on the food consumption patterns (as the clusters were obtained based on the food consumption variables). Descriptive statistics of the new family clusters were also computed for further interpretation.

4 Results and Discussions

4.1 Features and relationships of Different Dimensions of the model

We first describe the three socio - economic dimensions 'Family composition', 'Characteristics of parents' and 'Family expenditure and revenue' which are defined, described, and shown in the model.

A. Description of Family Composition

We have considered five variables Fsize, PrPSI, PrStu, PrUnE, and PrEID to describe the family composition. Because, Pre-School children, Infants, Students, Unemployed persons, Elders and Disabled persons give more burden to the chief occupants and spouse in determining the weekly food basket of their respective families. The descriptive statistics of these five variables for the six zones and the entire region were examined.

If we consider the entire study area, the family size varies from 3 to 13 and the average size is 6. Pre-school children and infants occupy nearly 10 percent in a family. Similarly students, whether they are school going or colleges and universities going, they occupy nearly 34 percent in a family, Unemployed adults

and youths occupy nearly 5 percent in a family. Similarly elders, disabled and handicapped persons together occupy nearly 5 percent in a family. These estimates are validated by their small standard errors, which is understandable due to the large sample. The proportions described are significant and they should naturally influence the food consumption patterns.

B. Description of Characteristics of the Parents.

We used eight variables AgeH, AgeW, EdLeH, EdLeW, OcLeH, OcLeW, SIHsH, and SIHsW to describe the characteristics of parents. The last two bariables, sleeping hours, were not measured from 34 husbands and 3 wives, as they were not residing at the houses during the study. The descriptive statistics of the characteristics of parents for the six zones and the entire region were examined. In the entire area average ages of husbands and wives seem to be 47 and 42 years respectively. These ages vary from 22 to 80 years and 19 to 79 years respectively. Average educational levels for them are around 9 years. Average occupational levels, on a 50 - point scale defined in JSEHS, are 18 for husbands and 9 for wives. Average sleeping hours seems to be 7 hours for all the parents and vary from 3 hours to 11 hours. The standard error of occupational level of husbands seems to be very high; this is because of the varying occupations of the husbands. This could be due to the frequent shifting of occupations due to the exodus happened in 1995 and continuous war atmosphere.

We further analysed the characteristics of parents by PCA. The results revealed that the first four components all together explain 83.5 percent of the total variation and hence we examined them. The first two components (PC1 and PC2) which absorb 54 percent of the total variation, leads the following conclusions. The PC1 is highly influenced by educational levels and occupational levels of both husbands and wives, while both sleeping hours affect the component in the opposite direction. Though this component explains only 31% of the total variation, it can be seen from Figure 2 that there appears to be a demarcation between families with notable educational level of husbands and wives and the occupational levels of husbands from others. The PC1 is a contrast between sleeping hours with the rest of the variables, among which educational level and occupational level have large negative loading.

The PC2, which alone explains 23% of the total variation, is influenced by ages of both husbands and wives and hence the age effects could be seen in the component and figure. The sleeping hours of husbands and wives seem to influence the third component, which explains 19% of the variation. The fourth component with 10% variation is highly affected by the occupational levels of wives. As a whole, from the figure, we could see two different sub groups of families, one influenced by occupational levels and other influenced by ages, from the main group of families.

C.Description of Family Expenditure and Revenue

In this case we have considered 1121 families for income and revenue data and 1120 for expenditure data, since the respondent of one family refused to disclose the details of expenditure only. We have considered eleven variables ExFoo, ExHih, ExEdu, ExHoM, ExOth, TotSa, InH&W, InOth, ReA&L, ReOth, and FoSub to describe the monetary status of a family. The descriptive statistics of the variables for the entire region and for the zones are given in Table 1 of Appendix B. Here the first five variables explain the direct expenditure categories, sixth variable explains the total savings (an indirect expenditure), the next four variables explain direct income and revenue and the last explains the food subsidy amount indirectly paid (indirect income) by the Government.

Average food expenditure per family is Rs. 4184 and it is a good estimate supported by its standard error Rs. 43. This expenditure varies from Rs.500 to Rs. 12000. The minimum food expenditure Rs.500 is reported from NALL zone. The family related to this minimum manages its food security with the food subsidy given by the Government. The maximum food expenditures Rs.12000 is observed from a rich family living in JAFF zone. Expenditure on Health and Education come to the second importance to the families. The average expenditures on both of these per family seem to be Rs.228 and Rs.489 respectively. Here also the standard errors are very low. These expenditures also vary from Rs.0 to Rs.3000 and Rs.4000 respectively. Both maximum expenditures are observed from the urban JAFF zone.

The average expenditures on Household management and Pooled other expenditure categories seem to be Rs.593 and Rs.1249 respectively. The

standard errors also very small here. These expenditures vary from Rs.0 to Rs.4950 and Rs.9100 respectively. The maximum expenditures on household management is observed from NALL zone and on other categories observed from JAFF zone. The average total - savings seems to be Rs. 1954, but its standard error is little higher than the previous four expenditure types. This varies from Rs.0 to Rs 70300. This reveals that the savings of the families must follow a distribution with broad variation. The unusual maximum of total - savings is observed from a family form JAFF zone whose chief occupant is a higher level proprietor.

The average income of husbands and wives together and all others in the families together seem to be Rs.5702 and Rs. 1126. The standard error of first income is higher, but of second income is small. The occupational inequality and hence the heterogeneity on salaries or wages reflect through this measure. Both incomes vary from Rs.0 to Rs. 70000 and Rs. 26000 respectively. The maximum Rs. 70000 is observed from the some family mentioned above from the JAFF zone. The maximum Rs. 26000 is observed from a family from NALL xone.

The average revenue on Agricultural and Livestock production together and all other categories together seem to be Rs. 774 and Rs. 1236 respectively. The standard errors of these mean revenue estimates are small and support the estimation. These revenues vary from Rs. 0 to Rs. 25000 and Rs.45000 respectively. The maximum revenue of the first case is observed from VASO zone, which is an agricultural zone. The maximum revenue of the second case is observed from JAFF zone, which has more businessmen and large property owners. The last variable is the food subsidy amount provided by the Government. The average amount seems to be Rs.866, and its standard error is also small. This amount varies from Rs.0 to Rs. 2940.

Since the characteristics of monetary variables examined above show contrasting features 'Factor analysis' on these eleven variables was also performed. The factor analysis has become the most appropriate one here as one may argue that there may be some common causes for these contrasting features. The results due to varimax rotation are given in Table 2. Five factors have been extracted and all these together explain 70 per cent of the total variation. The factor loading vectors are also presented in this table.

Table 2: Results of factor analysis on the variables of Expenditure and Revenue.

Factor Analysis

Rotated Factor Loading and Communalities, Varimax Rotation

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Communality
ExFoo	0.644	0.066	0.262	0.217	-0.213	0.581
ExHlh	0.142	0.130	0.124	0.019	-0.896	0.855
ExEdu	0.616	0.114	-0.233	0.140	-0.251	0.529
ExHoM	0.616	0.102	0.214	-0.033	-0.119	0.450
ExOth	0.705	0.098	0.190	0.096	-0.155	0.576
TotSa	0.610	0.543	0.356	0.068	0.191	0.834
InH&W	0.829	0.188	-0.004	-0.209	0.142	0.787
InOth	0.113	-0.051	0.916	-0.038	-0.122	0.871
ReA&L	-0.000	-0.017	-0.044	0.961	-0.017	0.927
ReOth	0.105	0.909	-0.100	-0.022	-0.190	0.883
FoSub	-0.623	0.201	0.212	0.292	-0.054	0.526
Variance	3.1617	1.2536	1.2424	1.1372	1.0599	7.8548
% Var	0.287	0.114	0.113	0.103	0.096	0.714

If we consider the loading coefficients of the first factor in the table above, the first factor heavily positively loaded by the variables ExFoo, ExEdu, ExHoM, ExOth, TotSa and InH&W, and also highly negatively affected by the variable FoSub. This reveals that there must be a common cause in the monetary environment of the families that is created by the income of husband and wife together with various expenditures other than expenditure on health. But the food subsidy directly affects all these characters. If we inspect the loading coefficients of the other four factors they are heavily loaded by single variables. The second factor is heavily loaded by 'Revenue from other sources' (ReOth) and the third factor is similarly loaded by 'Income of other members in the family' (InOth). The fourth factor is loaded by 'Revenue due to Agricultural and Livestock production' (ReA&L) and the fifth factor is loaded by 'Expenditure on Health' (ExHih). The variable 'Food subsidy' (FoSub) seems to load only the first factor in contrast.

Hence we could name the factors of the monetary status of families as; 'Effective Income as controlled by non - health expenditure and food subsidy', 'Revenue from Other sources', 'Income of other members in the Family', 'Revenue from Agriculture and Livestock production', and 'Expenditure on Health card',

Food consumption data.

First of all, the overall picture of food consumption is described by the intermediate index 'Type and Number of meals per day', followed by the 'Food consumption by Quantity of food items", and finally 'Nutrient intakes' have been described.

A. Description of Type and Number of meals

The types of meals consumed per day are explained above in section 1. The three variables NoR&C, NoP&C and NoB&S are defined as the number of such three types of meals. The cross - tabulated frequency distributions of type and number of meals for all the six zones and the region revealed that out of 1121 families sutdied, 761 families consume exactly one and 358 families consume exactly two rice and curry (R&C) meals. Only 2 families have reported that they consume R&C meal at all three times. More people of VAWE zone consumed two R&C meal per day, while, majority of the people from other zones consumed one R&C meal. It is also clear that only 170 families do not eat rice/wheat flour made meals, palakaram and curry (P&C). But it is clear that majority of the families (632) consumed only one such meal per day. A considerable number of families (319) consumed P&C meal.

Further, only 17 families have reported that they consume two 'bread and supplements' (B&S) meal. Also 568 families consume one such meal. But, 536 families never eat this type of meal. It is also clear that the rice and curry meal is more popular as every family consumes at least one such meal. This is because this meal is the traditional meal of the people of this region. Further, palakaram and curry meal is also popular next to rice and curry. But it seems that the bread and supplements meal is less popular. Hence from the above review, we can characterize the typical meal of Jaffna society as; 'one rice and curry,' 'one palakaram and curry' and 'one bread and supplements' per day.

B. Weekly consumption of Quantities of Food Items

The variables in this section measure the quantities of seventeen food items consumed weekly. The descriptive

statistics are calculated and presented in Table 2 of Appendix B.

These descriptive statistics reveal that, weekly average consumption of 'rice and rice flour', 'wheat flour', 'pulses and cereals' and 'bread' seems to be 8.66 kg, 4.57kg, 1.19kg, and 2.72 kg per family respectively. The consumption of these four basic food items vary from 0 kg to 28kg, 15 kg, 10 kg, and 21 kg respectively. The wheat flour consumption seems to be high in the JAFF zone, as the urban people always depend on this type of food 'Palakaram and Curry', but rice consumption seems to be high in the rural zone VAEA, which has more paddy fields.The consumption of bread is high in NALL zone. Weekly average consumption of 'biscuits', 'sugar'. 'milk products', 'tea and coffee', and 'fresh mild' seem to be 0.34 kg, 2.94kg, 0.48kg, 0.25 kg, and 1.77 leter per family. The consumption of these five sub food items vary from 0 kg/ltr to 4kg, 20kg, 10.4kg, 6.5kg, and 35 leters respectively. Milk products and fresh milk consumption seem to be very high in VASW zone, this means that most of the people of this zone must have more kowledge on netrition. Suger, tea & coffee consumption seem to be very high in VAWE zone, this means that most of the people of this zone are most habituated to drink tea and coffee.

Weekly average consumption of starchy roots, green leaves, other vagetables, edible oils, and coconuts seem to be 1.62kg, 1.05kg, 2.35kg, 1.01 letter, and 21 numbers per family. The consumption of these five vegetable food items vary from 0 kg/Ltr/Nos to 30Kg, 9Kg, 9kg, 15 Liters, and 21 numbers respectively. Consumption of starchy roots is high in VAWE zone, this may be because the production of roots is very high in that zone. Similarly, green leaves and vegetables are highly consumed by the people of VASO zone, because this zone is an agricultural zone and has more farmers on vegitable production. Further, edible oils and coconuts are mostly consumed by the people of VAEA zone, and this may be due to the mumber of coconut trees are more in this zone. If we consider the non-vegetable food items, weekly average consumption of seafood, meat, and eggs seem to be 1.85kg, 0.28kg, and 9 numbers per family. The consumption of these three items vary from 0 Kg/Nos to 20.50kg, 4 kg, 40 numbers respectively. The seafood consumption seems to be very high in VAEA zone, this is because of the accessibility of fish from lagoon also an additional reason. The meat and egg consumption seems to be high in the

urban JAFF zone.

As already argued finding common causes for contrasting features has become necessary in the consumption of different food items. Hence factor analysis was carried out on the seventeen food consumption variables and the results are given in Table 3. Eight factors were extracted. If we consider the factor loadings of the variables in Table 3, the first factor is seemed to be highly loaded by the consumption variables of 'Rice and Rice flour', 'Wheat flour', 'Pulses and cereals', and 'Cocounts'. Though the first factor explains only 11% of the variation, it appears that there exist two extreme groups of families according to its score plot. They are namely those consume more 'Rice and rice flour', 'wheat floor', 'pulses and cereals' and 'coconut', and less of these but more of other food items. Also there is a middle group which uses a nominal amount of

Table : 3 Results of factor analysis on the variables of seventeen food items

Factor Analysis

1120 cases used 1 cases contain missing values

Rotated Factor Loading and Communalities, Varimax Rotation

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Communality
CoRic	0.528	0.047	-0.355	-0.337	0.201	0.126	-0.145	-0.130	0.615
CoWFi	0.790	0.019	0.035	0.075	0.093	-0.012	0.010	0.022	0.641
CoPul	0.478	-0.113	-0.469	-0.092	-0.178	-0.072	0.041	0.096	0.518
CoBre	-0.176	-0.039	-0.123	-0.805	0.056	0.031	0.003	0.054	0.702
CoBis	-0.049	0.423	-0.118	0.210	-0.499	0.087	-0.114	0.130	0.525
CoSug	0.422	0.183	0.005	-0.560	-0.201	0.081	-0.089	0.086	0.587
CoMkp	0.036	0.061	-0.103	-0.077	0.070	0.037	-0.048	0.914	0.866
CoSeF	0.151	0.672	0.065	-0.398	0.148	0.009	-0.084	-0.038	0.668
CoMea	-0.042	0.723	-0.242	-0.007	-0.003	-0.032	0.076	-0.073	0.595
CoStR	0.161	-0.005	-0.468	-0.125	0.262	0.208	-0.312	-0.231	0.523
CoGrL	-0.022	0.150	-0.785	-0.016	-0.089	-0.010	0.023	0.119	0.662
CoVeg	0.278	0.005	-0.397	-0.137	-0.145	0.442	-0.076	0.221	0.525
CoT&C	0.030	0.013	0.017	-0.030	-0.014	0.927	0.033	-0.013	0.864
CoMlK	0.073	-0.057	-0.039	-0.079	-0.844	0.025	-0.060	-0.114	0.746
CoEdo	0.032	0.000	-0.024	-0.036	-0.118	-0.028	-0.941	0.062	0.907
CoCoN	0.609	0.277	-0.084	0.074	-0.200	0.169	-0.051	0.014	0.532
CoEgg	0.143	0.668	0.073	0.064	-0.091	0.026	-0.006	0.141	0.505
Variance	1.8717	1.7574	1.4569	1.3491	1.2719	1.1686	1.0559	1.0489	10.9804
% Var	0.110	0.103	0.086	0.079	0.075	0.069	0.062	0.062	0.646

the food items. These food items are connected to main meals either with lunch or with dinner.

Similarly the second factor, with 10% of the total variation, is highly loaded by the consumption variables of 'Seafood', 'Meat', and 'Eggs'. This essentially tells us there are two groups of people; one who uses more of non - vegetable foods and the other uses less of non - vegetable foods. Hence the second factor essentially explains the cause created by non - vegetable food items. The third factor, with 8% of the total variation, is highly negatively loaded by the consumption variables of 'Starchy roots', and 'Green leaves'. That is the food items used for curry. Similarly, the fourth factor is highly negatively loaded by the variables of 'Bread' and 'Sugar'. These items are mostly consumed for break - fast. Fifth factor is highly negatively loaded by the consumption variables of 'Biscuits' and 'Fresh milk', which are nutritional supplements to the children.

Sixth factor is highly loaded by the variables of Vegetables, and Tea and Coffee. Seventh factor is highly negatively loaded by the variable of Edible oils and the eighth factor is highly loaded by the variable of Milk products. All these eight factors together explain 65 per cent of the total variation explained by the factor loading. From the above analysis, we could name the above eight factors as 'Consumption of food items for Lunch', 'Consumption of Non-Vegetable food items', 'Consumption of food items for curry', 'Consumption of food items for Breakfast', 'Consumption of Vegetable, Tea and Coffee', 'Consumption of Edible oils', and 'Consumption of Milk products'.

C. Daily Nutrient Intake

This is an analysis of the transformed data of three types of nutrient intakes. in this section we have considered the variables EneIn, proIn, and FatIn. The three type of nutrient intakes have been calculated for the family per day. The descriptive statistics of these three nutrient variables are given in Table 3 of Appendix B.

If we consider the entire region, the average energy intake per family per day seems to be 14338 Calories. It varies from 4578 to 35123 Calories. The minimum and maximum energy intakes are repotted for VASW and JAFF zones respectively. Among the four rural zones VASW has the majority of economically poor people and hence the results give valuable information. It is also clear from these results that the maximum energy intake family cones from developed

urban zone JAFF. The average protein intake and average fat intake per family per day for the region seem to be 398.37 and 363.24 grams. These nutrient intakes vary from 139.36 to 1266.91 grams and 104.64 to 2475.33 grams respectively. Both the minimum protein and fat intakes are reported in NALL, which is the only urban suburb zone. This may be because most of the people are vegetarians in this zone and the consumption of animal protein must be less compared to other zones. The maximum seafood and meat consumption levels are lower in this zone compared to other zones. Both the maximum protein and fat intakes are reported in VAEA, which is the most developed zone among the four rural zones.

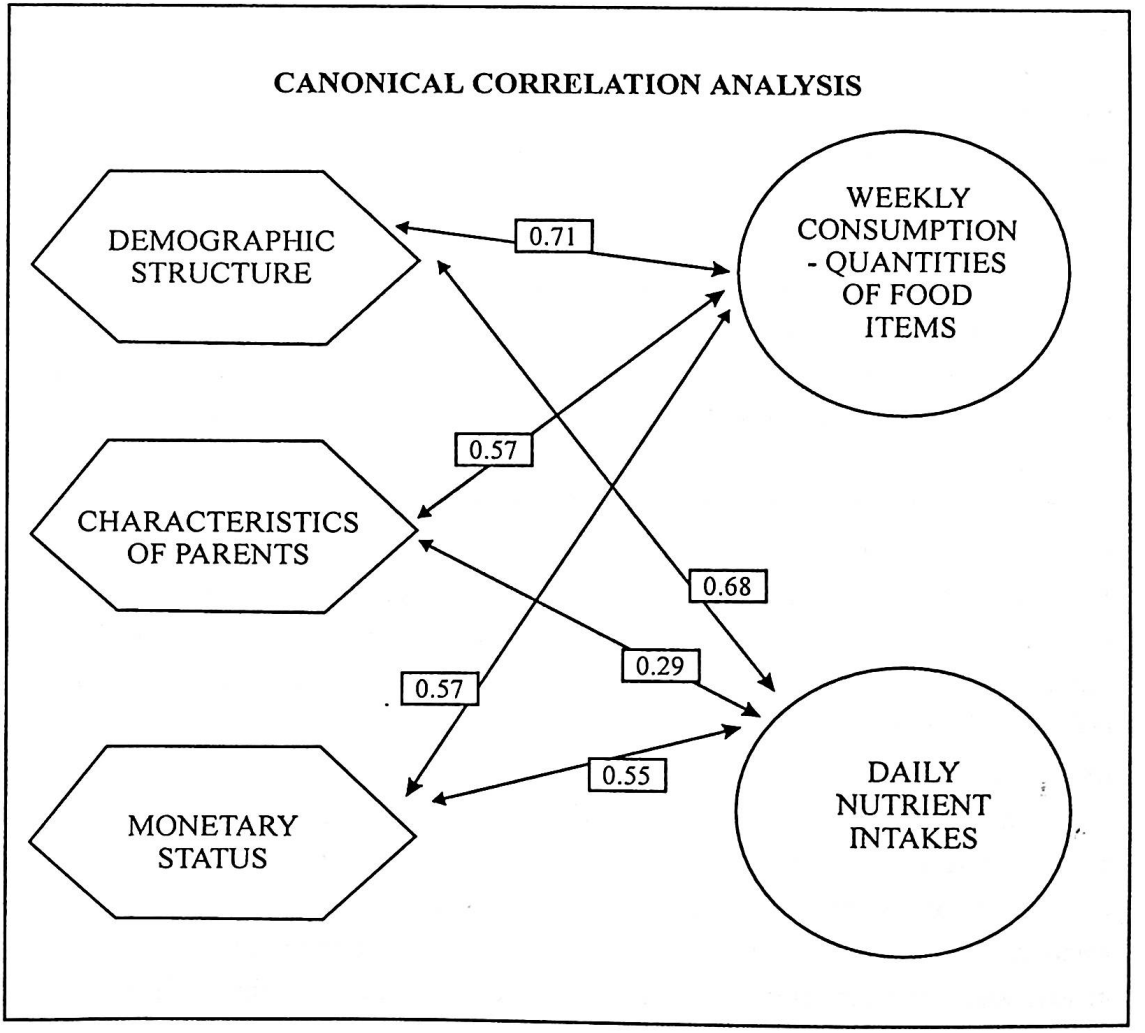
Interrelationships between Socio-Economic Status and Food Consumption - Canonical Correlation Analysis

The multidimensional analysis on food consumption patterns commenced with a total of 1121 responded families. However, at the first instance the families related to partial response data and single parent families were deleted. Further, on the basis of the results obtained in this section the outliers detected were also deleted. Hence the number of families subjected to the continuing analyses was 1032. We intend to analyze the variation in food consumption pattern and to find out the socio - economic causes, which determine such variations. Hence we need to study the structural relationships between the socio - economic dimensions and food consumption . Suitable statistical tool applied here is Canonical Correlation Analysis (CCA).

The following six pairs of sets are suitable, according to the consumption model given in Figure 1. Family Composition versus Different Food Items (FC - FI), Characteristics of Parents versus Different Food items (CP-FI), Monetary Status versus Different Food Items (MS -FI), Family Composition versus Nutrient Contents (FC-NC), Characteristics of parents versus nutrient Contents (CP - NC), and Monetary status versus Nutrient Contents (MS - NC). The canonical correlations between the linear combinations of the two sets of variables were calculated. The corresponding vectors of canonical coefficients for both sets were also found. Overall inspection of the first two canonical correlations revealed that the 'Family Composition' has the most positive effects on food consumption of both different food items and nutrients . The 'Characteristics of

parents' has average positive effects on 'Consumption of Different Food items' and very low positive effects on 'Nutrient intakes'. The 'Monetary status' seems to have average positive positive effects on both type of consumption. The details are shown by Figure 2.

Figure 2 : Canonical correlations between socio - economic dimensions and food consumption patterns



We can further elaborate the individual effects of different variables on the above structural relationships by inspecting the related vectors of canonical coefficients. The Table 4 of Appendix B gives the corresponding vectors of standardized canonical coefficients between the sets of variables of Economic dimensions and Food consumption by different food items. If we inspect the canonical vector of 'Family composition', it seems that 'Family size' is the most influencing variables on food consumption by different quantities. Other family structures seem to have no effects. Further this effect is also seen mostly on the 'Consumption of Rice and rice flour' and some effects on the 'Consumption of Bread'. Consumption of other food items have no relationships with the family structure.

As already mentioned above 'Characteristics of Parents' has average effect and this is also only dud to 'Educational level of wife' for certain extent and 'Educational level of husband' for some extent. No other characters have any influence. These effects have not clearly reflected on the consumption of different food items. We have also seen that the monetary status has average effects on food consumption. These effects are created due to expenditure on food and the food subsidy given by the Government. But these effects have not shown any clear picture of the consumption of any type of food items.

Similarly the corresponding vectors of standardized canonical coefficients between the sets of variables of Economic dimensions and Food Consumption by three nutrient contents were examined. Similar results are obtained for 'Family composition'. That is, family size has the influence on nutrient intakes. Mostly energy intake seems to have been affected by the family composition. If we consider the characteristics of parents, educational level of wife gives some positive effects, but the age of husband gibes some negative effects. Here the protein intake seems to be positively related with characteristics of parents. If we consider the third relationship with monetary status, here also food expenditure and food subsidy, give positive influences. These influences are highly related to the energy intake of families.

4.2 Clustering and Discrimination of Consumption Data

The food consumption patterns have been analyzed so far with the model

defined above. We have described the Socio -Economic dimensions and Food consumption separately. Further more, the inter- relationships have also been analyzed. However, the real food consumption patterns will be highlighted only if we could find different segments of the society, which will have distinct types of food consumption patterns. One way to achieve this goal is to classify all the families in the sample into a suitable number of clusters in terms of their food consumption habits. Hence, we carried out Cluster analysis to find clusters of families. The 'Food consumption quantities' and 'Nutrient contents' were separately used as response variables for clustering. This is then followed by Canonical Discriminant Analysis (CDA) to determine the responses that influences the clusters.

a) Clustering Families

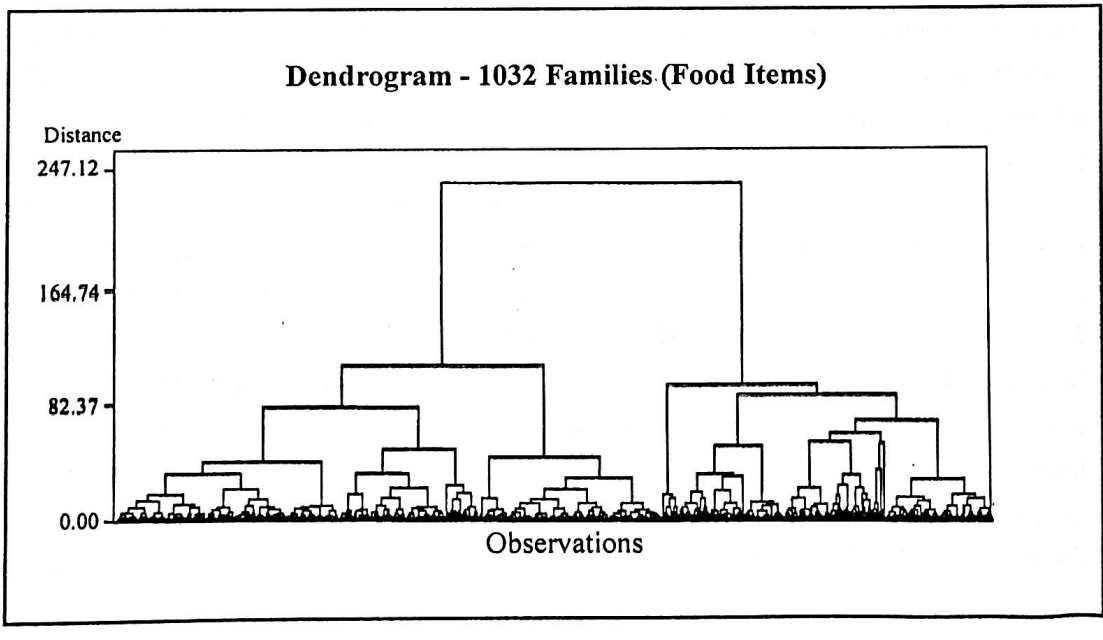
We classified the entire set of 1032 families into a suitable number of clusters. Since the units of the variables are different (Kg, Litre, and Count) the variables were standardized before clustering. At the first stage, clustering was done with seventeen food consumption quantities. Two to six clusters were obtained and the amalgamations were observed. The maximum number of clusters decided was six, because we wondered if there was a relationship with the clusters and the six administrative zones covered in the study area. The corresponding dendrogram is presented in Figure 3. The dendrogram reveal that, as far as the seventeen food items quantities are concerned, the society has highly varying food consumption patterns. Hence, the varying food consumption patterns among the families of Jaffna society is confirmed. The same type of clustering was also performed on the basis of three nutrient variables. Here also we picked up to six clusters.

Here our interest was to see whether there exists any natural grouping in terms of food consumption among the individuals of the population where our sample was taken. This will simplify the description of a large set of multivariate data to generate hypothesis to be tested on future samples. Though the consumption pattern vary among people, in an individual basis, there is always a general pattern exists among groups of individuals, for example, vegetarians and non - vegetarians. By looking at the dendrogram it is very clear that there exists a minimum of three to a maximum of six reasonably homogeneous groups.

Therefore, our interest is also to see what variables or group of variables brings such groupings. This is determined by the Canonical Discriminant Analysis.

The crossed - classified frequency distributions of the 1032 families in terms of cluster memberships derived on the basis of seventeen food quantities versus three nutrient intakes were obtained for three, four, five and six clusters. This distribution revealed that, the clustering on the basis of both seventeen food-items and three nutrient contents yielded almost similar results, but do not help us to select the best classification. These descriptive statistics of the seventeen food items and the three nutrient contents for the different clusters were obtained and examined. The descriptive statistics support to certain extent to select the best pattern among them. Note that the three - cluster means seem to be different rather than four, five or six cluster - means.

Figure 3 : Dendrogram for Hierarchical clustering of 1032 families on the basis of seventeen food items.



We had to choose the best among the four cases of clustering mentioned above for both types of clustering. We confirmed this by applying the technique MANOVA in conjunction with CDA for selecting the best classification. We also analyzed the clustering variation across the DS divisions. A cross - classification was performed for the cluster members on the basis of three nutrients versus DS divisions. The distributions for three, four, five and six clusters revealed that the spread of the members of all the clusters across all the six DS divisions appears to be uniform. That is, the food consumption patterns can not be related to the DS divisions. Hence any rehabilitative process on the basis of the food consumption patterns by DS divisions is meaningless.

b) Canonical Discriminant Analysis

It was decided to apply Canonical Discriminant Analysis (CDA) seperately for 2,3,4,5, and 6 cluster contexts, and allow taking a decision by comparison. At the first step, the CDA was applied on the clusters based on seventeen food items and it was found that three- cluster grouping is optimal. The Table 6 describes the results of MANOVA and Eigen analysis of the CDA applied on three-cluster grouping. This table reveals that the mean vectors of seventeen food items are significantly different among the three clusters obtained. Further, the first two canonical variates respectively explain 85 per cent and 15 per cent of the total variations. A careful inspection of the standardized canonical coefficients of both of the canonical variates and the score plot of canonical scores obtained, given by Figure 3, for all the 1032 families confirmed the existence of three different clusters on food consumption patterns. The direction of first canonical axis, which alone explains 85 per cent, separates the first group from the other two groups. The second canonical axis, which explains 15 per cent, separates second and third groups. The significance of this discrimination was confirmed by the one way ANOVA on the scores of both canonical variates.

We noticed from the canonical vectors produced in this analysis that, the consumption of bread, sea food, meat, and coconut influences the first canonical variate and hence the first group differs from the other two groups by the consumption of these food items. Further, the second canonical variate is influenced positively by the consumption of pulses, sugar, and milk and negatively by the consumption of bread, meat and sea food and hence, the

Table 6 : Results of MANOVA and CDA on three cluster grouping for seventeen food items.

Multivariate Statistics and F Approximations

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.37792626	37.34	34	2026	<.0001

F Statistic for Wilks' Lambda is exact.

Eigenvalues of Inv (E) * H = CanRsq/ (1 - CanRsq)

	Eigenvalue	Difference	Proportion	Cumulative
1.	1.1883	0.9791	0.8503	0.8503
2.	0.2092		0.1497	1.0000

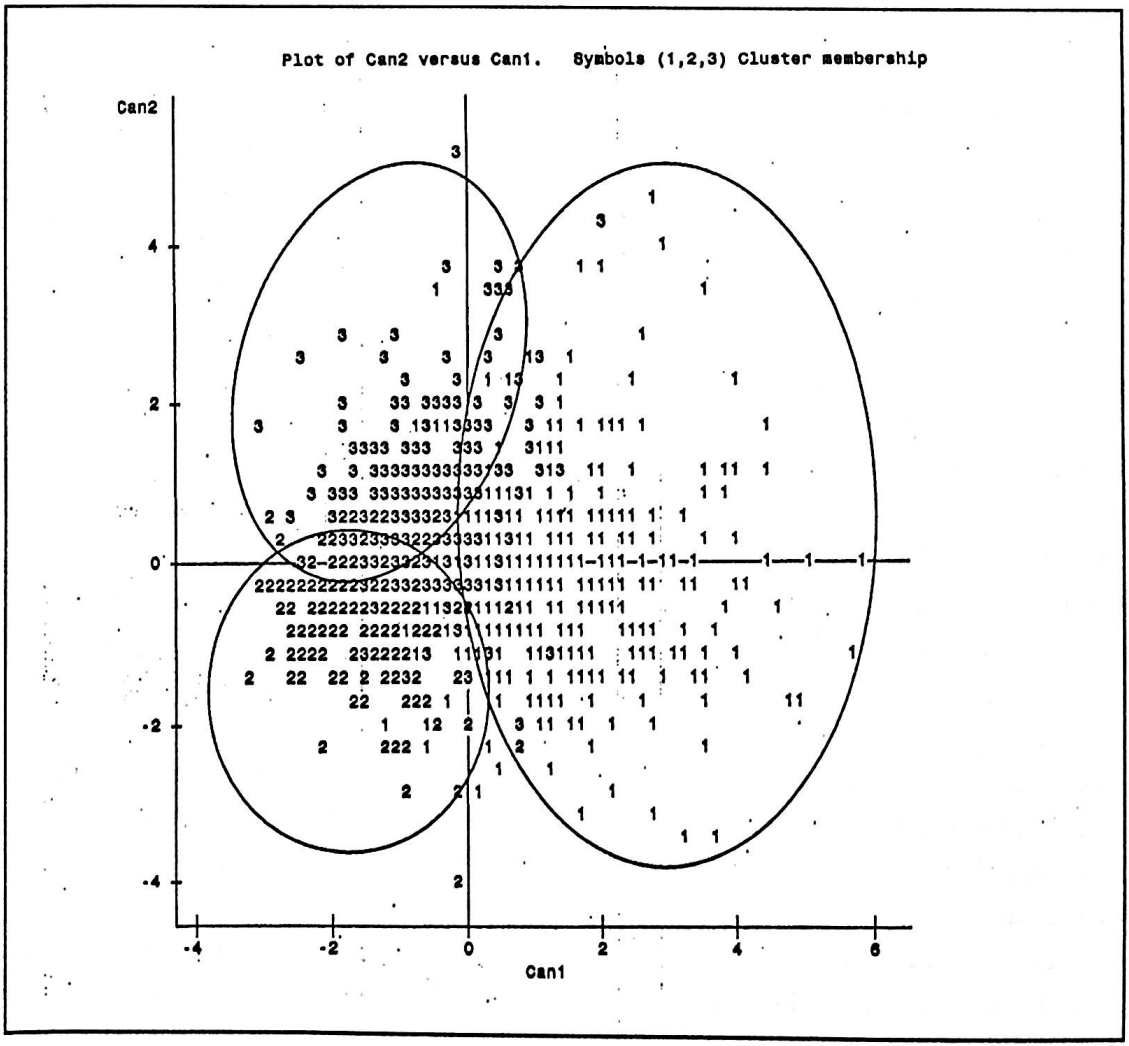
second and third groups are discriminated by these food items. Similar score plots drawn for four, five and six cluster groupings gave evidence that the existing three clusters were segregated in the subsequent stages, but those sub clusters did not show any natural groupings. Hence, the three - cluster pattern was finally accepted.

At the second step the CDA was applied separately to the three, four, five and six clustered groups obtained on the basis of three nutrient contents. The results due to CDA were compared among the three, four, five, and six clusters and it was found that three - cluster grouping is optimal. The results revealed that the mean vectors of three nutrient contents are significantly different among the three clusters obtained. Further, the results revealed that the first two canonical variates share 99.6 per cent and 0.4 per cent of the total variations respectively. We noticed from the canonical coefficients of the first canonical variate that, this is highly influenced by the consumption of energy. The protein intake also has some influence. Hence the pattern is determined by the consumption of energy.

The canonical scores obtained for all the 1032 families on the basis of the above coefficients were plotted and inspected. This inspection clearly confirms the existence of three different clusters on food consumption patterns by three nutrient contents. The direction of first

canonical axis, which alone explains 99.6 per cent, separates all the three groups significantly and confirmed by ANOVA on the first canonical scores. On the basis of the Cluster analysis and subsequently with the Canonical discriminant analysis we have found that the food consumption patterns of Jaffna peninsula can be expressed by three different major consumption groups based either on the seventeen important main food items by quantities or on the three main nutrient contents energy, protein and fat.

Figure 4 : Scatter plot of the scores of two canonical variates on 17 food items.



c) Discriminatory power of socio-Economic Variables

The descriptive statistics of family composition on the above identified three clusters revealed that the variation in the food consumption patterns has been influenced by all the five family composition variables in both types of clustering. The influence by family size is quite natural, but the other variables have produced meaningful results. Among them, proportion of preschool children - infants and proportion of students have given more influence compared to other proportions of members in the families. The second cluster in both types has high proportion of students. Further, we noticed that the consumption of food items and nutrient contents seem to be high in the first cluster, medium in the third cluster, and low in the second cluster, Hence it is clear that, high food consumption have been influenced by 'proportion of preschool children and infants.'

The descriptive statistics of the variables of characteristics of parents in the newly found three clusters, revealed that ages and sleeping hours of husbands and wives seem to have no influence on the clusters obtained by both methods. Educational levels of husbands and wives seem to be high in the third cluster on the clustering by food items and high in second cluster on the clustering by nutrient contents. They are low in second cluster and first cluster by food items and nutrient contents respectively. This again confirms that the educational level has contradictory influence on the food consumption patterns of the society. Similar results are revealed for the occupational levels of husbands and wives. The descriptive statistics of the variables of family expenditure, household income and revenue in the newly found three clusters, revealed that the expenditure on food and education seem to be high in the first cluster and low in the second cluster. All other types of expenditure seem to be contradicting results and hence the consumption of food depends only on the expenditure on food and education.

The incomes due to occupations of husbands- wives and all others seem to be high in the first cluster and low in the second cluster on both type of clustering. As we expect these incomes have direct influence on food consumption. The same results is obtained on the case of revenue due to agricultural and livestock production. But revenue from the other sources has no influence on the

consumption patterns. As explained in the previous sections, here also the food subsidy seems to influence the food consumption patterns as all the three clusters have unequal cluster means in both types of clustering.

5. Conclusions

Socio - Economic Conditions

There is a notable variation in the 'Family size', proportions of 'Pre-school children and infants', 'Students', 'Unemployed adults and youths', 'Elders and disabled persons' in the families. The overall averages of these variables in the region are 6, 10%, 34%, 5%, and 5% respectively. These numbers vary from location to location. For example, unemployed people are less in urban area and high in rural areas. A close look at the data on characteristics of parents reveal that, the ages range from 19 to 80 years, average educational level is 9 years, and average occupational levels of husbands and wives are 18 and 9 respectively in a 50 point scale. A global view of the data revealed that there are two different subgroups of families one influenced by occupational levels and other influenced by ages from the main group of families.

Looking at the family expenditure and household income data it is very clear that the families spend less on food and uses the government subsidy 'Nivaranam' to complement their food expenditure. The major emphasis is on health and education. The average monthly expenditures on Household management and Pooled other expenditure categories seem to be Rs. 593 and Rs. 1249 respectively. The average total - savings seems to be Rs. 1954, which varies up to Rs.70300. Further the savings of the families follow a distribution with broad variation. There is a high heterogeneity on 'salaries or wages' of the parents and the other members. The monthly average revenue on 'Agricultural and Livestock production together, and 'all other categories together' seem to be Rs.774 and Rs.1236 respectively and these revenues vary up to Rs.25000 and Rs.45000 respectively. The average of food subsidy amount provided by the Government seems to be Rs.866, which varies up to Rs.2940.

Positive correlations of 'Income of husband and wife' with 'Expenditure on Food, Education, Household Management, and Total - Savings' seem to be significant. Further the positive correlations of Food expenditure' with 'Expenditures on Education', and

'Income of husband and wife' reveal that the expenditure on education affect the food expenditure through the income of husband and wife. Factor analysis among the monetary variables revels that the first factor is heavily loaded with expenditures on 'Food, Education, Household Management, Total - Savings' and Income of 'Husband and Wife', and is also highly affected by Food Subsidy. Hence this factor is identified and named as 'effective Income' as controlled by 'Non - health expenditure and food subsidy. Other factors are named accordingly.

Food consumption

Overall food consumption pattern by type and number of meals show that majority of the families is found to consume one rice meal a day. Palakaram meal is also equally popular but taken once a day. It was also noticed that average families consume one brad meal every day.

If we consider the seventeen food items, weekly average consumption of rice and rice flour, wheat flour, pulses and cereals, and bread seem to be 8.66 kg, 4.57kg, 1.19kg, and 2.72kg per family respectively. The consumption of these four items vary up to 28kg, 15 kg, 10kg, and 21 kg respectively. The wheat flour consumption seems to be high in the Jaffna zone, as the urban people depend on this type of food 'Palakaram and Curry', but rice consumption seems to be high in the rural zone Valikamam east. The consumption of pulses and cereals is more in another area Valikamam west. The consumption of bread is high in Nallur zone, because the farming people of this urban suburb zone do not engage on the cultivation of paddy or cereals. Weekly average consumption of biscuits, sugar, milk products, tea and coffee, and fresh milk seem to be 0.34 kg, 2.94 kg, 0.48kg, 0.25kg, and 1.77 litre per family. The consumption of these five items vary up to 4 kg, 20kg, 10.4kg, 6.5kg, and 35 litres respectively. Milk products and fresh milk consumption seem to be very high in Valikamam south-west zone. Sugar, tea and coffee consumption seem to be very high in Valikamam west zone.

If we consider three nutrients, the average energy intake per family per day seems to be 14336 calaries. It varies from 4578 to 35123 calaries. The minimum and maximum energy intakes are reported from Valikamam south-west and Jaffna zones respectively. Among the four rural zones Valikamam south-west has the majority of

economically poor people and hence the results give valuable information. It is also clear from this results that the maximum energy intake family comes from urban zone Jaffna. The average protein intake and average fat intake per family per day seem to be 398.37 and 363.24 grams. These nutrient intakes vary from 139.36 to 1266.91 grams and 104.64 to 2475.33 grams respectively. Both minimum protein and fat intakes are reported in Nallur zone, which is the only urban suburb zone. This may be because most of the people are vegetarians in this zone and the consumption of animal protein must be less compared to other zones. Both maximum protein and fat intakes are reported in Valikamam east zone. This is because the maximum seafood consumption is higher compared to other zones.

The correlations of energy intake with the other two nutrient intakes seem to be positive and high. However, the correlation between protein intake and fat intake seems to be weak. This means that the people of this region have an alternative dietary habit on choosing the foods for protein and fat. Further it was found that there exists a sub division of families such that these families have more energy consumption from the rest of the families.

Inter - relationship : Socio-Economic Status and Food Consumption

Food consumption patterns are found to be independent of age, educational level and occupational level of parents of the families. Other socio-economic variables also appear to be independent of the food consumption variables. Further, there is a significant association beet ween consumption of rice and monthly food subsidy. It was also noted that large number pre- school children and infants in the family consume low nutritional diets. The food expenditure has strong positive association with the nutrient intake variables. Protein intake has stronger association than energy intake, but fat intake has negligible association.

In a stable environment, the people can make their own food consumption pattern and other life style well ahead in time and budgeting can be made accordingly. But, in Jaffna during this survey the political situation was very unpredictable and therefore the people are unable to make decisions ahead of time for their daily living and other activities. This could be the reason for our findings that, for example the education level of the parents, which normally enhance the food patterns in the family, is found to be unrelated in our survey. This is mainly due to the fact that the people are making instantaneous

decisions because of the everlasting unrest in this region. This again necessitates the importance of a stable social and economic environment in this region.

When we looked at the structural relationships between socio - economic status and food consumption, it is very clear that the family composition has the most positive effect on food consumption. Family size appears to be the most influencing factor. The 'Characteristics of Parents' has average positive effects on 'Consumption of Different Food items'. The 'Monetary status' seems to have average positive effects. Other family structures seem to have no effects. We have also seen that the monetary status has average effects on food consumption. These effects are created due to expenditure on food and the food subsidy given by the Government.

Clustering and Discrimination of Food Consumption pattern

Clustering of families on the basis of seventeen food items by quantities and as well as three types of nutrient intakes produces similar pattern of clusters. It was noted that there is a minimum of three to maximum of six groups of similar consumption patterns. This problem is not related to different zones of study area. We noted that three clusters are significantly different in the means. This was also seen in the plot of discriminating scores. Further it was noted that the first cluster was characterized by the highest consumption of food items and nutrient intakes which are not much in the other two clusters. It is clear that both family size and proportion of students have influenced high food consumption.

The results on family expenditure, household income and revenue in the newly found three clusters revealed that the expenditure on food and education is high in the first cluster and low in the other clusters. It appears that the income of parents and their educational level has direct influence on the consumption of food. The food subsidy has a direct influence on the food consumption.

Food consumption data were collected for the family rather than individuals as the methodology of the present study dose not include the individual's food consumption data. Further, the physical consumption of food items from the markets were only supplied by the respondents. According to the limitations of this research we have not collected the actual or real consumption quantities, edible portion of consumed food items, from the individuals or from the whole family. Hence further analysis or comparisons are impossible.

Acknowledgements

I wish to acknowledge my Ph.d supervisors Dr. S.Ganesalingam and Dr.Siva Ganesh of the Institute of Information Science and Technology, Massey University, New Zealand, for reading the first draft of this paper and making necessary corrections, alterations and amendments to get the revised final version. I am also obliged to acknowledge my internal supervisor Prof.C.Sivagnanasundram, Porfessor of Community Medicine, University of Jaffna for initiating this research and giving me the fundamental ideas to commence and develop this research.

References

Ariyawardana, A, Nithiyanandam,V., and Bailey, W.C (1999) Changing food consumption patterns in Sri Lanka. Paper presented at the 7th Sri Lanka studies conference on Asia, Sri Lanka, and the Diasporic communities, Australia, 3-6 December 1999.

Bryan, F.J.M (1994) Multivariate Statistical Methods. A primer (Second Edition). Chapman & Hall..

Dixon, J.A (1982) Use of Expenditure survey data in staple food consumption analysis: Examples from Indonesia, In Chisholm,A.H. and Tyers.R.(eds) Food security: Theory, Policy and Perspectives from Asia and the Pacific Rim. Lexington Books, Lexington, Massachusetts, Chapter 11.

Elankumaran,C. (2001) Food Insecurity and Armed Conflict in Jaffna peninsula: Some experiences from Jaffna Socio- Economic Health Study - 1999. Asian Economic Review, Vol.43, No.2, pp324-338.

Genesalingam, S.(1992) Some Multivariate Statistics and Applications. Occasional Publication in Mathematics and Statistics, Number 24. Department of Mathematics and Statistics. Massey University, New Zealand.

Harold Alderman and Marito Garcia (1993) Poverty, Household Food Insecurity, and Nutrition in rural Pakistan. Research report 1996. International Food Policy Research Institute, Washington D.C.

Huang,J.and Bouis, H. (1996) Structural changes in the demand for food in Asia. Food, Agriculture, and the Environment Discussion paper No. 11. International Food Policy Research Institute, Washington,D.C.

JSA (1993) Food and Food Habits. Collection of seminar papers of annual session 1992 held on 23.04.1992. Jaffna Science Association, University of Jaffna.

Karin, F.A.M., Hulshof,M., Wedel,M.R.H., Lowik,F.J., Kod,C.Kistemaker, R.J.J., Hermust, F ten Hoor, and Th Ockhuizen (1992) Clustering Dietary variables and Other lifestyle factors in Dutch Nutritional Surveillance System. Journal of Epidemiology and community Health 1992, Vol.46, pp417-424.

Nachchinarkiniyan,C.S.(1993) Food Habits, Health and Illness. Seminar paper. In; Food and Food Habits. Jaffna Science Association, Annual Session1992. University of Jaffna, pp41-46.

People's Bank (1995) Poverty: Issues and Challenges. Economic Review, Vol.21, No.5, August 1995.A People's Bank publication, Government of Sri Lanka.

Rae,A,N.(1997) Changing food consumption patterns in East Asia: Implications of the trend towards livestock products. Agribusiness: An International Journal. Vol. 13, No.1,pp33-44.

Rae,A,N.(1998) The effects of expenditure growth and urbanization on food consumption in East Asia: A note on animal products. Agricultural Economics, Vol, 18, No.3, pp291 -299.

Rae,A.N (1999) Food consumption patterns and nutrition in urban Java households: The discriminatory power of some socioeconomic variables. The Australian Journal of Agricultural and Resource Economics. 43:3. pp 359-383.

Telku, T.and Johnson,S.R. (1988) Demand systems for cross section data: An application to Indonesia, Canadian Journal of Agricultural Economics, Vol.36, No.1, pp83-101.

Timmer, C.P. and Alderman,H. (1979) Estimating consumption parameters for food policy analysis. American Journal of Agricultural Economics, Vol.61, No.5, pp982-987.

Van de Walle (1998) On the use of the SUSENAS for modelling consumer behaviour, Bulletin of Indonesian Economic Studies, Vol,24, No.2, pp107-122.

Wikramanayake, T.W. (1987) Food Consumption Data, In: Food and Nutrition. Trumpet Publishers, Colombo, Sri Lanka. Chapter 27, pp231-236.

Appendix A:Data Type

Socio Economic Data

1. Family Composition: (1)Number of members in the family (Fsize), (2) Proportion of Preschool Children and infants in the family (PrPCI), (3) Proportion of Students in the family (All School/ College/University students) (PrStu), (4) Proportion of Unemployed Adults and youths in the family (PrUnE), (5) Proportion of Elders and Disabled persons in the family (PrEID).

2. Characteristics of Parents of the Family: (1) Age of Husband (AgeHu), (2) Age of Wife (Age Wi), (3) Educational Level of Husband (EdLeH), (4) Educational Level of Wife (EdLeW), (5) Occupational level of Husband (OcLeH), (6) Occupational level of Wife (OcLeW), (7) Daily Sleeping Hours of Husband (S1HsH), (8) Daily Sleeping Hours of Wife (S1HsW).

3. Family Expenditure and Revenue
Family Expenditure: (1) Expenditure on Food consumption (ExFoo), (2) Expenditure on Health Care (ExHih), (3) Expenditure on Education (ExEdu), (4) Expenditure on Household Management (ExHoM), (5) Expenditure on All other purposes (ExOth), (6) Total Family Savings (TotSa).
Family Income and Revenue: (1) Income due to Occupations of Husband and Wife (InH&W), (2) Income due to Occuptions of Other members in the family (InOth), (3) Revenue due to Crops and Livestock production (ReA&L), (4) Revenue from All other Sources (ReOth),(5) Food subsidy amount (Nivaranam) paid to the Family (FoSub).

Food Consumption Data

1. Number and type of meals per day: (1)Nubers of meals with Rice and Curry NoR&C), (2) Number of meals with Palakaram and Curry (NoP&C), (3) Number of meals with Bread and Supplements (NoB&S).

2.(a) Weekly Consumption of Different food items by quantities by the Family:
(1) Consumption of Rice and Rice flour (CoRic), (2) Consumption of Whear flour (CoWFl), (3) Consumption of Pulses and Cereals (CoPul), (4) Consumption of Bread (CoBre), (5) Consumption of Biscuits (CoBis), (6) Consumption of Sugar (CoT&C), (9) Consumption of Fresh Milk (CoMlk), (10) Consumption of Starchy Roots (CoStR), (11) Consumption of Green Leaves (CoGrL), (12) Consumption of Main vegetalbes (CoVeg), (13) Consumption of Edible Oils (CoEdO), (14) Consumption of Coconuts (CoCoN) (15) Consumption of Seafood (CoSeF), (16) Consumption of Meat (CoMea), (17) Consumption of Eggs (CoEgg).

2(b). Daily Nutrient Intakes by the Family: (1) Energy intake (Calories) (EneIn), (2) Protein intake (Grams) (ProIn), (3) Fat intake (Grams) (FatIn).

Appendix B: Tables of Descriptive Statistics

Table 1: Descriptive statistics of the variables of Expenditure and Revenue (Rs).

Variable		JAFF	NALL	VASW	VAWE	VASO	VAEA	Region
ExFoo	Mean	4747	4364.5	3911.9	4014	4178.0	3903.8	4184.3
	StErr	149	95.1	97.8	101	86.9	89.2	43.0
	Min	1500	500	1200	1000	1500	600	500
	Max	12000	9000	9000	9000	8000	10000	12000
ExHih	Mean	272.1	216.3	228.3	187.8	251.5	217.6	228.1
	StErr	26.7	15.3	18.5	14.0	20.7	14.1	7.5
	Max	3000	2000	1500	1000	3000	2000	3000
ExEdu	Mean	678.4	567.2	399.4	380.1	452.7	442.0	488.9
	StErr	52.9	35.7	34.6	34.0	36.0	31.3	15.6
	Max	4000	3000	3000	3000	3500	3000	4000
ExHoM	Mean	986.8	784.2	346.2	331.3	531.9	527.5	593.5
	StErr	50.6	41.5	27.5	20.1	32.2	26.5	15.8
	Min	50.0	0.0	0.0	50.0	90.0	0.0	0.0
	Max	4500	4950	3000	1700	4050	3000	4950
ExOth	Mean	1673.5	1401.6	915.6	1127.2	1113.0	1214.7	1249.1
	StErr	9736	75.7	50.5	49.4	58.4	59.7	28.6
	Min	0.0	100.0	50.0	250.0	50.0	100.0	0.0
	Max	9100	8200	4550	3650	4800	5300	9100
TotSa	Mean	3327	2246	1592	1317	1809	1482	1954.0
	StErr	520	250	207	151	198	132	109
	Max	70300	31000	17000	12500	21000	16000	70300
InH&W	Mean	8691	6974	4249	4677	4685	4807	5702
	StErr	575	328	300	222	352	221	148.0
	Max	70000	35000	23500	21500	45000	20000	70000
InOth	Mean	1546	1182	918	1247	918	814	1125.8
	StErr	246	188	163	154	150	113	70.2
	Max	24000	26000	14500	9000	10000	9500	26000
ReA&L	Mean	68.9	246.9	713	758	1570	1231	774.0
	StErr	43.2	62.0	141	108	208	136	54.5
	Max	7000	8000	18500	13000	25000	15000	25000
ReOth	Mean	1461	1174	1365	695	1622	1127	1235.8
	StErr	304	121	200	100	273	115	78.7
	Max	45000	11000	16000	7000	40000	10000	45000
FoSub	Mean	620.0	648.4	1127.7	982.1	964.8	915.4	865.7
	StErr	52.0	43.5	43.7	48.1	47.5	44.4	19.8
	Max	2520	2268	2268	2940	2884	2464	2940.0
No of Families		167	224	156	167	184	222	1120

(Minimum values are also included where ever possible, other minimums are zeros)

Table 2 : Descriptive statistics of the variables - Quantities of different food items.

Variable		JAFF	NALL	VASW	VAWE	VASO	VAEA	Region
CoRic	Mean	7.984	7.915	8.627	10.205	8.659	8.791	8.663
	StErr	0.248	0.185	0.260	0.263	0.241	0.241	0.099
	Min	3.000	3.000	0.000	1.000	3.000	3.000	0.000
	Max	18.000	21.000	22.000	19.000	22.000	28.000	28.000
CoWFi	Mean	4.219	4.668	4.421	4.077	4.771	5.087	4.578
	StErr	0.218	0.146	0.198	0.146	0.185	0.174	0.073
	Max	15.000	10.500	14.000	14.000	14.000	14.000	15.000
CoPul	Mean	1.2557	1.0779	0.9606	1.4506	1.0783	1.3172	1.1913
	StErr	0.0578	0.0423	0.0609	0.0402	0.0467	0.0714	0.0231
	Max	3.5000	4.000	7.0000	2.5000	3.5000	10.0000	10.0000
CoBre	Mean	3.408	2.585	2.585	2.746	2.902	2.298	2.7273
	StErr	0.181	0.143	0.158	0.158	0.176	0.149	0.066
	Max	13.000	14.000	12.2000	10.000	15.000	21.000	21.000
CoBis	Mean	0.3743	0.2850	0.3026	0.3384	0.3625	0.3914	0.3425
	StErr	0.0340	0.0199	0.0315	0.0290	0.0396	0.291	0.0125
	Max	3.0000	1.5000	3.000	2.0000	4.0000	3.0000	4.0000
CoSug	Mean	3.0416	2.8627	2.7500	3.2760	2.7538	2.9889	2.9427
	StErr	0.0941	0.0649	0.0841	0.1250	0.971	0.0884	0.0378
	Min	0.7000	0.5000	1.0000	.03000	0.0000	0.3000	0.0000
	Max	7.000	7.5000	7.0000	20.0000	10.0000	10.0000	20.0000
CoMkp	Mean	0.5398	0.4596	0.4452	0.5009	0.4646	0.4912	0.4828
	StErr	0.0229	0.0238	0.0666	0.0473	0.0268	0.0457	0.0165
	Max	1.2000	4.0000	10.4000	8.0000	3.5000	9.0000	10.4000
CoSef	Mean	2.0930	1.5480	2.0237	2.1881	1.6223	1.8018	1.8536
	StErr	0.1020	0.0595	0.0870	0.0923	0.0730	0.109	0.0370
	Max	6.0000	3.5000	6.0000	6.0000	5.0000	20.5000	20.5000
CoMea	Mean	0.4524	0.2263	0.2063	0.3107	0.2443	0.2522	0.2780
	StErr	0.0488	0.0230	0.0266	0.0263	0.0334	0.0289	0.0131
	Max	4.0000	1.5000	1.000	2.5000	3.000	3.5000	4.000
CostR	Mean	1.1608	1.2627	1.5628	2.1580	1.7939	1.8690	1.6174
	StErr	0.0580	0.0470	0.0946	0.1830	0.0922	0.0917	0.0417
	Max	5.000	5.0000	10.0000	30.0000	7.0000	10.0000	30.000
CoGrL	Mean	1.1353	0.9687	0.8603	1.5839	0.9628	0.8638	1.0491
	StErr	0.0482	0.0345	0.372	0.0599	0.0588	0.0391	0.0203
	Max	4.5000	3.0000	3.5000	4.0000	9.0000	4.0000	9.000
CoVeG	Mean	2.2530	2.3167	2.2583	2.7321	2.3234	2.2661	2.3525
	StErr	0.0656	0.0498	0.0812	0.0787	0.0872	0.0733	0.0299
	Min	1.0000	1.000	0.0000	1.0000	0.0000	0.5000	0.0000
	Max	7.0000	4.5000	6.0000	7.0000	9.0000	7.0000	9.0000
CoT&C	Mean	0.2659	0.2183	0.2446	0.2838	0.2648	0.2707	0.2568
	StErr	0.0123	0.0116	0.0128	0.0381	0.0212	0.0290	0.0094
	Min	0.1000	0.0000	0.1000	0.1000	0.0500	0.02000	0.0000
	Max	1.5000	2.5000	1.8000	6.5000	3.0000	6.0000	6.5000
CoMlk	Mean	1.933	1.981	1.956	1.473	1.496	1.759	1.7706
	StErr	0.2070	0.1590	0.3220	0.2030	0.1640	0.1650	0.0820
	Max	10.5000	8.0000	35.0000	14.0000	10..5000	10.5000	35.0000
CoEdO	Mean	0.8087	0.8147	1.0140	1.5098	0.8000	1.1720	1.0140
	StErr	0.0522	0.0271	0.1220	0.0647	0.0472	0.1260	0.0348
	Min	0.0000	0.2500	0.2000	0.0000	0.0500	0.1000	0.0000
	Max	8.0000	5.0000	10.0000	10.000	7.5000	15.0000	15.0000
CoCoN	Mean	6.772	7.172	5.808	6.869	6.297	7.100	6.7189
	StErr	19.10	0.173	0.188	0.160	0.203	0.236	0.082
	Min	1.000	0.500	1.000	1.000	0.000	2.000	0.0000
	Max	14.000	17.000	14.000	15.000	21.000	21.000	21.000
CoEgg	Mean	10.030	8.946	8.728	9.994	8.322	8.864	9.1160
	StErr	0.575	0.437	0.454	0.400	0.468	0.451	0.1910
	Max	40.00	40.00	25.00	21.00	28.00	35.00	40.00
No of Families		167	224	156	168	184	221	1120

(Minimum values are also included where ever possible, other minimums are zeros)

Table 3 : Descriptive statistics of the Variables of nurient intake

Variable		JAFF	NALL	VASW	VAWE	VASO	VAEA	Region
EneIn	Mean	14055	13455	13783	16093	13880	14887	14338
	StErr	335	215	346	258	272	338	123
	Min	6225	5768	4578	8683	5747	6051	4578
	Max	35123	23438	29761	26118	25682	34650	35123
ProIn	Mean	414.40	370.73	385.04	436.67	385.16	405.54	398.37
	StErr	10.3	6.37	9.64	7.88	7.72	9.58	3.57
	Min	182.30	139.36	150.27	195.15	158.79	156.87	139.36
	Max	1044.80	689.71	960.37	730.29	689.16	1266.91	1266.91
FatIn	Mean	346.10	332.63	346.50	446.40	319.83	391.90	363.24
	StErr	10.90	6.03	19.20	10.40	8.83	19.50	5.67
	Min	124.80	104.64	108.50	216.70	153.83	111.90	104.64
	Max	1438.30	894.67	1770.20	1690.30	1271.64	2475.30	2475.33
No of Families		167	224	156	168	184	221	1120

(EneIn - Calories, ProIn and FaaIn -Grams)

Table 4 : Standardized canonical coefficients of Economic dimensions with seventeen food items

FC versus FI		CP versus FI		MS versus FI	
FSIZE 0.90326	CORIC 0.6055	AGEHU -0.0478	CORIC 0.6055	EXFOO 0.7933	CORIC 0.6055
PRPCI -0.2169	COWFL 0.2666	AGEWI 0.0262	COWFL 0.2666	EXHLH -0.0489	COWFL 0.2666
PRSTU 0.0792	COPUL 0.0813	EDLEH 0.3544	COPUL 0.0813	EXEDU 0.2254	COPUL 0.0813
PRUNE 0.2003	COBRE 0.3367	DELEW 0.5482	COBRE 0.3367	EXHOM -0.0615	COBRE 0.3367
PRELD-0.0729	COBIS -0.0070	OCLEH 0.2518	COBIS -0.0070	EXOTH 0.0764	COBIS -0.0070
	COSUG 0.1038	OCLEW 0.0094	COSUG 0.1038	TOTSA -0.1514	COSUG 0.1038
	COMKP 0.0455	SLHSH -0.0720	COMKP 0.0455	INH&W 0.0937	COMKP 0.0455
	COSEF 0.0515	SLHSW 0.0230	COSEF 0.0515	INOTH 0.1898	COSEF 0.0515
	COMEA 0.0117		COMEA 0.0117	REA&L 0.2084	COMEA 0.0117
	COSTER 0.0708		COSTER 0.0708	REOTH 0.0046	COSTER 0.0708
	COGRL 0.0183		COGRL 0.0183	FOSUB 0.3778	COGRL 0.0183
	OVEG 0.0616		OVEG 0.0616		OVEG 0.0616
	COT&C -0.0031		COT&C -0.0031		COT&C -0.0031
	COMLK-0.0337		COMLK-0.0337		COMLK-0.0337
	COEDO -0.0139		COEDO -0.0139		COEDO -0.0139
	COCON 0.0178		COCON 0.0178		COCON 0.0178