DRAFT

Nigeria Food Consumption and Nutrition Survey 2001

Volume 1

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List of Acronyms and Abbreviations

AEZ	Agroecological Zone
A R S	Agricultural Research Services
B C G	Bacillus Calmete Guerin
B M S	Bench Mark Survey
CDC	Center for Disease Control
CNRG	Community Nutrition Research Group
CV	Coefficient of Variation
D P T	Diphtheria, Pertussis and Tetanus
E A	Enumeration Area
F A O	Food Agriculture Organization
F C N S	Food Consumption and Nutrition Survey
F G D	Focus Group Discussion
F G N	Federal Government of Nigeria
FIB	Food Instruction Booklet
FIAS	Food Intake Analysis System
F M O H	Federal Ministry of Health
H H	Household
H H H	Household Head
I I T A	International Institute of Tropical Agriculture
LGA	Local Government Area
M I C S	Multiple Indicator Cluster Survey
N E P A	National Electric Power Authority
N D H S	National Demographic and Health Survey
N P C	National Planing Commission
O M N I	Opportunities for Micronutrients Interventions
O R T	Oral Rehydration Therapy
O R S	Oral Rehydration Solution
PFC	Principal Food Crop
P H C	Primary Health Center

P I C	Participatory Information Collection
U N I CE F	United Nations Children's Fund
U S A I D	United States Agency for International Development
U S D A	United States Department of Agriculture
R E B	Rural Electrification Board
V I P	Improved Ventilated Pit Latrine
W H O	World Health Organization

EXECUTIVE SUMMARY

The Food Consumption and Nutrition Survey 2001 (FCNS) is a national survey from which data on the nature and extent of food security, food and nutrient intakes, and anthropometric and biochemical parameters were collected and used to determine the nutritional status of women and children in rural and urban populations in Nigeria. The survey design targeted the entire federation of Nigeria. Considering the obvious and documented relationships between (a) the agroecological zone and type of farming systems; (b) crops grown and foods consumed; and (c) type of food consumed (intake) and micronutrient deficiencies, the federation of Nigeria was initially stratified according to major agroecological zones and predominant food crops within agroecological zones.

Survey design and sampling

A stratified multi-stage procedure, with stratification at 2 levels [agroecological zone * Principal Food Crops] was used. Twelve States, representing a third of the total states of the federation were randomly selected. A total of 72 Local Government Areas (LGAs), 216 Enumeration Areas (EAs) and 30 households from each EA were selected from the selected states, making a total of 6,480 households. A sub-sample of 1080 pregnant women was also included.

Survey tools and manuals

The main data collection instrument (questionnaire) had several sections: questionnaire identification, household/demographic information, socio-economic characteristics of households, food security (food availability and affordability, food consumed away from home, and food related coping strategies), 24-hr dietary recall, health and care, anthropometry, and biochemical measurements. The following manuals were developed : Survey Design and Operations Manual, Interviewers Manual, Food Instruction Bookltet and other survey supporting documents.

The procedures for data collection involved

- Visits to community leaders to introduce the survey
- Mobilization of communities in support of the survey
- Numbering and listing of households and use of maps and local guides to locate sampled households and verify that they meet the selection criteria
- Administering the household questionnaire to all selected households
- Conducting the 24-hour dietary recall with the selected household
- Collecting biochemical samples from mothers and their children under-5 used for the 24-hour dietary recall
- Conducting the 24-hour recall and collecting biochemical samples from a sub-sample of pregnant women
- Conducting focus group discussions
- Collecting food and salt samples

A critical component of the FCNS is the food intake portion of the 24-hour dietary recall questionnaire. Respondents were asked to recall what they ate the day before the interview. A guidebook called the Food Instruction Booklet (FIB) was used to aid interviewers in obtaining detailed information on the types of food eaten and the quantity.

The research team in each state was made of a state supervisor, 4 interview teams with 2 interviewers per team. One pair of the interview teams was the medical laboratory technologists, who were responsible for biological sample (blood and urine) collection and processing. Data collection took place between August and October 2001.

Laboratory analysis of biological and salt samples

The vitamin A and E status of children under-5, their mothers and pregnant women were assessed by determining the serum retinal and tocopherol concentrations. Iron status was assessed by determination of serum ferritin while serum zinc was used in determining zinc status. Urinary iodine concentration was used to assess the iodine status of children under-5, mothers and pregnant women. All samples, including salt samples were analyzed at the Medical Research Council, Tygerberg, Capetown, South Africa.

Data sets processed for analysis

Variable	Children under-5	Mothers	Pregnant women
Household questionnaire	N/A	5325	N/A
Anthropometry	5028	N/A	N/A
Vitamin A	1770	3148	684
Vitamin E	1770	3148	684
Iron	2387	3949	829
Zinc	2725	3779	795
Iodine	2428	3104	660
Body Mass Index	N/A	5031	N/A

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Implemantation

The survey was implemented by the International Institute of Tropical Agriculture as a component of the project on "Micronutrient Enhancement of Maize and Plantains in Nigeria: A Sustainable Approach to Mitigate Hidden Hunger" which is funded by USAID and USDA-ARS. Researchers from national universities and other institutions were selected as zonal coordinators and state supervisors. Interviewers were recruited from each state.

Results

Household/Demographic information

- Ninety-four percent of the sampled household heads were male and 6% were female. There was more female-headed household (11.8%) in the humid forest than in the moist (2.4%) and dry savanna (1.6%) zone. The percentages of male-headed household were similar across the sectors.

- At the national level 62.8% households have one spouse and 25.6% have more than one spouse. There is a gradual increase in the number of households with two spouses with the dry savanna zone having the highest at 20.5% followed by moist savanna at 18.3% and the humid forest at 16.8%.

- Household heads in the 35-50 year range were 44.5% at the national level, followed by those in the age group of 18-34 years at 38.3%. Twenty seven percent of the head of households were above the age of 50 years. The dry and moist savanna zones were similar for the age group 18-34 years when compared to the humid forest. The medium sector had the highest percentage (41.5%) of heads of household in the 18 to 34 years age group.

- About half of the households (49%) have sizes between 3 and 5 persons while 35.1% of the households have sizes between 6 and 8 persons, with about 11 percent having household sizes between 9 and 11 persons. Although households with over 11 members were more in the moist savanna (8%), intermediate (4.7%) in the dry savanna and low (2.2%) in the humid forest zone. Across the sectors, households with sizes between 9 and 11 persons were more in the rural and urban sectors than in the medium sector.

- Slightly over 50% of the persons were in the 0-14 years old with 25.1% being children under-5. Those between 15 and 34 years old were 30.8%. Approximately 1% of the population is over 65.

- Nationally, 48.7% of the respondents had no form of education. This suggests a literacy rate of slightly over 50% among household heads. Most of the literate household heads did not complete primary school and there is a progressive decline in the percentage of literate household heads as educational level rises.

Socio-economic characteristics of household

- Over 40 per cent of household heads studied were farmers with about 15 percent each as traders, civil servants and artisan. Fishing was the occupational category with the least percentage of household heads (1.3%).

- While over 50 percent of the household heads in the dry and moist savanna were involved in farming, just about half of this proportion is involved in farming in the humid forest zone. About 15 percent of household heads are civil servants across the zones, artisans were disproportionately higher in the humid forest zone (24%), about half in the moist savanna (11.4%), and 6.2% in the dry savanna zone.

- The predominant source of energy is electricity used by about 38.4% of the households, thus implying that about 62.0% of the households do not have access to national electric supply. Access to other sources of electricity was however very low with less than one percent of households using personal generators and 3.5% utilizing rural electricity.

- About 75.0% of the households do not have electricity in the dry savanna, 45.0% in the humid forest and 57.0% in the moist savanna. Access to NEPA was highest in the humid forest zones (48.3%) and least in the dry savanna zone (23.4%).

- The most common primary source of water for drinking and other domestic uses available to households nationally is the well (37%), followed by springs or rivers (24%), and pipe borne water (20%). The use of boreholes is becoming increasingly popular (11.8%). Only about 5% of the surveyed households depend on rain as the primary source of water.

- The major primary sources of water differed markedly across the sectors. Well was the main source in the rural (44%) and medium (40%) areas, with pipe borne water as the main source in the urban areas. Rainwater was least used in urban areas (2.9%).

- The primary method of refuse disposal among households is the use of bush and other methods (78%). Less than 2 percents of households use city service nationally.

- Over 65% of households use pit latrines, with about 25% using the bush as their main type of toilet. Only about 5 percent of the households use the water closet system. While the use of pit latrines was predominant and consistent across the zones and sectors, over 80 percent of the households in the dry savanna used pit latrines, 59.2% in moist savanna, and 58.2 % in humid forest. The use of bush was however lowest in the urban areas (11%) compared to the rural (30%) and medium (27%) areas.

- While over 10 percent of the households had an estimated annual income of less than 15,000 Naira per annum, about 15 percent of the households estimated their annual incomes as less than 35,000 Naira. The modal income category was between N55, 000 and above (31%).

- Across the agroecological zones, most of the households had estimated annual incomes of N55, 000 and above though the percentage of households in this group

was highest (35%) in the humid forest zone. Also across the sectors, most of the households had estimated annual incomes of N55, 000 and above with 21.4 percent in the rural sector, 32.2% in the medium and 45.5% in the urban sector.

Food Security

- The result indicate that within the 9-12 months range, the percentage of households that could afford the foods available were usually less than the percentage that indicated availability. The most available staple foods that are major sources of energy (calories) were rice (14.8%), cassava (12.9%), maize (10.6%) and yam (10.1%).

- Cowpea, groundnut, and soybean are major source of plant proteins. Cowpea was the most available, followed by groundnuts, and soybean.

- The most available non-staple foods were meat products (14%), non-leafy vegetables (13%), leafy vegetables (9.5%) and fats and oils (8.9%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

- Within the 9-12months periods, rice was more available (16.4%) and affordable (13%) in the dry savanna zone, followed by maize at 12.7% and 10.5% for availability and affordability, and sorghum at 11.6% and 10.3% availability and affordability respectively. Cassava and yam were the least available and affordable

- In the dry savanna, the most available non-staple foods were meat products (12.4%), non-leafy vegetables (15.4%), dairy products (8.2%) and fats and oils (10.6%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

- In the moist savanna for 9-12months periods rice was more available (12.%) and affordable (9%), followed by cassava and maize (11%) and yam (10.5%). Soybean, plantain, and sorghum are the least available and affordable. Among legumes, cowpea was the most available and affordable followed by groundnut, and soybean.

- The most available staple foods that are major sources of energy (calories) were rice (15.7%), cassava (18.0%), maize (9.3%) and yam (12%) in the humid forest. Cowpea, soybean and groundnut are major sources of plant proteins. Cowpea was the most available, followed by groundnuts. Soybean was the least available. For affordability, the same trends were observed. Cassava was the most affordable, followed by rice, yam, and maize. For legumes, cowpea was the most affordable followed by groundnuts.

- In the humid forest zone, the most available non-staple foods were meat products (15.2%), non-leafy vegetables (11.8%), leafy vegetables (10.8%) and fats and oils (8.0%) and fish (8.5%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and dairy product

- In the dry savanna, 59.4% consume sorghum more than 4 times a week, followed by maize at 39.7% and rice at 25.5%. Yam and cassava are the least consumed. In the moist savanna, more households consumed maize (63.5%) followed by sorghum at 42.7%, rice 30.3%, cassava 25%, and yam 22%. The least consumed staple is plantain. Among those who responded in the humid forest, 53.3% consume cassava more than 4 times a week, followed by maize 38.3%, rice 22.4%, and yam 22.1%.

- Among the non-staple foods, fats and oils showed the highest frequency of consumption across the agroecological zones, 75.4% in the dry savanna, 76.5% in the moist savanna, and 84.1% in the humid forest. The second most widely consumed non-staple was fish product 75.5% in the humid forest, non-leafy vegetables 69.7% in the moist savanna and 62.5% in the dry savanna.

- Meat products, green leafy vegetables, and banana were the least consumed across the zones.

- Across sectors and agro-ecological zone, higher availability and affordability of foods is associated with residents in the medium and urban areas, and in the humid forest as opposed to those in the rural sector, and the dry and moist savanna zones respectively. In decreasing order, households in the rural sector are relatively more food insecure, followed by those in the medium and urban sectors. Similarly, households in the moist savanna agroecological zone are more food insecure compared to households in the dry savanna and the humid forest respectively.

- Comparisons across primary occupations of household heads show that families headed by farmers are the most severely affected by food insecurity. The level of severity decreases as one moves from being a farmer to trader, artisan, civil servant, and fishermen-headed households.

- Food insecurity is relatively more severe within households in the low living standard category, followed by those in the medium and high categories respectively. This suggests positive correlation between food security and living standards as measured in this study.

- At the national level there is evidence of high expenditure on staples with cereals attracting the highest expenditure of about N643.97 per week compared to average

expenditure of N347.73 on roots and tubers. Results further reveal that respondents spent more on sorghum (N228.3) than on either rice (N215.6) or maize (N127.2).

- Across agroecological zones, while households in the moist and dry savanna spent as much as N833.48 and N770.51 respectively on cereals, households in the humid forest zones spent average of N311.06 per week.

- Nationally, average household expenditures on non-staples were highest on fish (N140.84) followed by meat products (N81.54). Here the least weekly expenditure was on the fruits (N13.62) followed by weekly expenditure on the leafy vegetables (N20.88). Relatively, the highest expenditure on major non-staples was recorded in moist savanna zone while the least was recorded in the dry savanna zone.

- Nationally, over 13% of the population reported purchasing food on credit. Closely related to that is borrowing money to buy foodstuffs (11.5%) and borrowing foodstuffs (7.2%). More household heads in the humid forest (18.5%) purchased food on credit than in either moist (11%) or dry savanna zone (7.9 per cent) to cope with the situation of food insecurity.

- Other strategies considered include reliance on social-capital as a means to alleviate food insecurity in terms of possible assistance from friends and relatives. Up to 11 per cent of the respondents reported that they depended on friends and relatives for help to mitigate food insecurity.

Nutritional status of children under-5

- Nationally, 42% of children under-5 surveyed is stunted indicating long-standing dietary inadequacy or malnutrition.

- There are major agroecological zone differences in stunting. More children under-5 is stunted in the dry savanna (58%), which is more than twice the rate in the humid forest (27%). Stunting is equally high (46%) in the moist savanna.

- Except in the urban sector (36%) where slightly less children under-5 are stunted when compared to the national level, the rates of stunting in the rural sector are high at 44%.

- The dry savanna has the highest (13%) prevalence of wasting in children under-5 when compared to the national prevalence of 9%. In the moist savanna and humid forest zones and in the sectors the rate of wasting is less than 10%.

- Nationally a quarter (25%), of the children surveyed is underweight. The highest proportion (38%) is in the dry savanna and lowest (16%) in the humid forest. The variation of underweight across sector though differing is about 20%.

- The results show a very steep increase in the percentage of wasting between 6 to 12 months, which is also significant as these periods correspond to the time of breastfeeding, and introduction of complementary foods for most children. This may be the result of sub-optimal infant feeding practices and high rates of infectious morbidity.

- The critical period when all three forms of malnutrition (stunting, wasting, and underweight) are present is 6-24 months.

Nutritional status women

- Nationally 69% of all mothers surveyed had a normal range of BMI. The proportions in the dry savanna and moist savanna are close to the national average but higher (71%) in the humid forest. Paradoxically, a higher proportion of this group is in the rural (70.8%), medium (72.3%) than the urban (61.8%) sector.

- Nationally, 11.6% of women are suffering from chronic undernutrition. The condition is more prevalent in the dry savanna (16.4%) than in the moist (9.9%) savanna and humid (9%) forest zone. Within the different sectors, chronic undernutrition range from 10.3 to 12.7%.

- Further classification of the 11.6% undernourished mothers (BMI below 18.4) to the different levels of Chronic Energy Deficiency, showed that only 8.4% nationally fall in the Chronic Energy Deficiency Grade III.

- The highest percentage (12.1%) of Grade III Chronic Energy Deficiency is found in the moist savanna zone. This is about the same percentage (13.3%) found in the urban area, which is twice as much as that found in both the rural (7.6%) and medium (6.3%) sectors. Chronic energy deficiency has serious implications for morbidity and low productivity of women. This condition is associated with a higher prevalence of low birth weight pre-disposing to a higher infant mortality.

- Overweight (BMI 25.0-29.9)) is 14.2% nationally. It is higher in the moist savanna (16.4%) than in the dry savanna (11.6%) and humid forest (14.8%). In addition, the prevalence of overweight is higher in the urban (18.6%) sector when compared to the medium (13.4%) and rural (12.6%) sectors.

- Obesity (BMI>30) has a national prevalence of 5.7%. The moist savanna zone has slightly more obese women of childbearing age (6.6%), than the humid forest (4.3%) zone.

- The prevalence of obesity rate in the urban (9%) is twice that of the rural (4.6%) and medium (4.8%) sectors.

- The total percentage of women who are overweight is higher 19.9% than that of women suffering from undernutrition (11.6%).

- It is important to note that both conditions (undernutrition and overweight/obese) have serious implications for the health of women and their newborns. Chronic energy deficiency has serious implications for morbidity and low productivity of women. This condition is associated with a higher prevalence of low birth weight pre-disposing to a higher infant mortality. Obesity is significant as a risk factor for serious non-communicable diseases, including cardiovascular disease, hypertension and stroke, diabetes mellitus, and various forms of cancer.

Micronutrient Status of children under-5, women, and pregnant women

Vitamin A

Vitamin A status of children under-5

- At the national level, 24.8% of children under-5 suffers from marginal deficiency and therefore are vitamin A deficient and 4.7% are suffering from severe vitamin A deficiency (clinical deficiency). If those who are marginally deficient and those who are clinically deficient are merged, 29.5% of children-under 5 is vitamin A deficient.

- The level of vitamin A deficiency is high in the dry savanna at 31.3%, 24.0% in the moist savanna and 29.9% in the humid forest. More children with clinical deficiency live in the humid forest (7.1%) than in the dry savanna (3.1%) and moist savanna (2.4%).

- The distribution of vitamin A deficient children under-5 is 25.6% in rural, 32.6% in medium and 25.9% in the urban sector. Partitioning the observed deficiency levels showed that 7.5% of the children in the medium sector are clinically deficient and 3.4% and 2.2% in urban and rural sectors respectively.

- For the sub-sample of children with possible infection, results obtained indicate that 29.2% of the children are marginally deficient and 7.4% are clinically deficient resulting in 36.6% children being vitamin A deficient.

- When the sub-sample was disaggregated by agroecological zones, vitamin A deficiency (marginal plus clinical) is 50.0% in the dry savanna, 33.1% in the moist

savanna, and 36.0% in the humid forest. At the sector level, vitamin A deficiency rates are 43.2% in the medium sector, 33.8% in the rural and 30.1% in the urban sector.

Vitamin A status of mothers

- Thirteen percent of mothers are at risk of vitamin A deficiency.
- At the agroecological zone level, there was a decrease in the percentage of mothers at risk for vitamin A deficiency from 19.6% in the dry savanna to 14.5% in the moist savanna and 8.8% in the humid forest.
- Mothers at risk of vitamin A deficiency were more in the medium (30.7%) sector than in the rural (11.2%) and urban (10.0%).

Vitamin A status of pregnant women

- At the national level, 19.2% of pregnant women are at risk of vitamin A deficiency.
- The possibility of pregnant women being at risk of vitamin A deficiency shows a gradual decrease from the dry savanna (34.3%) through the moist savanna (28.3%) to the humid forest (21.6%).
- More pregnant women living in urban (25.2%) and rural areas (24.4%) are at risk of vitamin A deficiency than those living in the medium areas (17.3%).

Vitamin E

Vitamin E status of children under-5

- At the national level, 22.3% of children under-5 suffers from vitamin E deficiency.
- The level of vitamin E deficiency is high in the humid forest at 27.6%, 20.7% in the moist savanna and 15.5% in the dry savanna zone.
- The distribution of vitamin E deficient children under-5 is 21.5% in rural, 26.3% in medium and 17.8% in the urban sector.
- For the sub-sample of children with possible infection, results obtained indicate that 30.6% of the children are vitamin E deficient.
- When the sub-sample was disaggregated by agroecological zones, vitamin E deficiency was 16.7% in the dry savanna, 31.0% in the moist savanna, and 31.1% in the humid forest. At the sector level, vitamin E deficiency rates were 31.5% in urban, 29.1% in the medium sector, and 29.2% in rural areas.

Vitamin E status of mothers

- Nationally, 13.0% of mothers are vitamin E deficient.
- At the agroecological zone level, vitamin E deficiency levels were similar in the moist savanna (13.9%) and the humid forest (13.6%). The least deficient mothers were found in the dry savanna at 11.9%.
- In urban areas, mothers suffering from vitamin E deficiency are low (7.9%) followed by those in the rural sector (13.0%) and medium areas at 16.2%.

Vitamin E status of pregnant women

- At the national level, 12% of pregnant women are vitamin E deficient.
- The humid forest zone has the largest number of vitamin E deficient pregnant women at 14.6% almost double that of the dry savanna at 7.6%.
- More vitamin E deficient pregnant women are in the rural area (15.0%) than the urban (5.3%) area.

Iron

Iron status of children under-5

- At the national level, approximately 36.3% of children under-5 is at different stages of iron deficiency, with 13.4% of children under-5 already with iron stores (serum ferritin value of less than 20 ng/ml) and 22.3% (serum ferritin value of less than 10 ng/ml) suggestive of iron deficiency.
- A limitation of serum ferritin is the increase in serum ferritin concentrations in acute state of infections, infestations and inflammations. A 'higher than normal' level of serum ferritin could therefore imply increase total body iron or an acute phase situation like infection or both. Of the surveyed children, slightly over 20% had serum ferritin concentration between 101ug/dl and 300ug/dl at the national level.
- The proportion of children with varying degrees of iron deficiency is 47.3% for dry savanna, 30.4% for moist savanna and 33.4% for the humid forest. Iron deficiency is high in the dry savanna (32.2%) followed by the moist savanna (18.5%) and humid forest (18.7%). The same trend was observed for those with depleted iron store (<20 ng/ml), they were more in the dry savanna (15.1%) than in the moist savanna (11.8%) and humid forest (14.7%).
- The proportion of children with varying degrees of iron deficiency is 34.1% for rural, 36.2% for medium and 40.5% for urban. Iron deficiency (serum ferritin

concentration <10 ng/ml) is high in urban (27.8%) followed by medium (23.0%) and rural (18.7%) areas.

- Children under-5 with depleted iron store (serum ferritin concentration <20 ng/ml), were similar in the different sectors 15.3%, 12.7% and 13.2%, in rural, urban, and medium sector respectively.

- Iron deficiency is highest among two age groups: 7-12 months (26%) and 13-24months (22%), followed closely is the 0-6 months age group (18.5%) and falls to 12% amongst 24-60months.

- Except in the 49-60 months age group, where about 60% have normal serum ferritin concentration, all other groups have about 45-49% in the same category.

- The highest prevalence of iron stores depletion (9.8%) is amongst the 13-24month age group, while it is less in 25-26months (7.4%), 37-48 (7.7%) and 0-6 months (6.5%).

Iron status of mothers

- Nationally, 63.2% of women of childbearing age had normal iron status.

- Approximately 24.3% of women of childbearing age are at different stages of iron deficiency, with 12.7% of women already with iron stores (serum ferritin concentration <12 ng/ml) suggestive of iron deficiency

- Most of the iron deficient mothers reside in the dry savanna zone (33.2%) followed by the humid forest (24.1%) and moist savanna (18.4%).

- Twenty seven percent of mothers with iron deficiency reside in the urban areas while 24.7% are in the medium and 22.4% are in rural areas.

Iron status of pregnant women

- Nationally, 52.4% of pregnant women have adequate iron nutrition.

- About 43% of pregnant women with iron deficiency are in the dry savanna zone 31.5% moist savanna and 35.0% in the humid forest. The prevalence of iron store depletion is highest in the dry savanna and lowest in the moist savanna.

- About four out of every ten pregnant women (43.8%) in the urban areas are iron deficient, compared to slightly a third (33.6) in both rural and medium (34.0%) areas.

Zinc

Zinc Status of Children

- A national deficiency prevalence among children under-5 was 21%; one out of every five children.
- The deficiency in the dry savanna was about 74%; this is twice the level in the moist savanna and humid forest.
- The prevalence in the rural sector was about 26%, which is much higher than the 17% in the urban and medium sectors.
- Nationally, about 80% of the children surveyed had normal zinc status. When the data was disaggregated by agroecological zone, 64% of the children under-5 in the moist savanna and humid forest had normal zinc status and only 26% in the dry savanna zone.
- About 82% in the medium and urban sectors have adequate zinc level while about 75% are in the rural sector.

Zinc status in mothers

- Nationally, about 28% of the mothers surveyed were zinc deficient.
- The geographical distribution showed 48% are in the moist savanna, 35% in the dry savanna while a low (10.4%) prevalence was found in the humid forest.
- The percentage prevalence is higher in the medium (46%) than in the rural (43%) and urban (41%) sectors.

Zinc Status in pregnant women

- More than two-fifths (43.7%) of pregnant women throughout the country are zinc deficient.
- The prevalence of zinc deficiency in pregnant women was higher (73.39%) in the moist savanna, and lowest (23%) in the humid forest. The dry savanna zone has a prevalence of 42.6%.
- The prevalence across the three sectors was similar although the rural (43.3%) and medium (46.1%) seem to have slightly higher percentages than the urban (40.8%).

Iodine

Iodine status of children under-5

- At the national level, 3.7% of children under-5 suffers from severe iodine deficiency and 8.4% are suffering from moderate iodine deficiency. If those who are severely deficient and those who are moderately deficient are merged, 12.1% of children-under 5 is iodine deficient.

- The level of iodine deficiency is high in the moist savanna at 18.6%, followed by the humid forest at 9.2%, and 8.2% in the dry savanna zone. In addition, more children with mild deficiency reside moist savanna (19.3%) than in the humid forest (17.8%) and dry savanna (10.6%).

- The distribution of iodine deficient children under-5 is 13.2% in rural, 12.7% in medium and 9.7% in the urban sector.

- At the national level, 18.9% of children under-5 had more than adequate intake of iodine and 21.9% had possible excess. Those with more than adequate intake ranged from 18 to 19% and those with possible excess intake ranged from 17 to 28% across the agroecological zones.

- At the sector level, the percentage of children under-5 with more than adequate intake ranged from 16 to 20% and those with possible excess intake ranged from 20 to 26% across the sectors.

Iodine status of mothers

- Thirteen percent of mothers are suffering from iodine deficiency nationally.

- At the agroecological zone level, more mothers residing in the moist savanna (18.1%) were iodine deficient followed by those in the dry savanna (12.1%) and humid forest (10.3%).

- Mothers suffering from iodine deficiency were more in the rural (15%) than in the medium (12.7%) and urban (10.4%) sector.

- At the national level, 18.3% of mothers had more than adequate intake of iodine and 22.1% had possible excess. Those with more than adequate intake ranged from 17 to 19% and those with possible excess intake ranged from 16 to 27% across the agroecological zones.

- At the sector level, the percentage of mothers with more than adequate intake ranged from 16 to 19% and those with possible excess intake ranged from 18 to 26% across the sectors.

- Mothers with adequate iodine status were 28.8% at the national level, ranged from 26 to 30% across the sectors.

Iodine status of pregnant women

- At the national level, 12.4% of pregnant women are iodine deficient.
- In disaggregating by agroecological zones, pregnant women in the moist savanna were more iodine deficient (14.7%) followed by those in the humid forest (12.3%) and dry savanna (8.5%).
- Pregnant women suffering from iodine deficiency were more in the rural (14.8%) than in the medium (10.7%) and urban (9.7%) sector.
- At the national level, 18.2% of pregnant women had more than adequate intake of iodine and an equal percentage (18.7%) had possible excess. Those with more than adequate intake ranged from 16 to 20% and those with possible excess intake ranged from 18 to 19% across the agroecological zones.
- At the sector level, the percentage of pregnant women with more than adequate intake ranged from 16 to 21% and those with possible excess intake ranged from 17 to 20% across the sectors.
- Pregnant women with adequate iodine status were 19% at the national level, ranged from 29 to 37% across agroecological zones and 31-33% across sectors.

Child health

- Malaria was the most prevalent as it affected 71.3% of the children and a large majority (32.4%) between two to four times in the year. Prevalence of malaria was highest in the humid forest (75.7%) and lowest in the moist savanna (71.7%) and dry savanna (71.2%).
- Those who suffered malaria 2-4 times within the year were more in the dry savanna (36.3%) followed by those in the humid forest (35.2%) and moist savanna (31.1%). More children in the rural areas (73.9%) were affected by malaria than in the medium (70.6%) and urban (67.5%) sector.
- Prevalence of diarrhea is much more in the rural (52.5%) than either the medium (49.6%) or urban (42.7%) sectors. It was also higher in the dry savanna than the humid forest and least in the moist savanna (12.7%).
- The four popular options household caregivers usual adopt include the following in their order of importance: use of Primary Health Care (PHC) facilities (29%), going

to chemist shops (21%), traditional healing homes (17.6%), and the use of hospitals (13.5%).

- Across the zones, the most common option in the dry savanna is the traditional healing home (39%), PHC in the moist savanna (39%), the use of Chemist Shop (27.2%) and PHC (27%) in the humid forest. The use of PHC facilities is equally appreciably low in the dry savanna (22%), followed by the use of Chemist shop (18%), and a substantially lower use of hospitals (9.2%) compared to the other zones.

- The most popular method used in the prevention of malaria is insecticide spray (52%). Across the agroecological zones their use were 44.8%, 67.3%, and 49.9% in the dry savanna, moist savanna, and humid forest respecvtively. Only 4% use window netting. The use of insecticides in the prevention of malaria was 48.3%, 51.8%, and 60.4% in rural, medium, and urban sectors respectively.

- Nationally, 14.2% of the respondents use bed nets. In the dry savanna, only 18.0% use bed nets followed by those in the humid forest (15.0%) and moist savanna (7.4%). In the rural sector, 14.7% of the respondents, 14.8% in the medium sector, and 10.7% in the urban sector use bed nets in the prevention of malaria.

- Oral rehydration solution (ORS) was the most popular (55%) method of treating diarrhea, while homemade salt sugar solution comes a far second (26.8%). The use of ORS is by 64.8% of respondents in the dry savanna, 58.1% in the moist savanna and about 43% in the humid forest.

- Nationally only 21% of the children surveyed had all or 'complete' immunization prescribed against vaccine-preventable childhood illnesses (BCG, DPT and Oral Polio, Measles). Thirty-six percent (36%) had 'no immunization' at all, while 43% had 'some'.

- The proportion of those who had all immunization increased with mother's education, 11.7% in mothers with no formal education, and 24% in mothers with primary school (not completed), 32.6% in primary completed, 40% in secondary school completed and 45% in children of mothers with post secondary education.

- About 15% can be considered to have practiced EBF nationally for 6 months. Majority in all the agroecological zones introduced other foods in the first month, and about 20% waited until 3-6 months to introduce other food or water with breastfeeding in the moist savanna and humid forest.

Care for women

- A majority (70–80%) of cases, women will always discuss issues with their husbands especially when it relates to their own (71%) or their children (83%) health. Between 3.3– 4.4% of the respondents indicated that they would never discuss such issues with their husbands.

- When it comes to decision making however, just over half (50.4%) of respondents at the national level indicated that their husbands may reconsider his position or accepts hers in the event of a disagreement, for example, override her opinion.

- The percentage of those who indicated that their husband would reconsider his position or accepts her opinion was high in the dry savanna (61.2%) followed by moist savanna (48.9%) and humid forest (38.5%). For the sector, the percentage was not very different at 49.4%, 50.8%, and 52.0% in the rural, medium, and urban respectively.

- The workload for women seems to be heavier in dry savanna and humid forest compared to moist savanna. About 20% of women respondents in the dry savanna (19.9%) and humid forest (17.5%) indicated that their workloads never allow any time to rest. The corresponding figure in the moist savanna was 10%.

- Awareness of child spacing is higher in the humid forest (76%) than in the moist savanna (63%) or the dry savanna (48%). Discussing with spouses was highest in the humid forest (50%) than the moist savanna (33%) and least in the dry savanna (7%). There is a parallel between awareness and discussing the issue.

- Access to antenatal care and its utilization was higher in the humid forest (76%) and urban (75%), than in the moist savanna (69%) and medium (64%), dry savanna (39%) and rural (55%).

- When asked if women were allowed to participate in income generating activities, almost 90% in the humid forest were allowed by their husbands to participate in income generating activities. On the contrary, almost 40% of respondents in the dry savanna said they were not allowed. Differences in response to this question were not so different across rural (78.6%), medium (74%) and urban (75.7%) sectors.

- Nationally, 51% of women indicated that their food share improved during pregnancy. In the agroecological zones, approximately 50% of respondents in dry savanna (45.5%), moist savanna (52.3%) and humid forest (53.4%) said their food share within the family is increased during pregnancy.

- Seventy-three percent of the respondents said that women education is encouraged while only 26% said it is discouraged with less than 1% saying it was tabooed.

- Disaggregating by agroecological zone revealed that encouragement of women education is greater in the humid forest (94.6%), than in the moist savanna (68.3%) and dry savanna (49.3%).

- Responses collected on the most preferred person to go to school when resources are scarce indicates that 40% preferred the boy/girl jointly while 12.2% will send the most intelligent person to school irrespective of whether they are boys or girls.

- A majority (67%) of the respondents nationwide cover the food but keep it in the open. About 13% keep the food in the cupboard. Approximately the same percentage of respondents (11.1%) keeps the left over food warm. Only 4% of respondents preserve the food in a refrigerator. Significantly however, over 3% of women keep their food uncovered in the open.

CHAPTER 1
BACKGROUND INFORMATION

1.1 Geographical definition.

Nigeria is situated in West Africa on the Gulf of Guinea. The country lies between 4° and 14° North of the Equator and between 2° and 14° East of the Greenwich Meridian. It shares a border with Benin Republic (West), Niger (North), the Republics of Chad and Cameroon (East) and the Atlantic Ocean (South).

Nigeria is endowed with natural resources including a land mass estimated at 930,000 square kilometers. It has over 900 km of coastal waters which, when combined with the 320 km Exclusive Economic Zone and the vast resources of rivers and lakes, provide enormous fishery resources. The topography of the country consists of plain, lowland and plateau areas. The plateau area reaches a height of over 1800 meters in the Jos Plateau.

The vegetation can be divided broadly into tropical rain forest areas in the south and the savannas in the north. There are also low-lying mangrove swamp forests along the coastal line in the South and the savannas. The climate is hot and humid with temperatures between 25-35°C throughout the year and an annual rainfall of up to 4,000 mm in the south. The climate is mostly hot and dry in the north with occasional sandstorms or harmattan. Temperatures up to 40°C are recorded in the hottest months while the plateau area can record temperatures as low as 15°C in some months of the year. With exception of some parts of southern Nigeria that have bimodal rainfall patterns, rainfall is limited to one season (Jagtap, 1995). In the south, the rainy season is from March to July, while in the north, it is from July to September. About 75% of the country's total land area is suitable for agriculture/arable farming, forestry and animal husbandry. Rainfall agriculture is generally practiced while irrigation is carried out mostly along the large rivers and dams.

1.2 Basic administrative structure and socio-demographic characteristics

Nigeria is the most populous country in Africa with a population of about 120 million (NPC, 1991). Approximately 75% of the population is women and children with over 70 % residing and securing their livelihoods in the rural area. Administratively, the country consists of 36 states, a federal capital territory in Abuja and 774 Local Government Areas (LGA). A three-tier government system is being implemented: federal, state and local government levels. This administrative structure is meant to promote development at the community level. Nigeria is a nation with diverse cultures, ethnicity, as well as religious and political interests. There are estimated to be over 250 ethnic groups. The dominant groups are Edo, Fulani, Hausa, Ibibio, Idoma, Igbo, Ijaw, Kanuri, Tiv and Yoruba.

1.3 The macro and microeconomic and development environment

In the last two and a half decades, Nigeria has shifted emphasis from being a major agricultural producer to a single product economy. The oil boom transformed Nigeria from an agricultural economy to an oil producer and a mono-export culture. By 1980, oil accounted for 22% of GDP, 81% of government revenue and 96% of export earning (NASENI, 1992). This resulted in a decline in agricultural productivity and promoted the massive importation of food items. The concentration of industries in the urban centers exacerbated the problems of inadequate and uneven development of the rural areas and a depletion of the rural agricultural labor force.

As of 1999, the country experienced negative per capita income growth, limited foreign reserves, and external debt of over US$30 billion. As a result, deficits and inflation have been high and variable, social spending on health and education has been inadequate, state owned enterprises render poor service and incur monumental losses. Agricultural support systems have deteriorated and agro industries are under utilized. Farmers have little access to credit, agricultural inputs and extension services. Over 40 % of crops produced are lost to post harvest pests, spoilage and poor infrastructures, and as a result, poverty and malnutrition have increased and are most prevalent in the rural areas where over 70 percent of the poor live.

Various efforts have been made overtime to revive the Nigerian economy, which culminated in the return to a civilian government in 1999. In the last few years, there has been renewed interest in and support for social and economic development by the international community. A major indicator of such social and economic development is the nutritional health of the people. Nigeria made less progress over the past four decades in reducing mortality among under-five children than any other country in sub Saharan Africa (SAS, 2001). Almost one in five Nigerians dies before reaching the age of five. The under five-mortality rate is 30 times higher than in most industrialized countries. Maternal mortality ratio remains about a hundred times higher than in industrialized countries (SAS, 2001).

Despite considerable progress in understanding the nature and causes of malnutrition, it continues to be a problem. Stunting, wasting and underweight have remained unusually high coupled with high levels of micronutrient deficiency. The growing challenge of HIV/AIDS has not helped matters. Being the most populous country in Africa, Nigeria contributes about 8 percent of the global HIV/AIDS burden and over 10 percent of the African burden (SAS, 2001).

In view of this poor state of nutritional health and its consequences on economic productivity as well as physical and mental development of Nigerians, the government formulated and launched a National Policy on Food and Nutrition in November 2002.The Food and Nutrition Policy is to serve as "a framework to guide the identification and development of intervention programmes aimed at addressing

the problems of food and nutrition across different sectors and levels of the Nigerian Society"(NPC, 2001).The overall goal of the National Food and Nutrition Policy is to improve the nutritional status of all Nigerians , with particular emphasis on the most vulnerable groups.

The specific objectives of the National Food and Nutrition Policy are to:

- Improve food security at the household and aggregate levels to guarantee that families have access to adequate (both quantity and quality) and safe food to meet nutritional requirements for a healthy and active life.
- Enhance care-giving capacity within households with respect to child feeding and childcare practices, as well as addressing the care and well-being of mothers.
- Improve the provision of human services, such as healthcare, environmental sanitation, education and community development.
- Improve capacity within the country to address food and nutrition problems
- Raise understanding of the problems of malnutrition in Nigeria at all levels of society, especially with respect to its causes and possible solutions.

CHAPTER 2
INTRODUCTION

2.1 Introduction

When attempts are made to assess the prevalence of malnutrition, globally, regionally, or nationally, the first problem encountered is the paucity of data available. The data being currently used in nutrition circles in Nigeria are fairly old and drawn from different surveys of diverse or different methodologies and techniques, or notably focused on specific aspects of nutrition. Some of such data include data from the Nigeria Demographic and Health Survey (NDHS, 1990), the Participatory Information Collection Study (PIC, 1993), the Multiple Indicator Cluster Survey (MICS, 1995) and the Benchmark Survey (BMS, 1996), among others. Some of these are often confined to a segment of the population, which may not include all groups most at risk. Inevitably, the design of any relevant action plan to mitigate the problem of micronutrient deficiencies will be constrained by lack of understanding of how many people are affected, who they are, their location in the country, and to what extent they are affected.

Even the most recent findings of the Multiple Indicator Cluster Survey (MICS, 1999) and the Baby Friendly Hospital Initiative Impact Evaluation (BFHI, 1999) and the National Demographic and Health Survey (NDHS, 1999) fall short of covering all the relevant aspects of nutrition. The shortcomings of some of these surveys are that they had objectives other than nutrition but included some of the nutrition indicators as secondary foci. Others fell short technically because of the difficulties of combining biochemical techniques with participatory social sector and scientific methods in eliciting holistic nutrition data.

Generally, most of these surveys which attempted to address nutrition indicators used classical techniques that had little or no community participation, a key aspect of current techniques for eliciting information and feedback to beneficiaries as active participants in the development process. Further, the changing socioeconomic conditions have not only dimmed the relevance of these information sources but also made some of them obsolete and sometimes misleading as programming and planning tools.

More specifically, limited studies have been conducted in Nigeria to determine the prevalence of micronutrient deficiencies. Available data from smaller scale studies indicate that micronutrient deficiencies (vitamin A and iron, among others) are evident in many sub-populations. Data available on zinc deficiency for example, is minimal. Although some progress has been made in combating micronutrient deficiency, urgent action is needed to accelerate the efforts to bring micronutrient malnutrition under control. Assessment of the micronutrient problem and knowledge on nutrients supplied by the diet can play an important role in accelerating the efforts for combating micronutrient malnutrition.

It is therefore pertinent to undertake a holistic national survey to generate, in a participatory manner, very current data on all aspects of nutrition covering food security, health practices and care, for both planning and programming in Nigeria. The information should also be useful to all agencies with primary and secondary mandates and foci in nutrition.

2.2 Goal

The overall objective of the Food Consumption and Nutrition Survey (FCNS) is to assess the prevalence and spread of micronutrient deficiencies and determine the nutritional status and nutrient intakes of the rural and urban populations in Nigeria.

2.3 Specific objectives

1. Determine the level of food insecurity, nutritional status and nutrient intakes of the rural and urban populations in Nigeria

2. Assess the vitamin A, iron, zinc and iodine status of under 5-children, women and pregnant women from food intake and biochemical indices

3. Elicit from household and communities information on home health practices, food processing and preference

4. Update the Nigeria Food Database

2.4 Scope of the survey

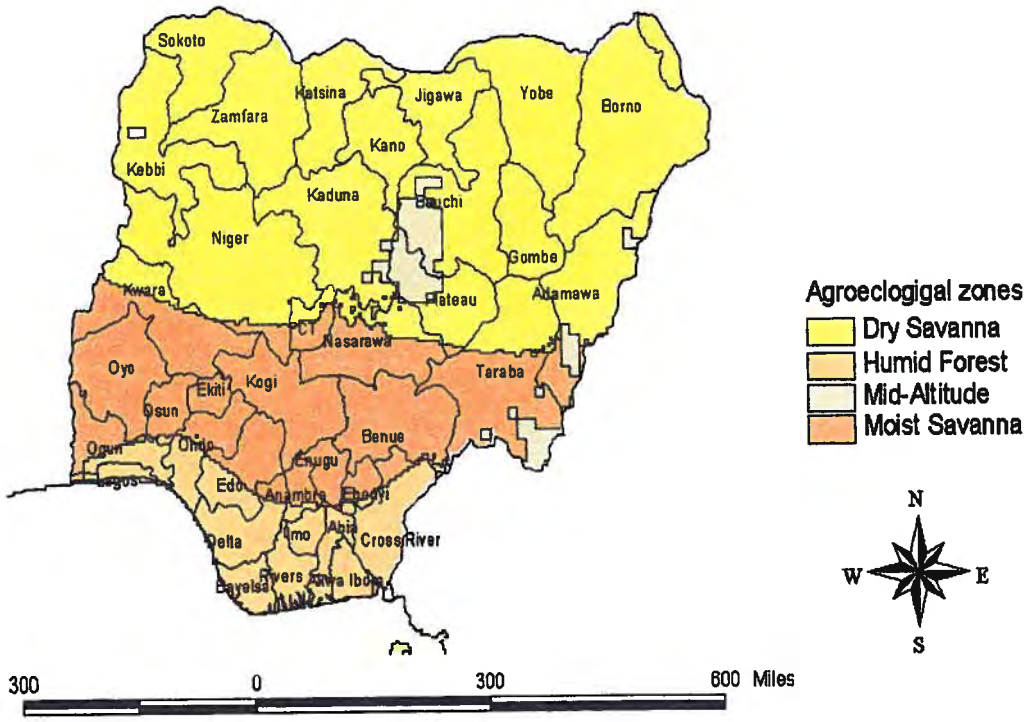
The scope of the survey is national, covering 12 states representing a third of the total states of the federation, 72 Local Government Areas (LGAs), 216 Enumeration Areas (EAs) and 30 households from each EA.

CHAPTER 3

SAMPLE DESIGN

3.1. Introduction

The design targets the entire federation of Nigeria. Considering obvious and documented relationships among (a) the agroecology and type of farming systems; (b) crops grown and food consumed; and (c) type of food consumed (intake) and micronutrient deficiencies, the federation of Nigeria was initially stratified according to major agroecological zones and predominant food crops within agroecological zones. Owing to lack of information on the principal variables of interest in the study, a sample size consistent with the cost of survey and availability of resources was aimed at. It is postulated that a large sample size, spread across agroecological and food type zones, shall be fairly representative of the whole country. There are three major agroecological zones in Nigeria: dry savanna, moist savanna and humid forest. The humid forest is characterized by a length of growing period (LGP) of 270 days, moist savanna LGP of 181-270 days and the dry savanna with LGP of 90-180 days.

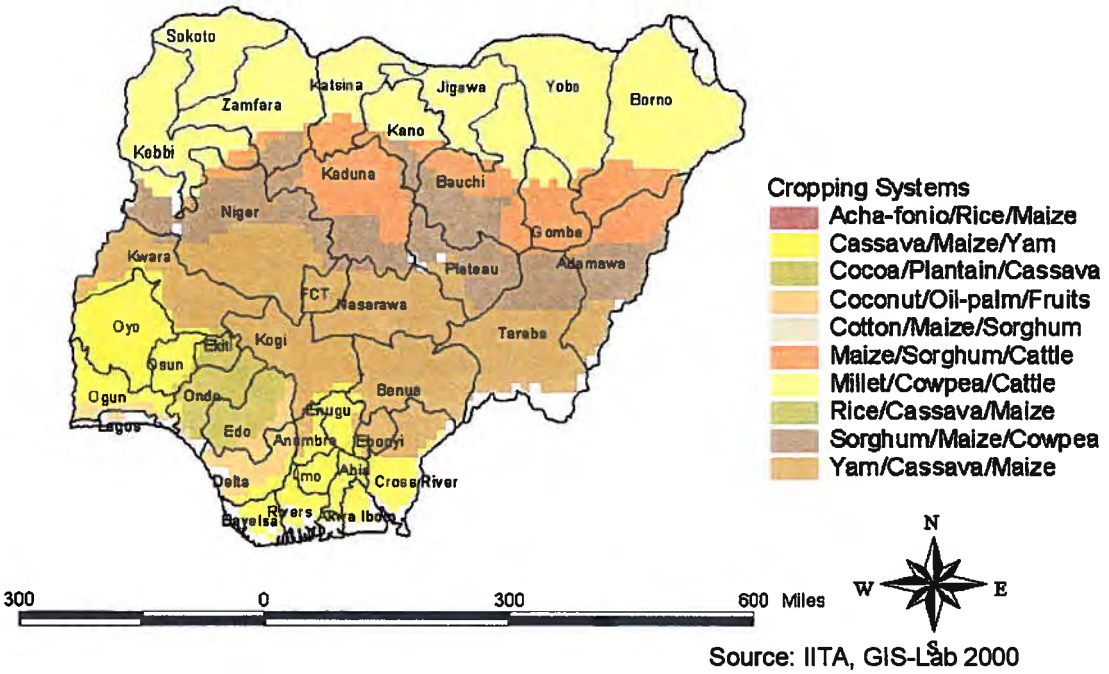


Source: IITA, GIS-Lab 2000

Figure 1. Map of Nigeria showing the different agroecological zones

3.2 Sampling procedure

A stratified multi-stage procedure, with stratification at 2 levels [AEZ * PFC, i.e. Agro-ecological zone *Principal Food Crops)] was used. **Figure 1** shows the AEZ group, while the PFCs varied within AEZs. AEZ1 is essentially a dry savanna zone, while AEZ2 is predominantly moist savanna, and AEZ3 the humid forest zone. The PFCs range from mainly cereal food crops to root crops and their combinations. Three PFCs were identified in each of AEZ1 and AEZ2, while 4 PFCs were identified in AEZ3 **(Table 1 and Figure 2).**



Source: IITA, GIS-Lab 2000

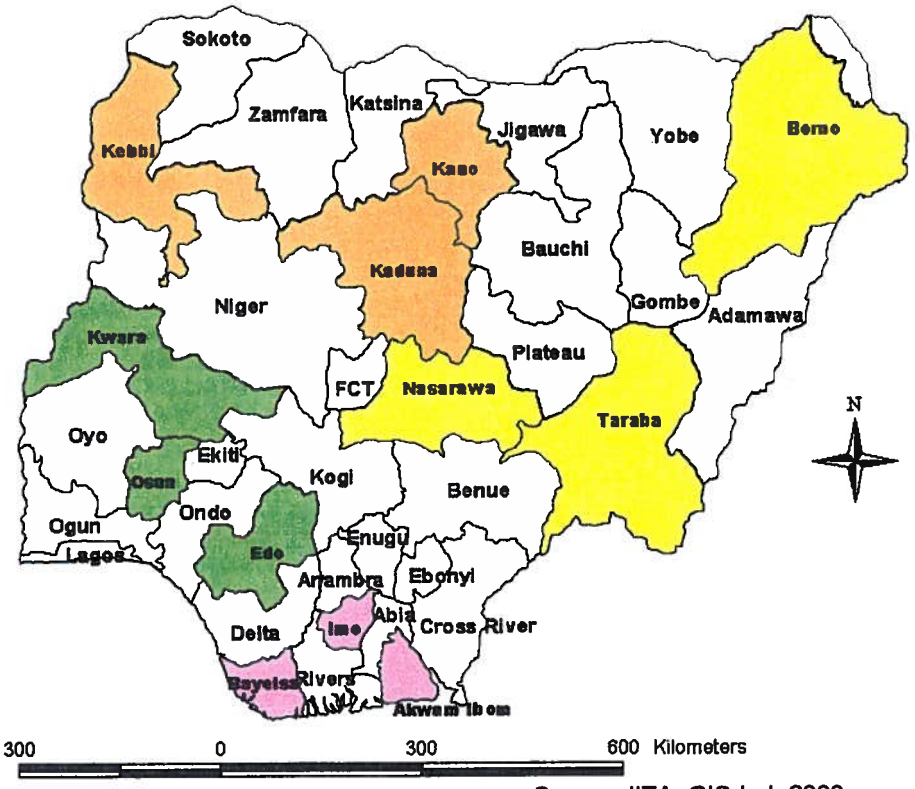
Figure 2. Map of Nigeria showing the different principal food crops (PFCs)

3.2.1. Selection of states

In each PFC, a random sample of one of the states within the particular PFC was taken (with the exception of a PFC in zone 3 where 2 states were taken due to the larger number of states present). Selection probabilities of states ranged from 1/18 to 1/48 [i.e., proportional to sizes of subgroups]. Twelve states were selected **(Figure 3).**

Table 1. Agro-ecological zones showing states in each zone and number of principal food crops per zone.

Dry savanna (AEZ 1):				
PFC1	SOKOTO	ZAMFARA	*KEBBI*	NIGER-N
PFC2	KATSINA	*KANO*	JIGAWA	BAUCHI
PFC3	YOBE	GOMBE	*BORNO*	
		ADAMAWA-N		
Moist savanna (AEZ 2):				
PFC4	KADUNA	NASSARAWA	PLATEAU	NIGER-S
PFC5	TARABA	ADAMAWA-S		
PFC6	KWARA	KOGI	BENUE	
Humid forest (AEZ 3):				
PFC7	OYO	OSUN	OGUN	LAGOS
PFC8	ONDO	EDO	EKITI	
PFC9	DELTA	BAYELSA	RIVERS	
PFC10	ANAMBRA	IMO	ENUGU	AKWA IBOM
	CROSS RIVER	ABIA	EBONYI	



Source: IITA, GIS-Lab 2000

Figure 3. Map of Nigeria showing States covered during the survey

3.2.2 Local Government Areas (LGAs)

Within each selected state, a listing of LGAs was obtained, grouped according to the level of urbanization (urban, medium, and rural) by Nigeria's Federal Office of Statistics. Two considerations formed the basis for the selection of the LGAs. The first was the need to ensure that the LGAs represent a range of rural/urban conditions, while the second was cost efficiency. The latter was related to the fact that coordinators for the projects had been identified along 4 geopolitical lines while indeed the selection of the states (from which the LGAs were selected) had been based on agroecological and food type/production/consumption groupings. For ease of coordination, the states selected were placed in their respective geopolitical zones as follows:

Zone 1: Borno, Taraba, and Nassarawa
Zone 2: Kebbi, Kaduna, and Kano
Zone 3: Kwara, Osun, and Edo
Zone 4: Bayelsa, Imo, Akwa-Ibom.

From each selected state, sampling was done such that all the 3 LGA-categories were represented. Further stratified sampling with probabilities proportional to number of LGAs in each category was adopted, subject to additional conditions that a minimum of one LGA from each group within LGA and a maximum of 18 for all the states making up a particular geopolitical zone were selected. The practical method for achieving this involved random selection of 1 from each of the 36 categories (12 states x 3 LGA groups), and the allocation of the remaining 36 samples proportionately to the total population of LGA groups. Sample sizes, for this stage of sampling, are given in **Table 2,** while a listing of the selected LGAs are given in **Table 3.**

Table 2. Distribution of sample by LGA categories and states.

Geo-Zone	AEZ[1]	State	Urban	Medium	Rural	Total
NE	TWO	Nassarawa	1	1	2	4
	TWO	Taraba	1	2	3	6
	ONE	Borno	2	3	3	8
NW	TWO	Kaduna	1	2	2	5
	ONE	Kebbi	1	1	2	4
	ONE	Kano	2	3	4	9
SW	THREE	Osun	2	2	3	7
	THREE	Edo	1	2	3	6
	TWO	Kwara	1	2	2	5
SE	THREE	Imo	2	2	4	8
	THREE	Bayelsa	1	1	1	3
	THREE	Akwa Ibom	1	3	3	7
Total LGA categories selected			**16**	**24**	**32**	**72**

[1] **Agroecological zone**

3.2.3 Enumeration Areas (EAs)

To facilitate the actual location of rural/urban LGA from selected LGAs; the EAs that fall entirely within a selected LGA were further sampled. Three EAs were randomly selected from among the list of EAs that are within a selected LGA. It is from these selected EAs, that a further breakdown of EAs was made for the selection of households.

A comprehensive list of all the EAs in selected LGAs was obtained from the National Population Commission (NPC[1]). The EA is the smallest geographical cluster of households as delineated by the NPC[1] for purposes of enumeration. The number of households within the area determines the size of the EA. The population of each of the EAs was obtained from the LGA headquarters.

3.2.4. Household level

The household unit (HH) represents the smallest unit to be observed. A list of all the households in each EA was made. A household is a family unit that feeds from the same pots and has a recognized head of authority. Households with under-five-year old children, women of childbearing age and/or pregnant women were identified during a household listing exercise, and constituted the target population. Detailed information (addresses) of the households were properly documented to ease identification.

3.2.5 Selection of households

From each LGA-EA, 30 HHs (according to size, that is the number of HH in the selected LGA-EA) from the target population of HHs with under-five's, etc., were randomly selected. The 24-hour dietary intakes recall section of the questionnaire was administered to the mother and child under-5 of the selected HHs.

3.2.6 Selection of persons for biochemical/anthropometric/health measurements

Anthropometric data and blood samples for biochemical analysis were collected from the pair of mother and child from the sample obtained from 3.2.5. However, where there was more than one child under five years, the youngest child was selected. Also, where there was more than one wife in the household, the youngest wife was selected with her youngest child.

Table 3. Listing of selected states and LGAs.

State Zone 1	code	Selected LGA	Status
Nasarawa	1	Keana	rural
	2	Nassarawa	urban
	3	Keffi	medium
	4	Wamba	rural
Taraba	5	Bali	medium
	6	Gassol	rural
	7	Ussa	rural
	8	Jalingo	urban
	9	Sardauna	medium
	10	Ardo Kola	rural
Borno	11	Maiduguri	urban
	12	Monguno	medium
	13	Damboa	medium
	14	Abadan	rural
	15	Bayo	rural
	16	Biu	urban
	17	Gubio	medium
	18	Kwaya Kwar	rural
Zone II			
Kaduna	19	Makarfi	medium
	20	Kauru	rural
	21	Tudun-Wada	urban
	22	Lere	medium
	23	Gwagwada	rural
Kebbi	24	Dandi	rural
	25	Birnin-Kebbi	urban
	26	Bagudo	medium
	27	Gwandu	rural
Kano	28	Kano Municipal	urban
	29	Bichi	medium
	30	Kura	medium
	31	Tofa	rural
	32	Tudun-Wada	urban
	33	Rano	medium
	34	Gwarzo	rural
	35	Bagwai	rural
	36	Takai	rural

State Zone III	code	Selected LGA	Status
Osun	37	Oshogbo	urban
	38	Ife South	medium
	39	Ifedayo	rural
	40	Ila	urban
	41	Ife East	medium
	42	Irepodun	rural
	43	Ola Oluwa	rural
Edo	44	Etsako West	medium
	45	Egor	rural
	46	Etsako East	rural
	47	Orhionmwon	urban
	48	Esan West	medium
	49	Ovia S.W.	rural
Kwara	50	Oyun	medium
	51	Ekiti	rural
	52	Offa	urban
	53	Ilorin West	medium
	54	Irepodun	rural
Zone IV			
Imo	55	Owerri Municipal	urban
	56	Oru East	medium
	57	Isu	rural
	58	Ohaji/Egbema	rural
	59	Aboh-Mbaise	urban
	60	Okigwe	medium
	61	Orsu	rural
	62	Njaba	rural
Bayelsa	63	Yenagoa	urban
	64	Sagbama	medium
	65	Ekeremor	rural
Akwa-Ibom	66	Etinan	medium
	67	Ikono	medium
	68	Ibesikpo Asutan	rural
	69	Ikot-Ekpene	urban
	70	Itu	medium
	71	Nsit-Ubium	rural
	72	Okobo	rural

3.3 Probabilities of selection and sample weighting

The analysis of data from survey having complex designs requires the use of sample weights to compensate for variable probabilities of selection. Sample weights are required for the analysis of the survey data. At each level of aggregation, the weight associated with a sample HH is the reciprocal of the probability of including that HH in the sample.

The HHs were selected through a multi-stage sample design involving the stratification of Nigeria into agroecological zones, selection of states within zones, LGAs within states, EAs, with LGAs and HHs within the target groups in the EAs. The size of the target population within the EA was determined after the HH listing exercise prior to the survey.

Empirical weights were derived on countrywide basis following the sampling plan. The following components are required:

- The probability of selecting the state.
- The probability of selecting the LGA within the state.
- The probability of selecting the EA within the LGA.
- The probability of selecting an eligible HH within the EA.

The product of these is the probability of an eligible HH having being selected for the survey. **Table 4** provides empirical probability values for selected states and LGAs.

Table 4. Empirical probabilities of selection for LGAs and states.

	Empirical selection probabilities			
State	**Within AEZ/PFC**	**Within Indicated State**		
Name of State	**State**	**Urban LGA**	**Medium LGA**	**Rural LGA**
Nassarawa	0.0333	0.077	0.077	0.154
Taraba	0.0556	0.063	0.125	0.188
Borno	0.0278	0.074	0.111	0.111
Kaduna	0.0222	0.043	0.087	0.087
Kebbi	0.0278	0.048	0.048	0.095
Kano	0.0278	0.045	0.068	0.091
Osun	0.0278	0.067	0.067	0.100
Edo	0.0278	0.056	0.111	0.167
Kwara	0.0370	0.063	0.125	0.125
Imo	0.0238	0.074	0.074	0.148
Bayelsa	0.0278	0.125	0.125	0.125
Akwa-Ibom	0.0238	0.032	0.097	0.097

The allocation of LGAs to selected states is in proportion to state size in terms of number of LGAs, and with reference to AEZ/PFC/geopolitical zone and hence weighting, the estimates according to their relative sizes will derive national estimates.

3.4 Development of survey tools

Survey tools development workshop
A series of workshops for the development of survey tools and manuals were conducted. The workshop consisted of both working groups and plenary sessions to develop the interviewers manual, Food Instruction Booklet and Survey Design and Operation manuals in collaboration with Community Nutrition Research Group (CNRG) of USDA/ARS. In addition, the questionnaire that was earlier developed by the National Planning Commission (NPC) and UNICEF was revised, modified and finalized for use in the survey **(Appendix 1-1 and Appendix 1-2).** Publicity materials were also developed. The draft questionnaire was tested during the state supervisors' training workshop to prepare the version to be used during the pilot study.

Ethical clearance
An ethical clearance for the conduct of the survey, including collection of biological samples was obtained after due process from the Federal Ministry of Health through the Nutrition Division of the Ministry.

Pilot study
For a study of this magnitude and importance, it is essential to test all aspects of the materials and procedures to be used before the main study begins. As part of the planning process, a pilot study duplicating the planned survey design on a small scale was conducted. The objective of the pilot study was to test the use of the questionnaires and procedures designed for use in the main study, as well as logistics.

The results of the pilot study and the experience of using these tools and procedures enabled the survey team to modify appropriately and improve them for the main study. The pilot study was conducted in 5 states. One LGA and one EA were selected in each state. Ten households were interviewed in each selected EA, making a total of 50 households. All parameters were taken during the pilot study. Biochemical samples were collected from all selected households. The pilot study provided an excellent opportunity to further refine the quality of survey instruments and improve the efficiency of survey operations.

Debriefing Meeting
To capture experiences and provide feedback on procedures and materials, a debriefing meeting was conducted after the pilot study. The participants included interviewers, state supervisors and zonal coordinators. Interviewers maintained a logbook. Field observations by zonal coordinators and state supervisors provided

additional information for identifying areas for improvement. A questionnaire was submitted to USDA, CNRG and USAID for input.

Mobilization and sensitization of communities
The selected states, LGAs, and EAs to be surveyed were mobilized and sensitized. The NPC employed the intergovernmental communication channels to notify and obtain the consent of the state governments, which in turn informed the LGAs covered by the survey, and subsequently, the EAs through the LGAs. The LGAs, in addition, provided guides to assist the interviewers in locating selected households and respondents. Community leaders were informed about the survey by the chairperson of the LGA, while members of the communities were mobilized before the arrival of the research team.

Interviewers used publicity materials to describe the survey to the households, establish the legitimacy of the survey, gain respondent cooperation, and answer respondent questions. The publicity materials used were a brochure and introductory letter **(Appendix 2-1 and 2-2)**. In some states, posters were also used. The brochure had general information about the survey, uses of the survey data and results from previous surveys. Interviewers to establish their legitimacy had a photo identification badge. Other supporting documents for the survey were developed and are presented in **Appendix 3-6**.

Project Teams
For data collection, IITA in collaboration with NPC and UNICEF recruited four zonal coordinators who in turn selected three state supervisors, making a total of 12 state supervisors. The state supervisors' identified 12 potential interviewers in their respective states who were trained by a team of resource persons. Eight interviewers per state were selected based on their performance during the training.

State supervisors
A 5-day training workshop for the selected State supervisors was conducted. The first day covered administration and project background and management information. The next 3 days covered topics in the survey tool. The last day was devoted to supervisory responsibilities, assigning work to interviewers, monitoring field progress, and conducting validation interviews and interviewer observations.
Limited field trials were conducted to ascertain that the supervisors have acquired the level of proficiency needed to undertake fieldwork.

Interviewer training
For the pilot study, 5 interviewers were selected per state and trained in a 5-day training workshop. The best 3 were selected. Prior to training, the interviewers were required to study at home the Interviewer Manual and the FIB. Home-study assignments for the interviewers were prepared by the resource persons and given

to the supervisor. This home-study assignment was discussed during the first day of training.

Zonal Training
For the main survey, 4 zonal training workshops were conducted in Akwa Ibom, Kano, Jos, and Osun States by a team of resource persons. The resource persons were the same through out the different training workshops. This arrangement maximized trainee participation and provided ample opportunity for supervisory staff to observe and evaluate trainee performance. It also ensured standardization of information presented to trainees. Throughout the training, extensive hands-on experience in filling the questionnaires, and using the FIB and measuring guides were used. Trainees were given the opportunity to interview respondents recruited for the training session. Training of interviewers before data collection was revised to reflect information obtained from the pilot study.

A total of 144 potential interviewers were trained during the zonal workshops. At the end of the training, 96 were selected for the survey. In cases where selected interviewers quit during the course of the survey, replacements were made from those trained during zonal training. The supervisor retrained the interviewers before they join the field team.

Training for Medical Laboratory Technologists
A separate 5-day training workshop was conducted for the medical laboratory technologists. The resource person came from the Medical Research Council, South Africa. A total of 24 Medical Technologists participated at the workshop. The purpose of the workshop was to: highlight and address problems encountered with respect to biological sample collection and processing during the pilot study, agree on procedures for sample collection so as to ensure uniformity in all the states to ensure standard sample analysis and validity of results, and familiarize the participants with the standard equipment and materials to be used during the survey.

Field monitoring
Certain procedures were used to monitor interviewers on the quality of their performance and the data they collect. These included in-person/team observations and validation of interviews by a monitoring team including IITA, UNICEF and NPC. The project monitoring team conducted in-person/team observations during data collection. Validation interviews were conducted to verify that an interview had been done at the selected household according to survey procedures.

Retrieval of questionnaires, biological, and food samples
Zonal coordinators collated the questionnaires from each state supervisor in their zone and sent them to IITA. Where this proved to be difficult, they were collected from the state supervisor by the principal investigator. A suitable cold storage facility was identified in each state for temporary storage of biological and food samples. Where this was unavailable, the team rented a generator, freezer and refrigerator. The samples were transferred to IITA every two weeks for onward dispatch to the

designated laboratory (Medical Research Council, Capetown, South Africa) for analysis.

3.5 Data collection procedure and type of information collected

The procedures for data collection involved:

- Visits to community leaders to introduce the survey
- Mobilization of communities in support of the survey
- Numbering and listing of households and use of maps and local guides to locate sampled households and verify that they meet the selection criteria
- Administering the household questionnaire to all selected households
- Collecting biochemical samples from mothers and their children under-5 used for during the 24-hour dietary recall
- Collecting salt samples

Information on questionnaire identification; household/demographic information; socio-economic characteristics of households; food security (food availability and affordability, food consumed away from home, and food related coping strategies), health and care; and anthropometric measurements was collected. In addition, biological (blood and urine) samples were collected.

CHAPTER 4
DATA COLLECTION, PROCESSING AND ANALYSIS

4.1 Data Collection

Data collection using the instruments developed for data collection **(Appendix 2)** commenced during the last week in July 2001 in all the states (Edo, Akwa Ibom, Kaduna, Osun, Kwara, Bayelsa, Imo, Kano, Kebbi, Borno, Nasarawa, and Taraba). Although a team of 9 persons (1 State Supervisor, 2 Medical Laboratory Technologists, and 6 Interviewers) formed the interview team per State, some of the States had either less or more, based on the number of Local Government Areas (LGAs) selected.

Data collection included information on household socioeconomics and demographic characteristics, food security (availability, affordability, foods eaten away from home; coping strategies), 24-hr dietary recall for the mother-child pair and pregnant women, health and care, anthropometry, and biological samples (blood and urine). In addition, Focus Group Discussions were conducted in each community.

Below are pictures that were taken in some States during data collection.

Before the interview team begins work in the LGA and community, they first make a courtesy call to the LGA Headquarters to meet the Chairperson and the Primary Health Care Coordinator. Shown in this picture are the Kano State Interview Team, the traditional ruler, and IITA staff.

A pair of interviewers during household listing. FCNS 2001 numbers were written on the walls and in a place where it was easily visible.

An interview in progress. Note that one interviewer is conducting the interview while the other is holding the Food Instruction Booklet helping with probing during the 24-hr dietary recall section.

Field monitoring was conducted within the first 3 weeks after commencement of data collection. The States that were identified as having weak State Supervisors in terms of supervision, based on the monitors' report, were identified and measures were taken to ensure a successful exercise. For example, project personnel were temporarily stationed in Akwa Ibom and Kano States to coordinate and supervise the interview team until data collection was completed. Also, the Kaduna State interview team was requested to continue with data collection in Kano State since Kano was having the largest number of LGAs (9). In addition, Zonal coordination was poor in

Zone 2 (Kebbi, Kano, and Kaduna States) and 4 (Bayelsa, Akwa Ibom, and Imo States), hence these zones were coordinated by project personnel.

A pair of Medical Laboratory Technologists collecting blood from a respondent (mother).

A pair of Medical Laboratory Technologists collecting blood from a respondent (child).

Biological samples were retrieved from each zone at 2-weeks intervals and transported to IITA by air. Since the States in Zone 1 (Kebbi, Kano, and Kaduna States) were far apart, each state supervisor brought the samples to IITA.

An interviewer measures the length of an infant.

Members of the community and the state supervisor during focus group discussion.

4.2 Data processing

All necessary precautions including coding were taken to ensure that entries into the questionnaires were as accurate as possible.

4.2.1 Household questionnaire

In processing the data collected during the survey, the following activities were performed.

Data collection and field editing
While data was being collected in the field, state supervisors, zonal coordinators and survey monitors edited some of the questionnaires thus ensuring that as much as possible errors observed were corrected while in the field.

Post-field editing by state supervisors
After the collection of data in the field, supervisors still edited the data to ensure data was in the best form for entry. This especially had to do with ascertaining that the identification codes were properly recorded and appropriate units for measures were put as necessary.

Training of Data Coders
Data coders (8) were recruited and trained for 2 days in order to minimize data entry errors. Those who had an error rate of less or equal to 0.05% were selected and further trained for 1 day on the different sections of the questionnaire. At the end of the training, 6 were selected to enter data collected. The database manager and Principal Investigator closely supervised data entry.

Checking and verifying printed data as entered
On completion of data entry, all data entered were printed and subjected to checking and verification. The objective of this exercise was to confirm that data entered were exactly as they were recorded in the questionnaire. This elaborate exercise included revisiting the questionnaires for confirmation. When it was observed that entries were truly in error, such observed data entry errors were corrected in the database by referring back to the original data in the questionnaire.

Data screening and verification
The data was further subjected to screening and verification to ensure those only analyzable sets of data was included in the analysis. This allowed for effecting corrections that were not essentially data entry errors such as ensuring that, for example, weight values were not recorded as height values.

4.2.2 Food security

How to measure household food security is the subject of debate within the scientific community. There is no simple formula for constructing valid measures because of the difficulties in defining the concept, which include quantitative, qualitative, cognitive and affective components of certainty, acceptability, and sustainability. Methods such as ethnography, Rapid Rural Appraisal, coping strategies, food economy approach, expert systems, livelihood security have been used in developing countries to gain an understanding of food insecurity and to develop measures (Wolfe et al., 2000). This section of the study recognizes this multidimensional facet of food security and uses a quantitative measure of availability and access to food by households across the rural, medium and urban sectors, and the dry savanna, moist savanna and humid forest agroecological zones in Nigeria.

During the survey respondents were asked to indicate the number of months within a period of 12 months that different food items were available or affordable to their households. The fraction of the year (numbers of months over 12) of each occurrence is taken as the unconditional probability of availability (p_a) or affordability (p_b) for the respective food products. Availability and affordability of a given food item (i) are considered two independent events (A) and (B) in the sense that the occurrence or non-occurrence of one does not affect the other. Therefore, we apply the multiplicative law of probability to derive the joint probability of such a food item being available and affordable to the household (h):

Joint Probability (A and B) = $jp_{hi} = (p_{ai}) * (p_{bi})$

An index of food security, as measured by availability and affordability, is constructed by aggregating the joint probabilities (jp_{hi}) over all food items consumed by each household. The approach used in the aggregation is similar to the construction of Consumer Price Index (CPI) in economics that employs expenditure proportions instead of fixed quantity shares of food items as weights.[1] The argument for using expenditure weights is the fact that consumers do insulate themselves from the impact of higher prices by adjusting their spending to favor relatively lower-priced goods. It is believed that expenditure weights estimator can better reflect the substitution effects of price changes in consumer spending than can the quantity weighted formula (US Bureau of Labor and Statistics, 1998). Moreover, expenditure weights are uniform for all food items and more convenient to estimate than quantity weights.

Therefore, the food security index (FSI_h) is calculated as a weighted-sum (or geometric mean) of the joint probability of availability and affordability of individual food items within the basket of food consumed by each household as follows:

$$FSI_h = \Sigma_i^J w_{hi}\, jp_{hi}$$

Where
$E_{hi} = P_i Q_{hi}$
$Y_h = \Sigma_i^J E_{hi}$
$w_{hi} = E_{hi} / Y_h$

E_{hi} is household (h)'s expenditure on the ith food product having a market price P_i, and Q_{hi} being the quantity consumed; Y_h, its total expenditure on all food items by the household and w_{hi}, the expenditure weight.

It is worth noting that the values of the unconditional probabilities (p_{ai} and p_{bi}), the joint probabilities (jp_{hi}), as well as the food security index (FSI_h) are comprised within the interval [0,1]. For the index, a small value is an indication that the overall basket of food products consumed by a household is both available and affordable for a few months only over the period of one year that was studied. The closer this index to one for a given household the better is its food security level in terms of joint availability and affordability.

4.2.3 Biological samples

The vitamin A and E status of children under-5, their mothers and pregnant women was assessed by determining the serum retinol and tocopherol concentrations using the method of Cathignani and Bieri (1983). Iron status was assessed by determination of serum ferritin using the Immuno-radiometric determination using a Packard gamma counter. The ICN Pharmaceuticals Ferritin Mab solid Phase Component System was used. Zinc status was determined using atomic absorption. Urinary iodine concentration was used to assess the iodine status of children under-5, mothers and pregnant women. A summary of the laboratory methods is presented in **Appendix 7**. Samples were analyzed at the Medical Research Council, Tygerberg, Capetown, South Africa.

4.3 Data analysis

4.3.1 Analysis of anthropometric data

The anthropometric data was analyzed using the EPI INFO 6.04d- statistical package updated till January 2001. EPI INFO was developed by the Centers for Disease Control (CDC), Atlanta, USA and the World Health Organization (WHO), Geneva for processing epidemiological data. The anthropometrics indices analyzed for using Z-scores were:

- Height for age (HAZ) indicating stunting
- Weight for age (WAZ) indicating underweight

- Weight for height (WHZ) indicating wasting.

Analyses for these indices were effected subject to the limitations of the NCHS growth curves as applicable in the software. As a result, inappropriate values, extreme values and sets of information that were considered unanalyzable were flagged, and subjected to further verification and exclusion from analysis.

In analyzing for HAZ, out of a sample size of 5325, 5028 records were analyzed. The records excluded constituted 4.5% of the total sample size. In analyzing for WAZ, a sample size of 4954 was used excluding children of age group above >59 months, records considered unanalyzable and children with edema. Approximately 0.6% of the total sample size had edema. For WHZ, a sample size of 4748 was used. In determining the level of malnutrition in children 0-59 months, all children with Z-scores <-2.00 SD classified as being malnourished.

Categorizing them as mildly, moderately and severely malnourished, the following classification was used:

- Mild <-1.00 Z-scores
- Moderate <-2.00 Z-scores
- Severe <-3.00 Z-scores

For the maternal anthropometry, 5031 records were used after verifying the data. The exclusion criteria used included maternal weights < than 30 (thus excluding 10 records), maternal weights > 150 (thus excluding 2 records), and maternal heights < 115 cm (thus excluding 79 records) The Body Mass Index was calculated as weight (kg)/height m^2). In determining the level of adult malnutrition, the following classification was used:

- BMI <18.5 malnourished
- BMI 18.5-24.99 within normal range
- BMI 25- 29.99 overweight
- BMI 30 and above obese

4.3.2 Cutoff points for biological indices

Biochemical Indicators

Estimates of prevalence are of limited value until they are compared either with norms or with other estimates. The World Health Organization suggests cutoff values and interpretations of prevalence below determined levels. For example, a prevalence of night blindness of more than 1% among preschool children and a prevalence of low serum retinal (<20 µg/dl) of more than 10% have been suggested as defining public health problems related to vitamin A deficiency (WHO, 1996). The following recommended cut off values for determining micronutrient deficiencies were used.

Serum Retinol (Vitamin A)

Children: Serum retinol cut off point: 20 µg/dl.

Serum retinol below 20 µg/dl (0.70 umol/l) indicates marginal vitamin A deficiency/ considered low.

Serum retinol below 10 µg/dl (0.35 umol/l) indicates clinical vitamin A deficiency.

Mothers: Serum retinol cut off point: 30 µg/dl

Serum retinol levels in adults below 30 µg/dl indicate vitamin A deficiency.

Serum retinol above 30 µg/dl (1.05 umol/l) indicates adequate vitamin A status

Serum retinol above 100 µg/dl indicates hypervitaminosis A status

Tocopherol (Vitamin E)

Children: from the age of 6 months the cut off point are between 4 and 14 mg/l.

Mothers: The cut off point is between 5 and 18 mg/l.

Iron

Iron store depletion is generally associated with values of 20ng/ml

Iron deficiency anemia is suspected with values of 10ng/ml or less

Iron overload values are significantly above 300ng/ml

NHANES II Survey cutoff points:

1–15 years	< 10 µg/l	indicates iron deficiency
15–74 years	< 12 µg/l	indicates iron deficiency

Zinc

Currently there are no generally accepted cut offs for the determination of zinc status. However, serum levels <80mcg/L have been suggested as indicating low zinc status (Brown and Wuehler, 2000).

Urinary Iodine
The cut off points used in classifying iodine status are shown as below.

Median Urinary Iodine Concentration (mcg/L)	Corresponding Approximate Iodine Intake (mcg/day)	Iodine Nutrition
<20	<30 insufficient	Severe deficiency
20-49	30-74 insufficient	Moderate deficiency
50-99	75-149 insufficient	Mild deficiency
100-199	150-299 adequate	Optimal
200-299	300-449 more than adequate	More than adequate
>299	>449 excessive	Possible excess

Source: ICCIDD/WHO/UNICEF (1996)

4.3.3 Statistical analysis

All the data sets were analyzed centrally. The Statistical software SAS® Version 8, EPI_INFO 6.04, SOLAS™ 3.2 and data management/input software ACCESS and EXCEL were used in the analysis of data for the study.

Frequency tabulations by agroecological zone, state, and sector provided a first-level summary of key variables. Classification or categorization of anthropmetric variables was done with EPI_INFO (version 6.04).

Histograms and box-whisker plots were determined for key variables including weight of mother and child, iron, zinc, vitamin A, vitamin E, and iodine measurements and departures or otherwise form normal and uni-modal distributions examined **(FCNS Supplement 1).** These were effected using SAS® procedures UNIVARIATE with options 'modes, normal and plot' and program statements requesting for histogram (additional option: normal) and the normal probability plot. The extent of skewness (departure from 1) and kurtosis (flatness) were similarly noted. Summary descriptive statistics, including means, mode, quartiles, standard error, inter-quartile range and others were accordingly determined for overall (national), agroecological zone, state and by sector. Test of significance of normality was done with the Kolmogorov-Smirnov D, Cramer-von Misses W-sq statistics and

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by examining the probability plot for linear trend. Extreme values were identified, verified and where appropriate deleted or declared missing.

Considering that the design was multi-stage (nested) for each of the three agroecological zones studied, sources of variation were determined using the VARCOMP procedure (option: Restricted maximum likelihood, REML) in SAS was used. This enabled examination of the distribution of variances across states, LGA, EA and Household level. In particular, it provided information as to the source of highest level of variation. This has implication for future intervention strategies. Incorporating these specific sources of random variation in SAS® MIXED procedure enabled effective comparison of the fixed levels of agroecological zone for the key biochemical variables.

In view of the large number of variables involved in the study, various variable reduction procedures were investigated with a view to identifying groups among variables, and the restricted use of all variables in the study. Procedures used included principal component and factor analysis, and variable clustering procedure with oblique principal component method. SAS procedures used were PRINCOMP, FACTOR (method=PrinComp) and VARCLUS.

Furthermore specific measures of associations among groups of variables were investigated using the method of canonical correlation. This technique consists of finding several linear combinations of the variables of one group and the same number of linear combinations (canonical variables) for the other group such that these linear combinations best express the correlations between the two sets. The correlations between corresponding canonical variables are referred to as canonical correlations, with the correlation among the best (first) canonical variables being the highest. Examining these correlations reveals key or important variables within each set of variables, and extent or likelihood of associations.

In this study, we examined using SAS Procedure CANCORR the group of biochemical variables [vitamin A, vitamin E, iron, iodine, and zinc] with:

(i) Non-Specific Ecological Demographic Variables [index2, annual income, exclusive breastfeeding, started feeding anything else other than breast milk, last child breast, age of child, food sharing tradition, least food share, age of mother, weight of mother, weight of child, height of mother, height of child, age of household head, household size, coping strategies, number of children, number of women/wives, cost of own production or purchase]

(ii) Illness, immunization and prevention methods [BCG, DPT1, DPT2, DPT3, measles, malaria, diarrhea, whooping cough, cough without fever, preserve food, open garbage, unwashed utensils, uncovered food, untidy child, swept house, animal droppings, stagnant water, treatment: nowhere, traditional primary health care center, chemist shop, and malaria prevention methods: insecticides, bed nets, windows/door netting ORS]

(iii) Socio-Economic and sanitation variables [primary occupation, primary energy source, primary source of water for drinking and other domestic uses, main type of toilet, primary refuse disposal, food preservation method, open garbage, unwashed utensils, uncovered drinking water, swept house, animal droppings, and stagnant water]. An elimination procedure was applied to reduce the number of variables in the non-biochemical. The likelihood ration statistic was used for the statistical test of significance of the canonical correlation.

Correspondence analysis (also referred to as weighted principal component analysis of contingency table) involves the partitioning of the chi-square statistic and enables the display in biplot format both the row and column variables on the same plot. This method was applied to indicate which levels of certain selected variables might be associated with the 12 states selected for the study. Response levels of variables used were: low birth weight, large household size, low affordability index, iron deficient, zinc deficient, iodine deficient, vitamin E deficient, vitamin A deficient, mother uneducated, child stunted, child wasted and child under weight.

The relationships between selected dependent variables and a wide range of categorical and/or continuous explanatory variables were determined using stepwise logistic regression. To facilitate maximum use of data (reduced missing data) for the regression analysis, the 'hot deck' method of imputation, with random allocation where there are none or more than one matching pairs, was used using SOLAS™ 3.2 software. Considerable agreement had been observed between descriptive statistics from imputed (expanded) and original data sets, justifying the use of the imputed data for further analysis.

Categorical dependent variables that were fitted included stunting for child (yes, no), wasting for child, underweight for child, BMI for mother, iron deficiency, zinc deficiency, vitamin A deficiency, Vitamin E deficiency and iodine deficiency. The model fitted probabilities associated with a level of the categorical dependent variable (e.g. Probability of Stunting = Yes).

The test statistic, minus twice the log likelihood (-2LogL), which is approximately chi-square distributed, was used as the test of model significance, while a desired measure of concordance in excess of 50%, non-significance of Somers' D statistic (for goodness of fit) and standard diagnostic statistics were employed to ensure appropriateness of models fitted. Furthermore, only explanatory variables with significance level of 0.20 or better (smaller) and with substantial gains in the Akaike-Information-Criterion (AIC) statistic were retained in the final models.

The sign and magnitude of regression coefficients (which maximum likelihood estimates) provide indication of strength and direction of probabilities associated with the occurrence of the event of interest (e.g. VAD = yes), while outputs on odds ratios with associated 95% Wald Confidence Limits are extremely useful. The odd ratio of one level over the other provides the magnitude of the probability of event of interest

in the first over the other. For a continuous variable, say X1, the odds ratio (which is obtained as exponent raised to the power of the maximum likelihood estimate (say, e^b) provides the factor by which the odds are increased for every unit increase in X1.

CHAPTER 5
DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTISCS

5.1 Household/Demographic characteristics

The section presents information on selected socio-economic and demographic characteristics of the households studied. Some of the characteristics presented include age, sex, education, primary occupation of household heads, primary sources of energy and water available to households, methods of refuse disposal, and types of toilets used and estimated annual household income. Information on these characteristics provide the socio-economic context for explaining and understanding issues on household food security and food consumption patterns, status of maternal and child health and care, malnutrition and micronutrient status of mothers and children under-5.

5.1.1 Gender of head of household

Gender of the household head may significantly influence household food security. For instance, women play important role in the labour force, both in the financial management of the household and in the labour market, but appear to face large degree of discrimination (Awoyemi, 2000). **Table 5** shows that 94% of the sampled household heads were male and 6% were female. There was more female-headed household (11.8%) in the humid forest than in the moist (2.4%) and dry savanna (1.6%) zone. The percentages of male-headed household were similar across the sectors.

Table 5. Percentage distribution of household heads by sex at the national level and by agroecological zone and sector

Category	Male	Female
National	93.9	6.1
Agroecological zone		
Dry savanna zone	98.4	1.6
Moist savanna zone	97.6	2.4
Humid forest zone	88.2	11.8
Sector		
Rural	94.0	6.0
Medium	94.1	5.9
Urban	93.4	6.6

5.1.2 Percentage distribution of households by number of spouses

Closely related to the above is the number of spouses per household. It is hypothesised that the higher the number of spouses the higher the number of children and dependency burden in the household. At the national level 62.8% households have one spouse and 25.6% have more than one spouse **(Table 6)**. There is a gradual increase in the number of households with two spouses with the dry savanna zone having the highest at 20.5% followed by moist savanna at 18.3% and the humid forest at 16.8%.

Table 6. Percentage distribution of households by number of spouses

Number of spouses	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
0	6.8	7.7	6.4	6.3	7.2	5.0	4.3
1	67.8	66.0	67.8	69.3	66.1	69.5	71.3
2	18.5	20.5	18.3	16.8	19.8	18.6	16.7
3	5.3	4.8	5.1	5.8	5.3	5.0	5.8
>3	1.8	1.0	2.5	1.9	1.6	1.8	2.0

Although households with spouses greater than 3 were not common, there were 3% in the moist savanna zone, 1% in the dry savanna, and 2% in the humid forest zone.

5.1.3 Marital status of head of household

Presented in **Table 7** is the percentage distribution of household head according to marital status. Generally, 96.5 % of the household heads are married with only 3.5% not married. The result indicates that the percentage of divorced, separated or widowed household heads is very low among the respondents.

Table 7. Percentage distribution of household head by marital status

Category	Married	Others
National	96.5	3.5
Agroecological zone		
Dry savanna zone	99.1	0.9
Moist savanna	99.1	0.9
Humid forest zone	92.9	7.1
Sector		
Rural	96.8	3.2
Medium	96.2	3.2
Urban	96.6	3.4

5.1.4 Age distribution of head of households

At the national level, 44.5% of the head of household are in the 35-50 years old age group, followed by 38.3% of those in the age group of 18-34 years old **(Table 8).** Twenty seven percent of the head of households were above the age of 50 years. The dry and moist savanna zones were similar for the age group 18-34 years when compared to the humid forest. The medium sector had the highest percentage (41.5%) of heads of household in the 18 to 34 years age group.

Table 8. Percentage age distribution of households' heads national and by agroecological zone and sector

Age group	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
18-34	38.3	40.8	39.7	35.6	37.1	41.5	32.5
35-50	44.5	44.6	46.1	43.5	44.0	43.5	49.1
51-64	14.4	13.2	12.6	16.6	16.1	12.8	14.7
> 64	2.8	1.6	1.7	4.4	2.9	2.2	3.7

5.1.5 Household size

The demographic characteristics of the households are presented in **Tables 9.** About half of the households (49%) have sizes between 3 and 5 persons while 35.1% of the households have sizes between 6 and 8 persons, with about 11 percent having household sizes between 9 and 11 persons. This trend was

consistent across the agroecological zones, though households with over 11 members were more in the moist savanna (8%), intermediate (4.7%) in the dry savanna and low (2.2%) in the humid forest zone. Across the sectors, households with sizes between 9 and 11 persons were more in the rural and urban sectors than in the medium sector. Only 5.7% of households in the urban sector had over 11 persons.

Table 9. Percentage distribution of household size: national, agroecological zone and sector

		Agroecological zone			Sector		
Household size	**National**	**Dry savanna**	**Moist savanna**	**Humid forest**	**Rural**	**Medium**	**Urban**
1-2 person	0.6	0.4	0.1	1.0	0.8	0.3	0.3
3-5 person	48.9	49.0	47.4	50.0	48.2	51.1	47.3
6-8 person	35.1	33.7	33.9	36.9	34.9	35.7	34.6
9-11 person	10.8	12.2	10.7	9.8	11.5	9.0	12.0
> 11 person	4.6	4.7	8.0	2.2	4.6	3.9	5.7

5.1.6 Percentage distribution of household members by age group

The distribution of household members by age group at the national level is presented in **Table 10.** From a total sample of 31,374 slightly over 50% of the persons were in the 0-14 years old with 25.1% being children under-5. Those between 15 and 34 years old were 30.8%. Approximately 1% of the population is over 65.

Table 10. Percentage distribution of household members by age group at the national level

Age group	**National**
Under 5	25.1
5-14 years	27.6
15-24 years	15.8
25-34 years	15.1
35-65 years	15.8
Over 65 years	0.7

When the data was disaggregated by sex and agroecological zone, the percentage distribution of girls to boys from 0-14 years were similar for sex and across the

agroecological zone **(Table 11).** There were more females in the age range of 15 to 34 years. However, there are more males than females in the 35-65 age group.

Table 11. Percentage distribution of household members by age group, sex, and agroecological zone level

	Agroecological zone		
Age group	**Dry savanna**	**Moist savanna**	**Humid forest**
Girls under 5	13.2	12.7	12.4
Boys under 5	12.3	12.4	12.4
Girls 5-14	13.7	13.1	12.6
Boys 5-14	15.3	14.7	13.7
Female (15-24)	9.2	9.4	10.1
Male (15-24)	5.5	6.9	6.3
Female (25-34)	9.4	9.5	9.0
Male (25-34)	6.1	6.3	5.3
Female (35-65)	4.9	4.5	6.8
Male (35-65)	10.3	10.1	10.4
Female over 65	0.1	0.2	0.4
Male over 65	0.2	0.3	0.7

At the sector level, the structure of the population is such that the percentage distribution of children under-5 are similar across the sectors, 24.6%, 25.7%, and 25.3% in the rural, medium, and urban sectors respectively **(Table 12).** While there were more females among the 15 to 34 age group, there are more males among the 35-65-age range.

Table 12. Percentage distribution of household members by age group, sex, and sector.

	Sector		
Age group	**Rural**	**Medium**	**Urban**
Girls under 5	12.7	12.9	12.7
Boys under 5	11.9	12.8	12.6
Girls 5-14	13.5	12.6	13.0
Boys 5-14	15.0	14.2	14.1
Female (15-24)	9.3	10.1	9.4
Male (15-24)	6.2	5.9	6.8
Female (25-34)	9.1	9.4	9.3
Male (25-34)	5.5	6.6	5.1
Female (35-65)	5.7	5.3	5.7
Male (35-65)	10.4	9.8	10.8
Female over 65	0.3	0.3	0.3
Male over 65	0.5	0.3	0.4

5.1.7 Educational levels of household heads

As part of the basic socio-economic characteristics of the respondents, information on the educational levels of household heads was collected. Nationally, 48.7% of the respondents had no form of education **(Figure 4).** This suggests a literacy rate of slightly over 50% among household heads. Most of the literate household heads did not complete primary school and there is a progressive decline in the percentage of literate household heads as educational level rises.

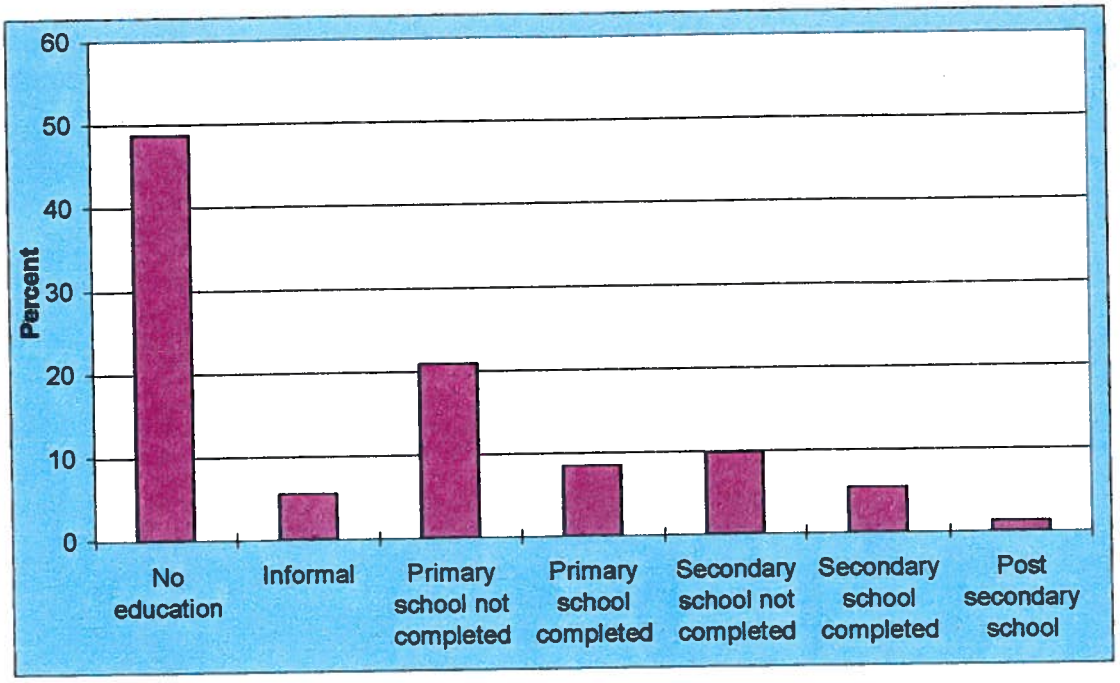


Figure 4. National Percentage distribution of educational levels of household heads

The percentage of household heads without any form of education is 57.5% in the dry savanna, 57.7% in moist savanna, and 35.4% in the humid forest zone **(Figure 4).** While the same trend of declining percentage of literate household heads as educational level rises was consistent across the zones, the humid forest zone had the highest percentage of household heads in all the literate categories **(Figure 5).**

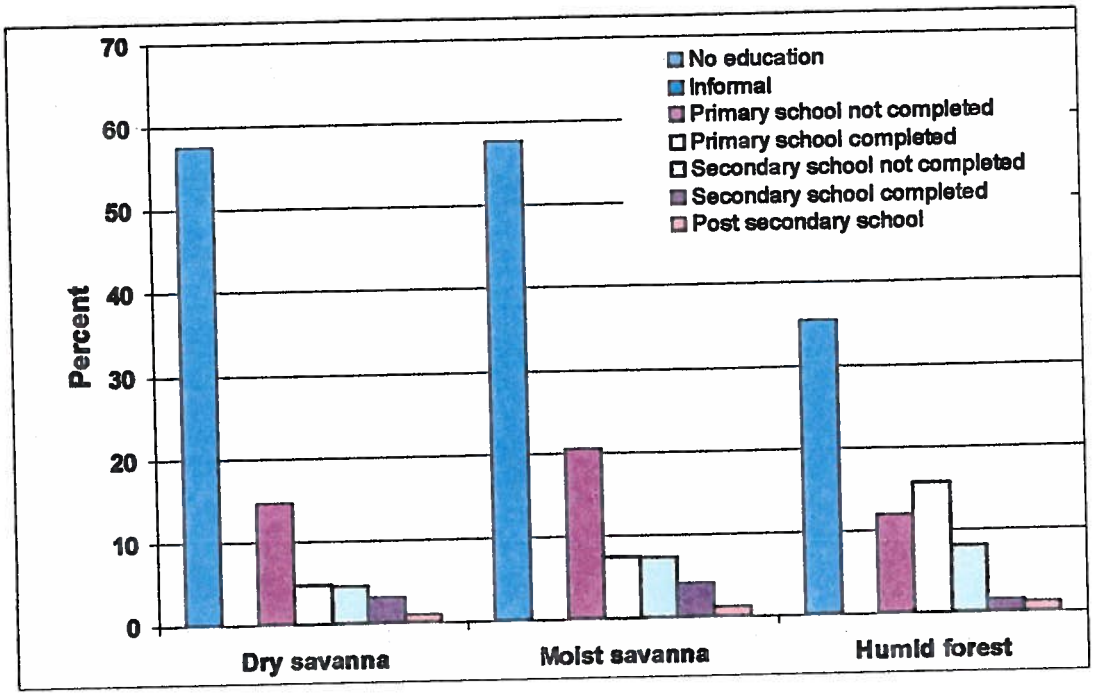


Figure 5. Percentage distribution of educational level of household heads by agroecological zone

Even across the sectors **(Figure 6)** the same trend was evident with the least percent of illiterate household heads in the urban sector (44.62%), and the least percent of household heads that had post secondary education in the rural areas (0.8%).

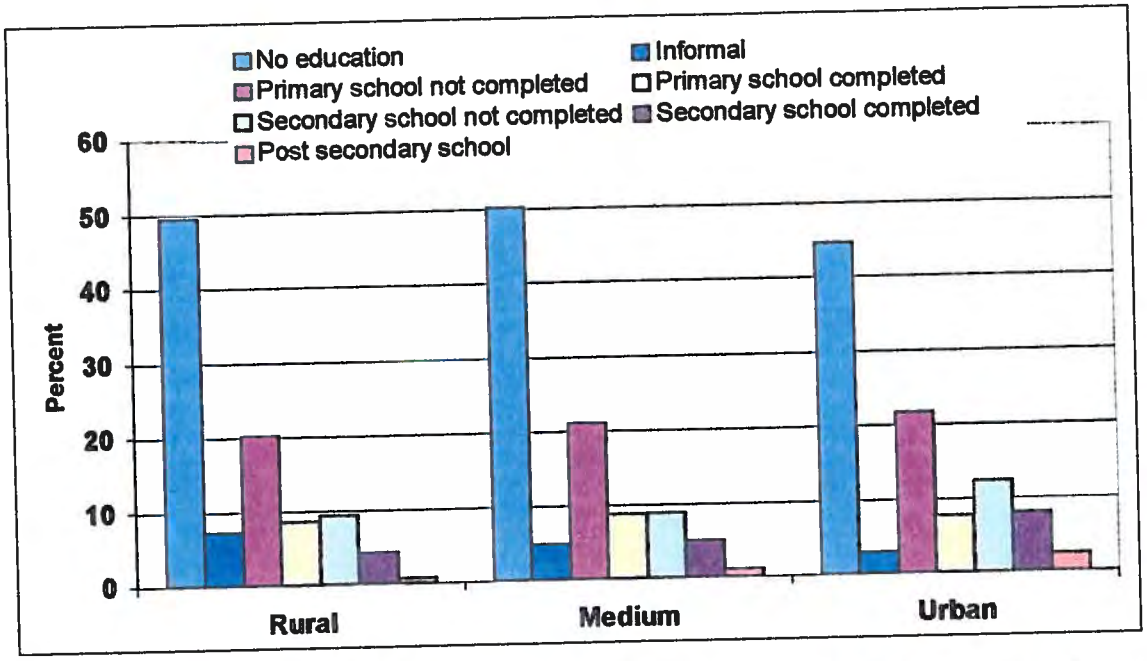


Figure 6. Percentage distribution of households according to educational level of household heads by sector

5.1.8 Education ratio

Table 13 shows the estimated education ratios, defined as the ratio of educated household members to non-educated household members, in other words those who completed secondary and post secondary schools. Values greater than 1 indicate more educated members in the household than non-educated members. There is a gradual increase in the value of this ratio from dry savanna (.6) through moist savanna (.9) to humid forest zone (1.4). This trend was trend was also observed, from rural (.8) through the medium (1.0) to the urban sector (1.6).

Table 13. Households average education ratio by primary occupation at the national level, agroecological zone and Sector

		Agroecological zone			Sector		
Primary occupation	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
Farming	0.4	0.3	0.4	0.6	0.4	0.4	0.4
Trading	1.1	0.6	1.2	1.5	0.8	1.1	1.6
Civil servant	2.3	2.1	2.4	2.4	1.8	2.1	2.8
Artisan	1.1	0.6	1.3	1.2	0.9	1.2	1.4
Fishing	0.3	0.4	0.2	0.4	0.2	0.5	0.4
Others	1.5	0.5	1.4	1.9	1.5	1.5	1.7
Education ratio	1.0	0.6	0.9	1.4	0.8	1.0	1.6

5.2 Socio-economic characteristics of households

5.2.1 Primary occupation of head of household

Over 40 per cent of household heads studied were farmers **(Figure 7)** with about 15 percent each as traders, civil servants and artisan. Fishing was the occupational category with the least percentage of household heads (1.3%).

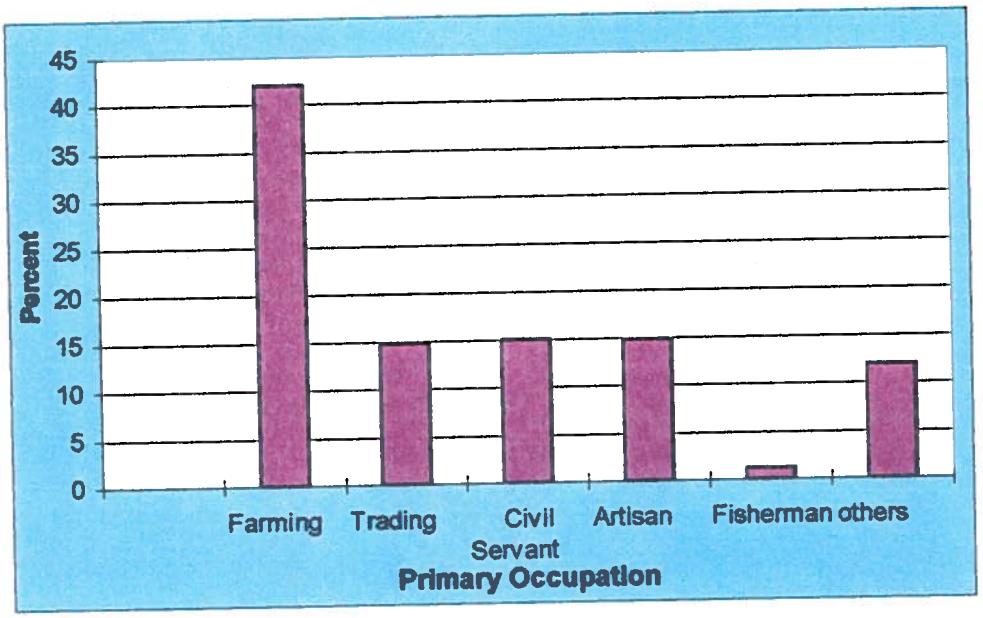


Figure 7. Percentage national distribution of primary occupation of household

Marked differences were observed across the zones. While over 50 percent of the household heads in the dry and moist savanna were involved in farming, just about half of this proportion is involved in farming in the humid forest zone. About 15 percent of household heads are civil servants across the zones, artisans were disproportionately higher in the humid forest zone (24%), about half in the moist savanna (11.4%), and 6.2% in the dry savanna zone.

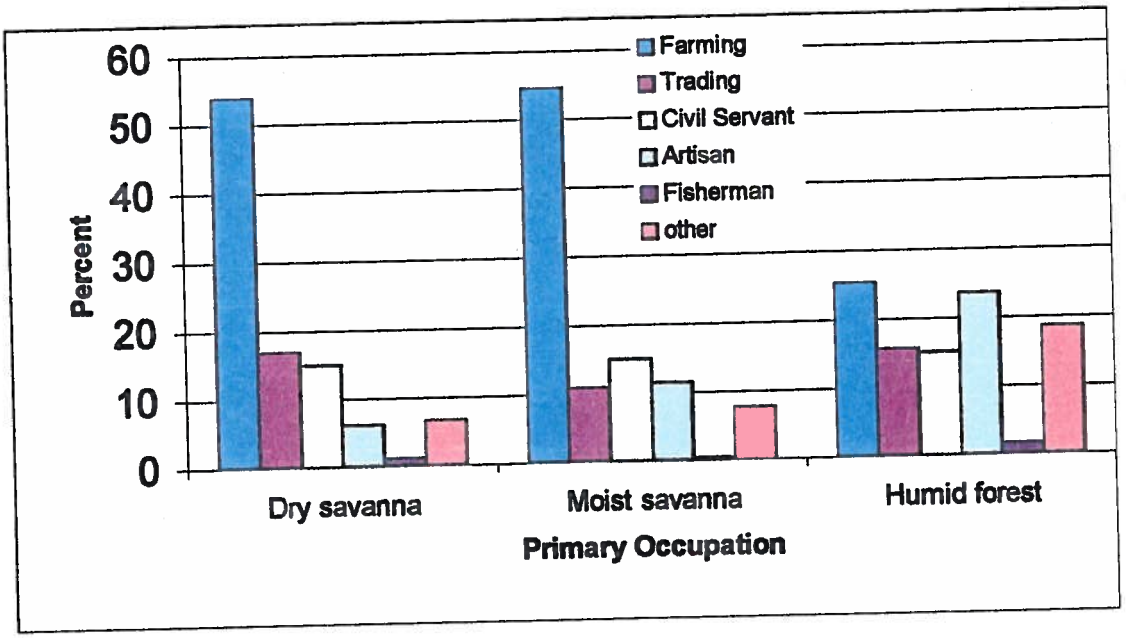


Figure 8. Percentage distribution of household heads according to type of primary occupation by agroecological zones

When the data was disaggregated by sector it showed that the highest percentages in all the occupational categories, with exception of trading were found in urban areas **(Figure 9)**. While most civil servants reside in urban areas, it is interesting to note that majority of the fishermen (18.4%) were located in the urban, 16.3% in the medium areas and 11.8% in the rural areas.

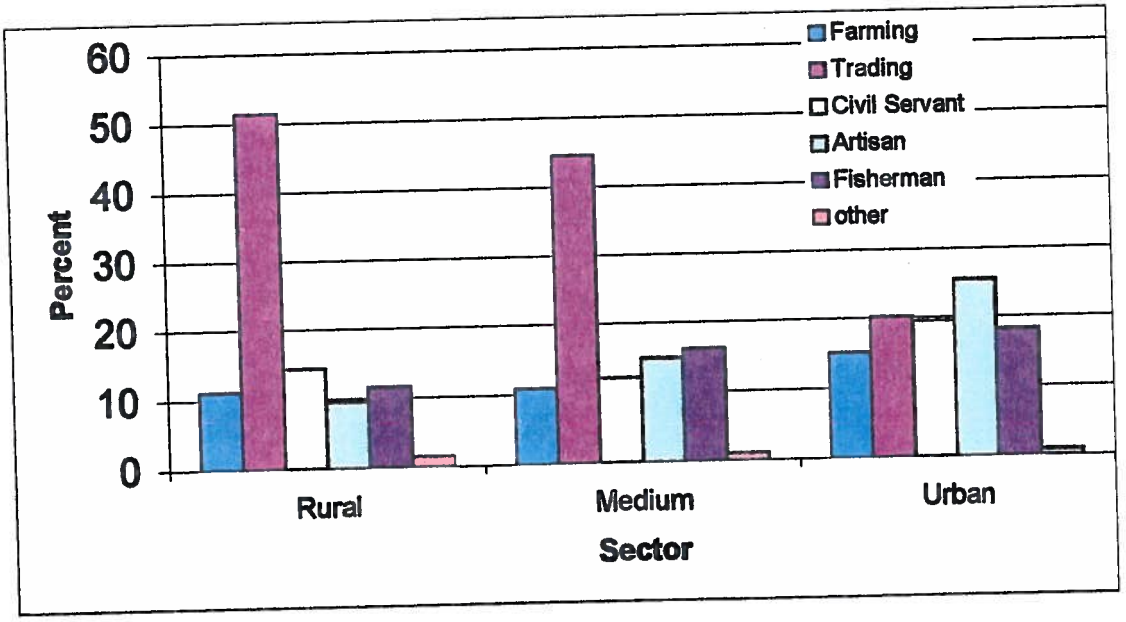


Figure 9. Percentage distribution of households according to the primary occupation of the household head by sector

5.2.2 Primary energy source

There are a variety of community-level characteristics that may be associated with food security for households in that community. At the community level, infrastructure is a major determinant of food security. Indicators of infrastructure development like proximity to the market, whether or not the community has electricity, availability of medical clinics in the area and availability of pipe-borne water.

Table 14 shows the primary sources of energy available to households. The predominant source of energy is electricity used by about 38.4% of the households, thus implying that about 62.0% of the households do not have access to national electric supply. Access to other sources of electricity was however very low with less than one percent of households using personal generators and 3.5% utilizing rural electricity. The use of solar energy is not yet a common practice in Nigeria. About 75.0% of the households do not have electricity in the dry savanna, 45.0% in the humid forest and 57.0% in the moist savanna **(Table 14).** Access to NEPA was highest in the humid forest zones (48.3%) and least in the dry savanna zone (23.4%). Across sectors, the results indicate that over 70.0% of households in the urban areas have access to electricity while almost the same percentage of households in the rural areas (69.6%) do not have access.

Table 14. Percentage distribution of primary energy source of household by national, agroecological zone and sector

Category	No electricity	Personal generator	Rural Electricity board	NEPA	Solar
National	**57.5**	**0.5**	**3.5**	**38.4**	**0.1**
Agroecological zone					
Dry savanna	74.5	0.2	1.9	23.4	0.0
Moist savanna	57.0	0.4	1.6	40.8	0.3
Humid forest	44.9	0.8	5.9	48.3	0.0
Sector					
Rural	69.6	0.6	2.6	27.1	0.1
Medium	61.4	0.4	3.1	35.0	0.0
Urban	27.9	0.4	5.9	65.7	0.1

5.2.3 Households' access to primary sources of water

The most common source of water available to households nationally is the well (37%) as shown in **Figure 10.** Next to this source are the springs or rivers (24%), and pipe borne water (20%). The use of boreholes (11.8%) is becoming increasingly popular, with only about 5% depending on rain as the primary source of water.

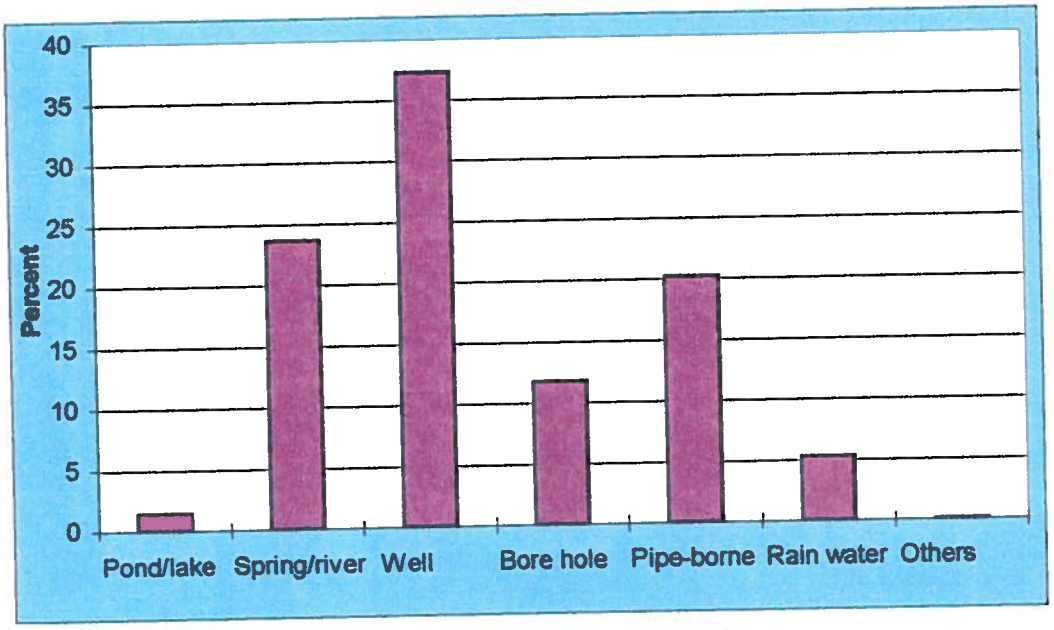


Figure 10. Percentage national distribution of primary source of water for drinking and other domestic uses

The use of wells was the main source of water in the dry and moist savanna and the least source in the humid forest zone **(Figure 11).** Springs and rivers constituted the major sources of water in the humid forest zone with the use of boreholes disproportionately higher in the zone than in other zones.

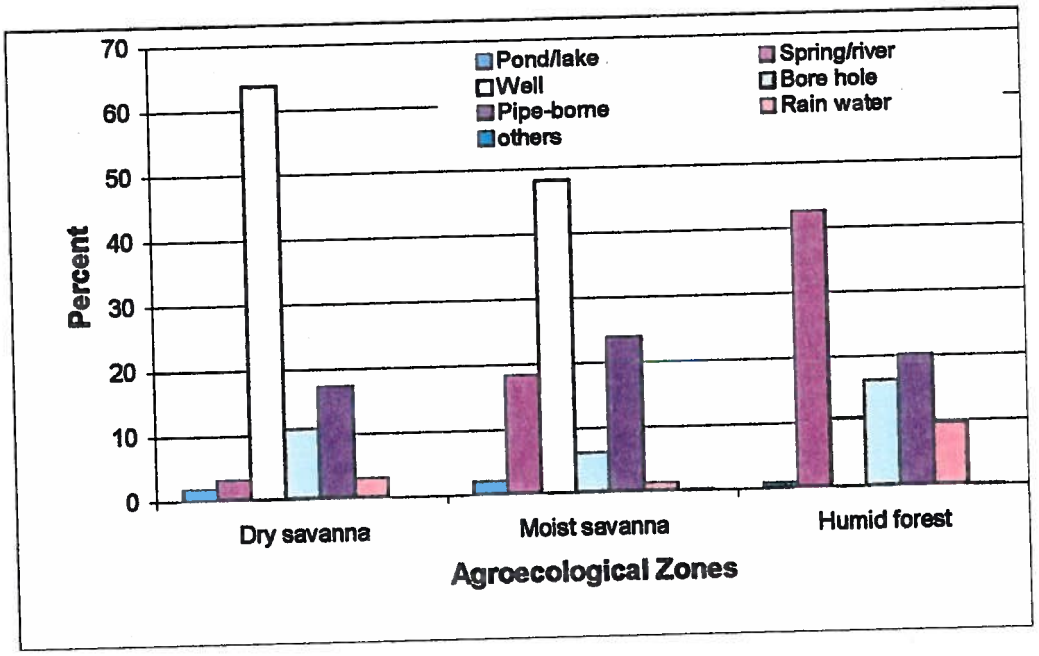


Figure 11. Percentage distribution of water by agroecological zones

The major primary sources of water differed markedly across the sectors **(Figure 12)** Well was the main source in the rural (44%) and medium (40%) areas, with pipe borne water as the main source in the urban areas. Rainwater was least used in urban areas (2.9%).

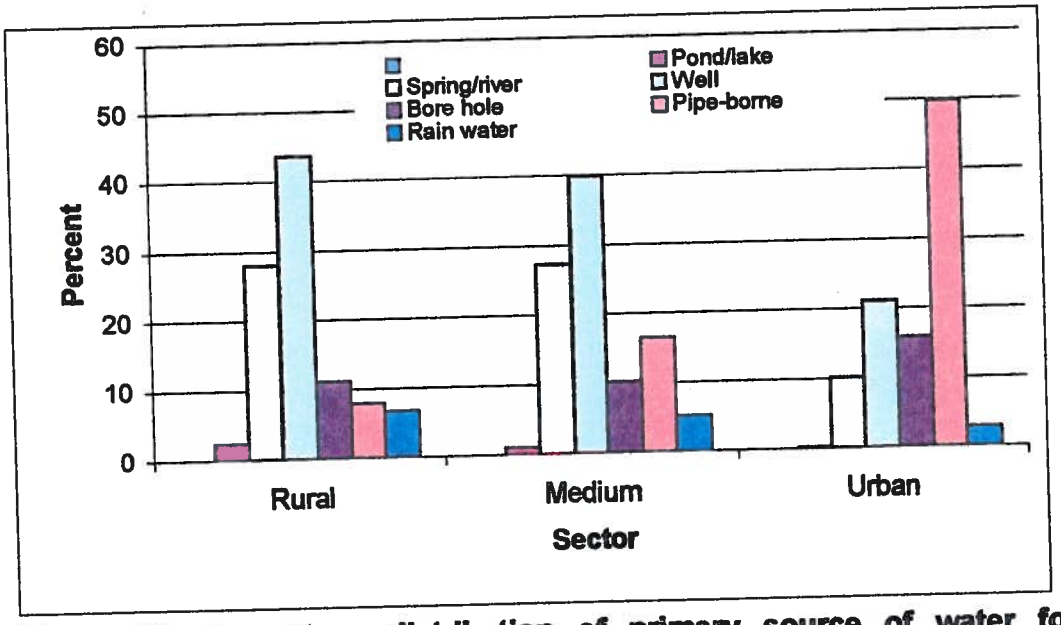


Figure 12. Percentage distribution of primary source of water for household by sector

5.2.4 Households' primary methods of refuse disposal and types of toilets used by households

The predominant pattern of refuse disposal among households **(Table 15)** is the use of bush and other unconventional methods (78%). Less than 2 percents of city service are being used nationally. Across the zones, this trend was consistent, though the use of bush and other methods was highest in the humid forest zone. The use of refuse dump was highest in the moist savanna zone (27%) while city service was about 2 percent in the dry savanna and humid forest zones, and least in the moist savanna zone (1%).

The predominant methods of refuse disposal in the rural and medium areas (over 80%) is the use of bush and other methods **(Table 15).** Over 50 % of urban households also used this method. The use of refuse dump is the next method commonly used across the sectors. While city service is the least used method, its usage is essentially an urban phenomenon (7%).

Table 15. Percentage types of primary methods of refuse disposal by households at the national, agroecological zone and sector levels

		Agroecological zone			Sector		
Method of refuse disposal	**National**	**Dry savanna**	**Moist savanna**	**Humid forest**	**Rural**	**Medium**	**Urban**
Bush & others	78.1	78.2	72.4	81.5	88.2	81.1	53.7
Refuse dump	20.1	19.7	26.6	16.3	11.4	18.7	39.1
City service	1.9	2.1	1.0	2.2	0.5	0.2	7.3

5.2.5 Main type of toilet

Results obtained indicated that over 65% of households use pit latrines, with about a quarter using the bush **(Table 16).** Only about 5 percent of the households use the water closet system. While the use of pit latrines was predominant and consistent across the zones and sectors, over 80 percent of the households in the dry savanna used pit latrines, with 59.2% of households in the moist savanna and 58.2 % in the humid forest. Rivers were only used in the humid forest zone. The use of bush was however lowest in the urban areas (11%) compared to the rural (30%) and medium (27%) areas.

Table 16. Types of toilets used by households at the national, agroecological zone and sector levels

Category	Bush	Pit latrines	VIP latrines	Water system	Rivers	Others
National	25.0	65.4	1.4	5.2	2.7	0.2
Agroecological zone						
Dry savanna	18.1	80.2	1.4	0.4	0.0	0.0
Moist savanna	33.5	59.2	1.3	6.0	0.0	0.1
Humid forest	25.0	58.2	1.6	8.3	6.5	0.4
Sector						
Rural	30.2	65.4	0.9	1.4	2.1	0.1
Medium	27.5	66.8	1.0	2.5	2.3	0.1
Urban	11.3	63.4	3.3	16.7	4.8	0.5

5.2.6 Estimated annual household income (per thousand Naira)

The annual estimated household incomes were presented in six categories ranging from less than N15, 000 to N55, 000 and above. While over 10 percent of the households had an estimated annual income less than 15,000 Naira per annum, about 15 percent of the households estimated their annual incomes as less than 35,000 Naira and less than fifty five thousand naira respectively **(Figure 13).** The modal income category was between N55, 000 and above (31%). Across the agroecological zones, most of the households had estimated annual incomes of N55, 000 and above though the percentage of households in this group was highest (35%) in the humid forest zone **(Figure 14)** Also across the sectors, most of the households had estimated annual incomes of N55, 000 and above with 21.4 percent in the rural sector, 32.2% in the medium and 45.5% in the urban sector **(Figure 15).**

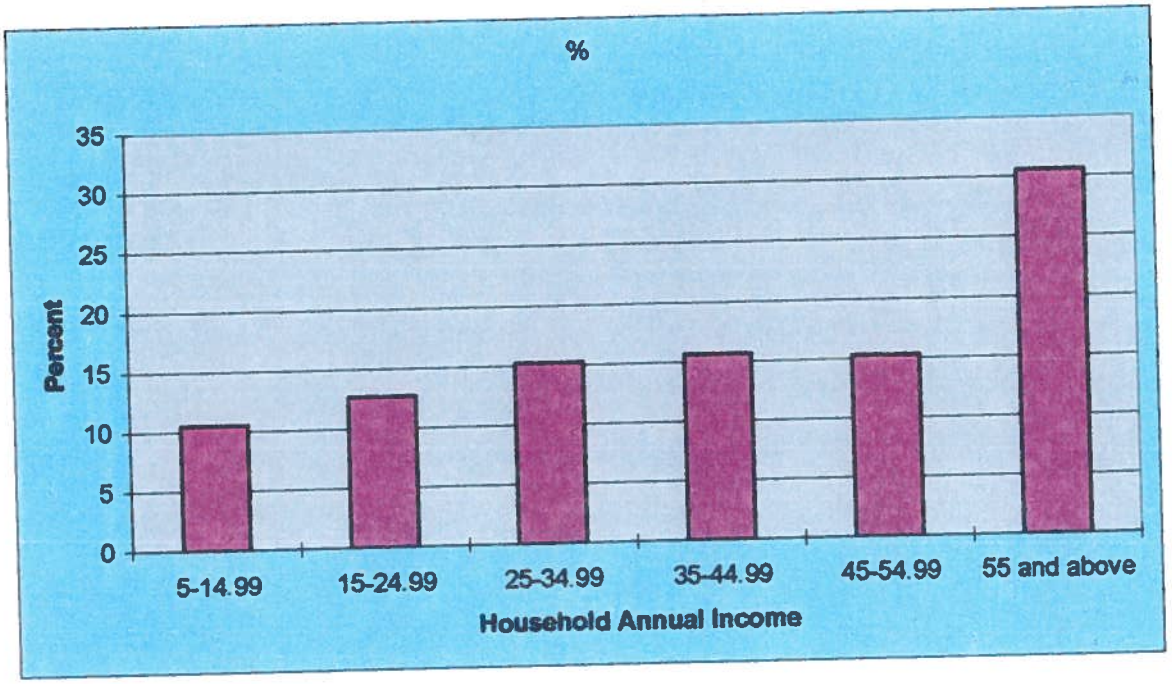


Figure 13. Percentage national distribution of estimated household annual income (thousand ₦)

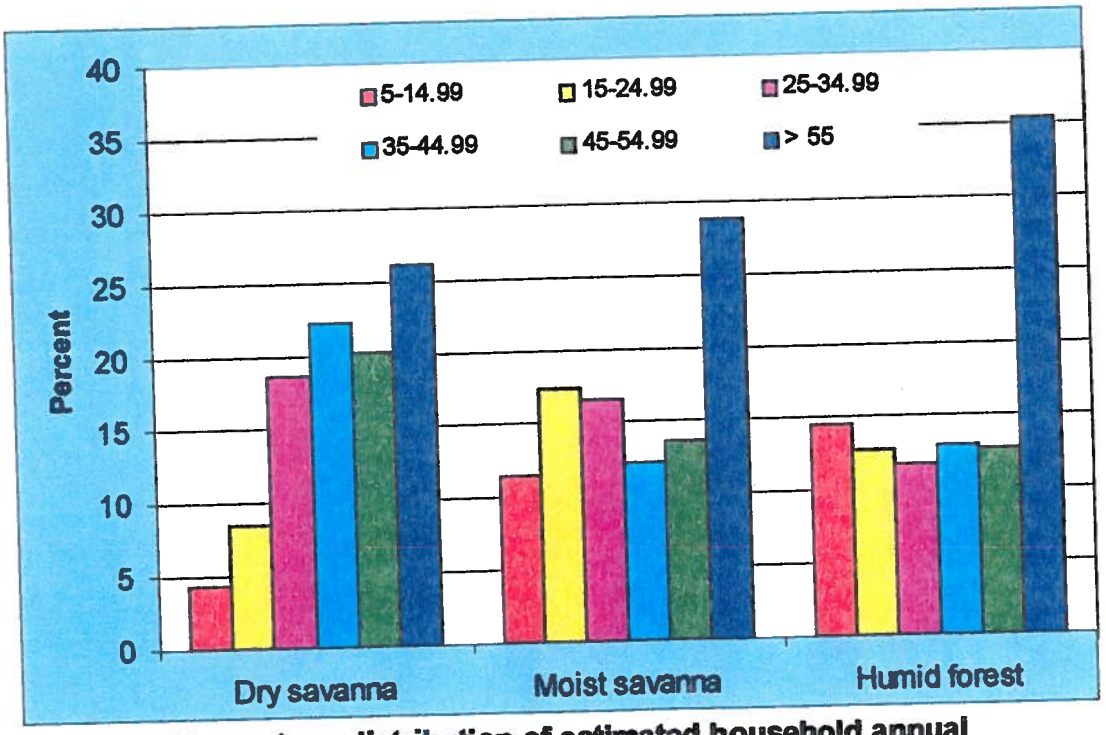


Figure 14. Percentage distribution of estimated household annual income (thousand ₦) by agroecological zones

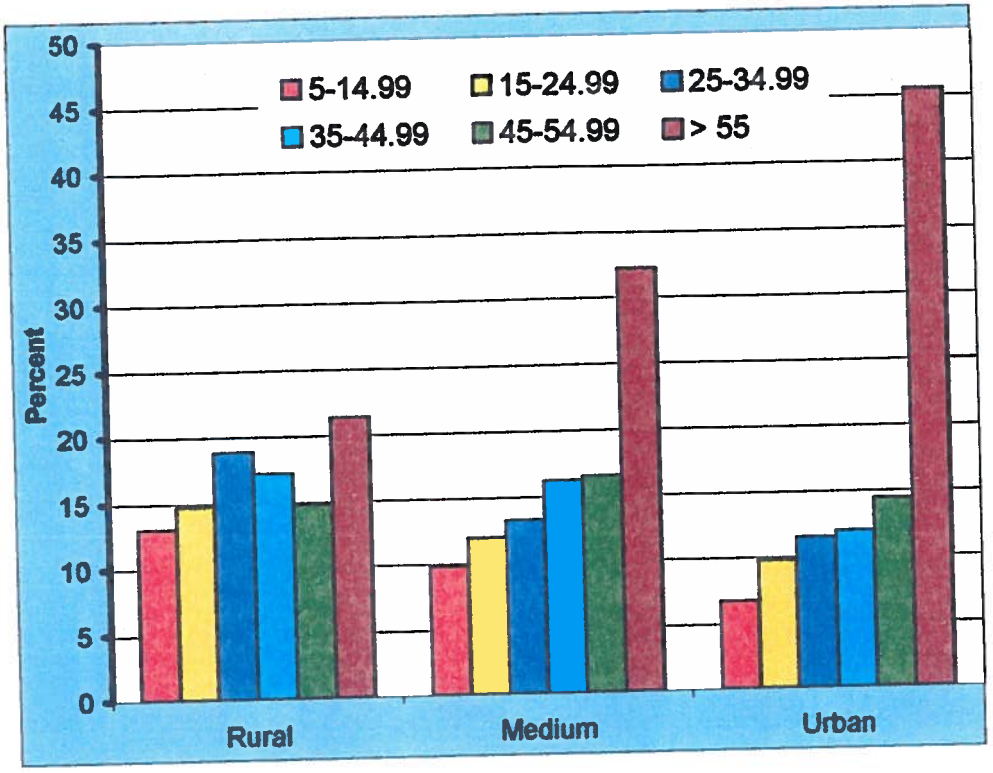


Figure 15. Percentage distribution of estimated household annual income (thousand N) by sector

5.2.7 Distribution of Education Ratio by level of income

Table 17 shows household education ratio and level of household income. Income shows an increasing return to education at the national level. In other words income levels are responsive to education ratio with increase in income as the education ratio increases. The low level of education ratio for most of the income groups underscores the need for intensive education. Estimated education ratio for the dry savanna zone was the smallest (1.2) while that of the humid forest was the highest (2.0). The education ratio was smallest in the rural sector (1.4) compared to 1.5 and 2.2 for the medium and urban sectors respectively.

Table 17: Household average education ratio by income group, agroecological zone and sector

		Agroecological zone			Sector		
Income category (N '000)	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
5 – 14.99	0.6	0.8	0.3	0.9	0.4	0.8	0.5
15 – 24.99	0.7	0.2	0.7	0.9	0.6	0.5	1.1
25 – 34.99	0.6	0.4	0.5	0.9	0.5	0.6	0.9
35 – 44.99	0.9	0.6	0.9	1.2	0.7	0.9	1.2
45 – 54.99	0.9	0.6	1.0	1.3	0.7	0.9	1.3
55 and above	1.7	1.2	1.7	2.0	1.4	1.5	2.2

Summary of demographic and socioeconomic characteristics oh households

Demographic characteristics

- Ninety-four percent of the sampled household heads were male and 6% were female. There was more female-headed household (11.8%) in the humid forest than in the moist (2.4%) and dry savanna (1.6%) zone. The percentages of male-headed household were similar across the sectors.

- At the national level 62.8% households have one spouse and 25.6% have more than one spouse. There is a gradual increase in the number of households with two spouses with the dry savanna zone having the highest at 20.5% followed by moist savanna at 18.3% and the humid forest at 16.8%.

- Household heads in the 35-50 year range were 44.5% at the national level, followed by those in the age group of 18-34 years at 38.3%. Twenty seven percent of the head of households were above the age of 50 years. The dry and moist savanna zones were similar for the age group 18-34 years when compared to the humid forest. The medium sector had the highest percentage (41.5%) of heads of household in the 18 to 34 years age group.

- About half of the households (49%) have sizes between 3 and 5 persons while 35.1% of the households have sizes between 6 and 8 persons, with about 11 percent having household sizes between 9 and 11 persons. Although households with over 11 members were more in the moist savanna (8%), intermediate (4.7%) in the dry savanna and low (2.2%) in the humid forest zone. Across the sectors, households with sizes between 9 and 11 persons were more in the rural and urban sectors than in the medium sector.

- Slightly over 50% of the persons were in the 0-14 years old with 25.1% being children under-5. Those between 15 and 34 years old were 30.8%. Approximately 1% of the population is over 65.

- Nationally, 48.7% of the respondents had no form of education. This suggests a literacy rate of slightly over 50% among household heads. Most of the literate household heads did not complete primary school and there is a progressive decline in the percentage of literate household heads as educational level rises.

Socioeconomic characteristics

- Over 40 per cent of household heads studied were farmers with about 15 percent each as traders, civil servants and artisan. Fishing was the occupational category with the least percentage of household heads (1.3%).

- While over 50 percent of the household heads in the dry and moist savanna were involved in farming, just about half of this proportion is involved in farming in the humid forest zone. About 15 percent of household heads are civil servants across the zones, artisans were disproportionately higher in the humid forest zone (24%), about half in the moist savanna (11.4%), and 6.2% in the dry savanna zone.

- The predominant source of energy is electricity used by about 38.4% of the households, thus implying that about 62.0% of the households do not have access to national electric supply. Access to other sources of electricity was however very low with less than one percent of households using personal generators and 3.5% utilizing rural electricity.

- About 75.0% of the households do not have electricity in the dry savanna, 45.0% in the humid forest and 57.0% in the moist savanna. Access to NEPA was highest in the humid forest zones (48.3%) and least in the dry savanna zone (23.4%).

- The most common primary source of water for drinking and other domestic uses available to households nationally is the well (37%), followed by springs or rivers (24%), and pipe borne water (20%). The use of boreholes is becoming increasingly popular (11.8%). Only about 5% of the surveyed households depend on rain as the primary source of water.

- The major primary sources of water differed markedly across the sectors. Well was the main source in the rural (44%) and medium (40%) areas, with pipe borne water as the main source in the urban areas. Rainwater was least used in urban areas (2.9%).

- The primary method of refuse disposal among households is the use of bush and other methods (78%). Less than 2 percents of households use city service nationally.

- Over 65% of households use pit latrines, with about 25% using the bush as their main type of toilet. Only about 5 percent of the households use the water closet system. While the use of pit latrines was predominant and consistent across the zones and sectors, over 80 percent of the households in the dry savanna used pit latrines, 59.2% in moist savanna, and 58.2 % in humid forest. The use of bush was however lowest in the urban areas (11%) compared to the rural (30%) and medium (27%) areas.

- While over 10 percent of the households had an estimated annual income of less than 15,000 Naira per annum, about 15 percent of the households estimated their annual incomes as less than 35,000 Naira. The modal income category was between N55, 000 and above (31%).

- Across the agroecological zones, most of the households had estimated annual incomes of N55, 000 and above though the percentage of households in this group was highest (35%) in the humid forest zone. Also across the sectors, most of the households had estimated annual incomes of N55, 000 and above with 21.4 percent in the rural sector, 32.2% in the medium and 45.5% in the urban sector.

CHAPTER 6
FOOD SECURITY

6.1 Food availability and affordability

Households are food secure when they have year round access to the quantity and variety of foods their members need to lead active and healthy lives. At the household level, food security refers to the ability of the household to secure, either from its own production or through purchases, adequate food for meeting the dietary needs of all members of the household. The nutritional status of each member of the household depends on several conditions being met: the food available to the household must be shared according to individual needs; the food must be of sufficient variety, quality, and safety, and each household member must have good health status in order to benefit from the food consumed. The objective of this section is to analyze the socio-economic and demographic factors that determine households' food security level as narrowly measured by the joint availability and affordability of food over a period of twelve months.

6.1.1 Availability and affordability of major staples and non-staples

Food availability and affordability constitute major indices of food security. During the survey, respondents were requested to indicate the number of months within a period of 12 months that different food items were available or affordable to their households. Nationally, most households indicated that staple foods are available to them for 9-12 months **(Table 18).** It was observed that especially within the 9-12 months range, the percentage of households that could afford the foods available were usually less than the percentage that indicated availability. The most available staple foods that are major sources of energy (calories) were rice (14.8%), cassava (12.9%), maize (10.6%) and yam (10.1%). Cowpea, groundnut, and soybean are major source of plant proteins. Cowpea was the most available, followed by groundnuts, and soybean.

For affordability, the same trends were observed. Rice was the most affordable, followed by cassava, maize, and yam. For legumes, cowpea was the most affordable followed by groundnuts and soybean.

Table 18. Percentage distribution: availability and affordability of major staple foods at the national level.

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	Available	Affordable	Available	Affordable	Available	Affordable
Cassava	1.58	2.87	2.09	2.30	12.90	11.04
Cowpea	0.08	0.68	0.16	1.14	10.75	9.47
Groundnut	0.31	1.12	0.77	1.39	9.31	8.11
Maize	6.11	7.81	2.62	3.00	10.62	8.66
Plantain	0.21	1.01	0.98	1.33	4.74	3.50
Rice	0.16	1.45	0.21	1.19	14.83	12.30
Sorghum	0.06	0.57	0.19	0.94	6.03	4.80
Soybean	0.02	0.31	0.18	0.28	2.87	2.12
Yam	0.50	2.14	1.52	3.10	10.13	6.80

Nationally, most households indicated that non-staple foods are available to them for 9-12 months **(Table 19).** The most available non-staple foods were meat products (14%), non-leafy vegetables (13%), leafy vegetables (9.5%) and fats and oils (8.9%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

Table 19. Percentage distribution: availability and affordability of major non-staple foods at the national level.

	1- 4 months		5 – 8 months		9 – 12 months	
Non-staple	Available	Affordable	Available	Affordable	Available	Affordable
Bakery	0.00	0.26	0.02	0.35	4.29	3.82
Banana	0.22	0.77	0.55	0.74	2.66	1.93
Beverages	0.01	0.37	0.04	0.47	5.60	4.17
Dairy	0.11	0.88	0.30	0.79	7.41	5.56
Fats and oils	0.02	0.53	0.12	0.57	8.89	7.84
Fish	0.13	0.48	0.16	0.53	6.91	6.30
Fruits	7.83	10.30	5.59	5.00	5.10	3.55
Leafy veg.	1.24	1.96	1.94	2.10	9.53	8.79
Meat prod.	0.26	2.88	0.80	2.01	14.00	9.42
Non-leafy veg.	1.50	2.42	1.40	1.83	12.96	11.91

When the data was disaggregated by agroecological zones, within the 9-12months period, rice was more available (16.4%) and affordable (13%) in the dry savanna zone, followed by maize at 12.7% and 10.5% for availability and affordability, and sorghum at 11.6% and 10.3% availability and affordability respectively. Cassava and yam was the least available and affordable **Table 20.** Among legumes, cowpea was the most available and affordable followed by groundnut, and soybean.

Table 20. Percentage distribution: availability and affordability of major staple foods by agroecological zone (Dry savanna).

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	**Available**	**Affordable**	**Available**	**Affordable**	**Available**	**Affordable**
Cassava	4.44	6.87	4.50	3.29	5.76	4.15
Cowpea	0.08	0.81	0.05	1.46	13.27	11.50
Groundnut	0.44	1.85	1.44	1.76	10.19	8.75
Maize	4.40	6.19	1.08	1.76	12.67	10.50
Plantain	0.16	0.19	0.10	0.13	0.53	0.36
Rice	0.15	2.55	0.09	0.96	16.35	12.98
Sorghum	0.01	0.56	0.05	0.90	11.60	10.29
Soybean	0.04	0.16	0.07	0.21	3.29	2.81
Yam	1.20	3.19	1.74	1.51	6.28	4.25

In the dry savanna, most households indicated that non-staple foods are available for 9-12 months **(Table 21).** The most available non-staple foods were meat products (12.4%), non-leafy vegetables (15.4%), dairy products (8.2%) and fats and oils (10.6%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

Table 21. Percentage distribution: availability and affordability of major non-staple foods by agroecological zone (Dry savanna).

	1- 4 months		5 – 8 months		9 – 12 months	
Non-staple	Available	Affordable	Available	Affordable	Available	Affordable
Bakery	0.00	0.38	0.02	0.45	4.60	3.85
Banana	0.55	1.14	0.66	0.62	2.18	1.66
Beverages	0.01	0.17	0.02	0.33	3.80	3.18
Dairy	0.33	1.08	0.56	0.74	8.18	6.92
Fats and oils	0.01	0.57	0.03	0.65	10.61	9.43
Fish	0.02	0.27	0.03	0.50	5.24	4.58
Fruits	8.87	11.60	5.05	3.93	5.36	3.89
Leafy veg.	1.44	1.99	1.21	1.31	7.51	6.85
Meat	0.10	1.93	0.12	1.22	12.42	9.48
Non-leafy veg.	2.65	3.98	2.03	2.71	15.38	13.57

Data for the moist savanna for the same period of within 9-12months periods indicates that rice was more available (12.%) and affordable (9%), followed by cassava and maize (11%) and yam (10.5%). Soybean, plantain, and sorghum are the least available and affordable **Table 22.** Among legumes, cowpea was the most available and affordable followed by groundnut, and soybean.

Table 22. Percentage distribution: availability and affordability of major staple foods by agroecological zone (Moist savanna).

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	Available	Affordable	Available	Affordable	Available	Affordable
Cassava	1.41	2.92	3.00	4.02	11.16	8.41
Cowpea grain	0.09	0.96	0.51	1.66	9.39	7.48
Groundnut	0.20	1.04	0.88	1.99	8.99	7.16
Maize	4.72	7.01	5.08	5.45	10.91	8.47
Plantain	0.10	0.89	1.54	1.46	2.20	1.28
Rice	0.22	1.45	0.54	2.15	11.98	8.95
Sorghum	0.10	0.80	0.50	1.98	8.45	6.30
Soybean	0.01	0.38	0.50	0.57	3.90	3.21
Yam	0.43	2.24	2.57	4.90	10.57	6.48

Most households in the moist savanna indicated that non-staple foods are available to them for 9-12 months **(Table 23).** The most available non-staple foods were meat products (13.5%), non-leafy vegetables (12.6%), dairy products (7.8%) and fats and oils (8.8%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

Table 23. Percentage distribution: availability and affordability of major non-staple foods by agroecological zone (Moist savanna).

	1- 4 months		5 – 8 months		9 – 12 months	
Non-staple	Available	Affordable	Available	Affordable	Available	Affordable
Bakery	0.01	0.35	0.04	0.58	4.50	3.66
Banana	0.07	0.78	0.80	1.03	2.51	1.58
Beverages	0.01	0.19	0.04	0.47	4.25	3.01
Dairy	0.05	0.80	0.56	1.27	7.67	5.34
Fats and oils	0.02	0.76	0.40	0.84	8.82	7.59
Fish	0.03	0.42	0.15	0.66	5.77	4.87
Fruits	6.73	10.17	7.33	6.16	5.13	3.04
Leafy veg.	1.00	2.16	3.75	3.90	9.37	8.10
Meat	0.29	3.42	1.28	3.02	13.50	8.48
Non-leafy veg.	0.80	2.07	2.20	2.67	12.64	11.00

In the humid forest, most households indicated that staple foods are available to them for 9-12 months **(Table 24).** It was observed that especially within the 9-12 months range, the percentage of households that could afford the foods available were usually less than the percentage that indicated availability. The most available staple foods that are major sources of energy (calories) were rice (15.7%), cassava (18.0%), maize (9.3%) and yam (12%). Cowpea, soybean and groundnut are major sources of plant proteins. Cowpea was the most available, followed by groundnuts. Soybean was the least available.

For affordability, the same trends were observed. Cassava was the most affordable, followed by rice, yam, and maize. For legumes, cowpea was the most affordable followed by groundnuts.

Table 24. Percentage distribution: availability and affordability of major staple foods by agroecological zone (Humid forest).

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	Available	Affordable	Available	Affordable	Available	Affordable
Cassava	0.07	0.56	0.19	0.68	17.96	16.60
Cowpea	0.07	0.43	0.00	0.63	10.15	9.53
Groundnut	0.31	0.76	0.33	0.82	9.00	8.33
Maize	7.89	9.22	2.01	2.19	9.29	7.72
Plantain	0.31	1.56	1.14	1.93	8.63	6.67
Rice	0.14	0.82	0.09	0.72	15.66	13.96
Sorghum	0.06	0.44	0.07	0.33	1.45	0.74
Soybean	0.01	0.35	0.05	0.14	2.03	1.05
Yam	0.16	1.49	0.77	2.91	12.04	8.45

Presented in **Table 25** is the percent distribution of non-staple food crops in the humid forest zone. The most available non-staple foods were meat products (15.2%), non-leafy vegetables (11.8%), leafy vegetables (10.8%) and fats and oils (8.0%) and fish (8.5%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and dairy products.

Table 25. Percentage distribution: availability and affordability of major non-staple foods by agroecological zone (Humid forest).

	1- 4 months		5 – 8 months		9 – 12 months	
Non-staple	Available	Affordable	Available	Affordable	Available	Affordable
Bakery	0.00	0.14	0.00	0.16	4.00	3.90
Banana	0.12	0.55	0.35	0.66	3.02	2.29
Beverages	0.01	0.59	0.06	0.55	7.35	5.41
Dairy	0.02	0.80	0.00	0.54	6.83	4.88
Fats and oils	0.01	0.38	0.02	0.37	7.95	7.04
Fish	0.26	0.64	0.23	0.47	8.47	8.13
Fruits	7.84	9.60	4.94	4.98	4.93	3.63
Leafy veg.	1.25	1.83	1.38	1.54	10.76	10.33
Meat	0.34	3.13	0.94	1.91	15.17	9.91
Non-leafy veg.	1.22	1.69	0.61	0.84	11.76	11.45

Rice, cassava, maize, cowpea, and yam were more available while soybean, plantain, and sorghum were the least available staple food crops in the rural sector. Among the most available staple foods, yam was the least affordable followed by maize **(Table 26).**

Table 26. Percentage distribution: availability and affordability of major staple foods by sector (Rural).

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	**Available**	**Affordable**	**Available**	**Affordable**	**Available**	**Affordable**
Cassava	1.57	3.05	1.98	2.20	13.35	11.41
Cowpea grain	0.08	0.91	0.20	1.17	10.73	9.17
Groundnut	0.32	1.32	1.07	1.45	9.25	8.07
Maize	6.64	8.46	2.51	2.84	10.60	8.42
Plantain	0.22	1.05	0.85	1.26	4.60	3.29
Rice	0.20	1.67	0.29	1.23	14.59	11.91
Sorghum	0.08	0.70	0.29	1.03	6.19	4.88
Soybean	0.02	0.23	0.19	0.31	2.55	1.96
Yam	0.66	2.36	1.56	2.85	9.36	6.11

Meat products, non-leafy vegetables, leafy vegetables, and fats and oils were the most available and affordable non-staples in the rural sector **(Table 27).** The least available and affordable were banana, fruits, and bakery products. It should be noted that fruits were more available and affordable for 1-4 months.

Table 27. Percentage distribution: availability and affordability of major non-staple foods by sector (Rural).

	1- 4 months		5 – 8 months		9 – 12 months	
Non-staple	**Available**	**Affordable**	**Available**	**Affordable**	**Available**	**Affordable**
Bakery	0.01	0.34	0.03	0.34	4.34	3.83
Banana	0.28	0.85	0.45	0.64	2.67	1.92
Beverages	0.01	0.41	0.05	0.40	5.21	3.72
Dairy	0.10	0.92	0.28	0.73	7.26	5.32
Fats and oils	0.02	0.63	0.17	0.54	8.86	7.83
Fish	0.16	0.54	0.17	0.53	6.95	6.34
Fruits	8.24	10.62	5.62	5.04	4.67	3.11
Leafy veg.	1.30	2.05	1.99	2.08	9.71	8.99
Meat	0.33	3.13	0.89	2.12	14.45	9.63
Non-leafy veg.	1.22	2.20	1.24	1.67	12.90	11.84

Rice, cassava, maize, cowpea, groundnut, and yam were more available while soybean and plantain were the least available staple food crops in the medium sector. Among the most available staple foods, yam was the least affordable followed by groundnuts **(Table 28).**

Table 28. Percentage distribution: availability and affordability of major staple foods by sector (Medium).

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	**Available**	**Affordable**	**Available**	**Affordable**	**Available**	**Affordable**
Cassava	2.07	2.44	0.06	3.07	12.58	10.73
Cowpea	0.14	1.19	0.01	0.58	10.94	9.72
Groundnut	0.56	1.47	0.01	0.92	9.67	8.41
Maize	6.09	2.97	0.04	7.73	10.83	8.90
Plantain	1.07	1.29	0.09	0.99	4.27	3.18
Rice	0.14	1.13	0.16	1.48	14.98	12.33
Sorghum	0.14	0.89	0.03	0.48	6.31	5.19
Soybean	0.15	0.29	0.05	0.31	3.04	2.18
Yam	1.67	3.41	0.05	2.00	9.59	6.25

Meat products, non-leafy vegetables, leafy vegetables, and fats and oils were the most available and affordable non-staples in the medium sector **(Table 29).** The least available and affordable were banana, fruits, and bakery products. It should be noted that fruits were more available and affordable for 5-8 months.

Table 29. Percentage distribution: availability and affordability of major non-staple foods by sector (Medium).

	1- 4 months		5 – 8 months		9 – 12 months	
Non-staple	**Available**	**Affordable**	**Available**	**Affordable**	**Available**	**Affordable**
Bakery	0.00	0.02	0.42	0.26	4.36	3.81
Banana	0.68	0.02	0.88	0.82	2.54	1.81
Beverages	0.04	0.18	0.55	0.36	5.71	4.10
Dairy	0.39	0.29	0.93	0.93	7.38	5.37
Fats and oils	0.06	0.05	0.69	0.54	9.01	7.72
Fish	0.17	0.01	0.56	0.50	6.75	6.13
Fruits	5.36	0.03	4.90	10.64	4.96	3.44
Leafy veg.	2.11	0.02	2.28	2.24	9.36	8.66
Meat	0.83	0.32	2.07	3.03	13.62	8.84
Non-leafy	1.37	0.03	1.97	2.54	12.77	11.74

Rice, cassava, maize, cowpea, and yam were more available while soybean, plantain, and sorghum were the least available staple food crops in the urban sector. Among the most available staple foods, maize was the least affordable followed by groundnuts **(Table 30).**

Table 30. Percentage distribution: availability and affordability of major staple foods by sector (Urban).

	1- 4 months		5 – 8 months		9 – 12 months	
Staple food	Available	Affordable	Available	Affordable	Available	Affordable
Cassava	2.31	0.12	2.26	2.23	12.59	10.87
Cowpea	0.11	0.00	1.00	0.42	10.49	9.60
Groundnut	0.57	0.01	1.17	1.09	8.84	7.71
Maize	3.16	0.14	3.32	6.73	10.31	8.70
Plantain	1.07	0.08	1.52	0.98	5.74	4.40
Rice	0.19	0.09	1.20	1.00	15.01	12.96
Sorghum	0.08	0.06	0.86	0.48	5.31	4.02
Soybean	0.21	0.06	0.22	0.45	3.19	2.30
Yam	1.21	0.01	3.05	1.98	12.4	8.91

Meat products, non-leafy vegetables, leafy vegetables, dairy products and fats and oils were the most available and affordable non-staples in the urban sector **(Table 31).** The least available and affordable were banana, fruits, and bakery products. It should be noted that fruits are more available for 1-4 months.

Table 31. Percentage distribution: availability and affordability of major non-staple foods by sector (Urban).

	1- 4 months		5 – 8 months		9 – 12 months	
Non Staple	Available	Affordable	Available	Affordable	Available	Affordable
Bakery	0.01	0.00	0.27	0.13	4.09	3.84
Banana	0.53	0.02	0.70	0.55	2.83	2.14
Beverages	0.03	0.07	0.46	0.33	6.11	5.02
Dairy	0.19	0.14	0.67	0.72	7.70	6.24
Fats and oils	0.12	0.09	0.44	0.35	8.78	8.04
Fish	0.11	0.04	0.48	0.36	7.06	6.50
Fruits	5.88	0.12	5.10	9.22	6.02	4.44
Leafy veg.	1.61	0.07	1.86	1.38	9.48	8.66
Meat	0.62	0.37	1.74	2.24	13.82	9.92
Non-leafy veg.	1.73	0.13	1.90	2.58	13.35	12.29

6.1.2 Frequency of Consumption

Cereals stand out, as the food people seem to find most convenient to consume several times. About 41 per cent of the respondents said they consume cereals more than four times in a week. This has a lot of implication on the need to increase the production of cereals in order to meet the rate of consumption. One striking result is the high percentage of the respondents who consumed maize almost daily in the moist savanna (63.5%) followed by humid forest (38.3%) and dry savanna (39.7%). This may lead to high demand pressure on the quantity available thus forcing the price above the reach of the poor majority. The intensity of maize consumption was more in the moist savanna (63.5 %) than in either dry savanna zone (39.7 %) or humid forest zone (38.3 %) for those who eat it for more than four times in a week **(Table 32a, b, and c).**

Table 32a. Frequency of consumption of staple food crops by agroecological zone (Dry savanna)

Staple food	0 times/week	1-2 times/week	3-4 times/week	Over-4 times/week
Cassava and products	4.8	29.3	62.9	3.0
Maize	3.3	7.3	49.6	39.7
Rice	3.4	19.8	51.4	25.5
Sorghum	6.2	4.7	29.7	59.4
Yam tuber and products	11.0	38.8	47.3	3.2
Plantain	39.0	23.3	30.0	7.8

Table 32b. Frequency of consumption of staple food crops by agroecological zone (Moist savanna)

Staple food	0 times/week	1-2 times/week	3-4 times/week	Over-4 times/week
Cassava and products	5.3	18.3	51.5	25.0
Maize	0.8	1.5	34.3	63.5
Rice	3.8	13.6	52.3	30.3
Sorghum	8.9	6.7	41.7	42.7
Yam tuber and products	3.1	15.7	59.2	22.0
Plantain	24.7	31.1	38.6	5.3

Table 32c. Frequency of consumption of staple food crops by agroecological zone (Humid forest)

Staple food	0 times/week	1-2 times/week	3-4 times/week	Over-4 times/week
Cassava and products	2.2	5.5	39.0	53.3
Maize	6.9	11.3	43.6	38.3
Rice	2.8	12.0	62.7	22.4
Sorghum	19.9	9.5	24.9	45.7
Yam tuber and products	13.0	13.5	48.4	22.1
Plantain	21.4	27.0	42.8	8.9

Considering those who ate rice for more than four times in a week, the pattern of consumption shows an increase from dry savanna (25.5%) to moist savanna (30.3%). However, lower proportion of the respondents in the humid forest zone reported they ate rice for more than four times in a week. As high as 20 per cent of the respondents in the humid forest zone did not consume sorghum in a week. For the tubers, the pattern of cassava consumption increases from dry savanna through moist savanna to the humid forest zone. The results also established that yam is not only largely produced in the moist savanna zone the intensity of its consumption is also highest.

The frequency of consumption of major non-staple foods is presented in **Table 33a, b, and c.** From those respondents who indicated that fats and oils were available and affordable, 75.4% consume them more than 4 times a week, followed by non-leafy vegetables (62.5%), beverages (33.0%). Although leafy vegetables are consumed 3-4 times a week when available, there are less consumed over four times a week. This is true for fruits and fish products **(Table 33a).**

Table 33a. Frequency of consumption of non-staple food by agroecological zone (Dry savanna)

Staple food	0 times/week	1-2 times/week	3-4 times/week	Over 4 times/week
Bakery products	3.0	33.2	44.5	19.3
Banana	16.3	43.6	38.1	2.0
Beverages	7.9	18.8	40.4	33.0
Dairy products	3.4	13.4	53.3	29.9
Fats and oil	0.7	2.6	21.3	75.4
Fish product	2.7	18.3	50.5	28.5
Fruits	1.9	13.6	66.9	17.5
Leafy vegetable	2.5	21.4	72.3	3.8
Legumes	1.0	8.5	63.5	27.0
Meat product	5.2	35.7	49.5	9.6
Non leafy vegetable	0.6	5.3	31.6	62.5

The frequency of consumption of major non-staple foods is presented in the moist savanna is presented in **Table 33b.** From those respondents who indicated that these foods were available and affordable, 76.5% consume fats and oils more than 4 times a week, followed by non-leafy vegetables (69.7%), and fish products (51.7%). Although leafy vegetables are consumed 3-4 times a week when available, there are less consumed over four times a week. This is also true for fruits and fish products **(Table 33b).**

Table 33b. Frequency of consumption of non-staple food by agroecological zone (Moist savanna)

Staple food	0 times/week	1-2 times/week	3-4 times/week	Over-4 times/week
Bakery products	6.9	23.0	41.4	28.6
Banana	26.2	27.5	36.7	9.5
Beverages	11.2	15.9	47.1	25.8
Dairy products	3.7	19.4	54.5	22.5
Fats and oil	0.9	1.2	21.4	76.5
Fish product	4.9	10.6	32.8	51.7
Fruits	1.2	8.9	63.4	26.5
Leafy vegetable	1.5	11.7	76.1	10.7
Legumes	1.0	10.3	66.8	21.9
Meat product	8.9	31.8	51.0	8.3
Non leafy vegetable	0.1	0.93	29.3	69.7

Those who reside in the humid forest, their frequency of consumption is high for fats and oils (84.1%), followed by fish products (75.5%) non-leafy vegetables (59.4%) and bakery products (36.0%) **(Table 33c).** Legumes are consumed 3-4 times per week across the agroecological zones.

Table 33c. Frequency of consumption of non-staple food by agroecological zone (Humid forest)

Staple food	0 times/week	1-2 times/week	3-4 times/week	Over-4 times/week
Bakery products	4.0	10.6	49.5	36.0
Banana	29	28.1	35.2	7.8
Beverages	12.3	15.3	49.1	23.3
Dairy products	13.8	18.3	48.5	19.4
Fats and oil	0.78	1.3	13.9	84.1
Fish product	0.8	1.8	22.0	75.5
Fruits	5.0	11.6	58.5	24.9
Leafy vegetable	1.7	13.6	71.6	13.1
Legumes	4.0	18.1	61.0	16.5
Meat product	16.7	29.3	46.3	7.8
Non leafy vegetable	0.5	1.4	38.7	59.4

6.1.3 Food Insecurity

In computing the level of food insecurity, the fraction of the year (numbers of months over 12) of each occurrence was taken as the unconditional probability of availability (pa) or affordability (pb) for the respective food products. Availability and affordability of a given food item (i) are considered two independent events (A) and (B) in the sense that the occurrence or non-occurrence of one does not affect the other. Therefore, we apply the multiplicative law of probability to derive the joint probability of such a food item being available and affordable to the household (h):

Joint Probability (A and B) = jphi = (pai) * (pbi)

An index of food security, as measured by availability and affordability, was constructed by aggregating the joint probabilities (jphi) over all food items consumed by each household. The approach used in the aggregation is similar to the construction of Consumer Price Index (CPI) in economics that employs expenditure proportions instead of fixed quantity shares of food items as weights.[1] The argument for using expenditure weights is the fact that consumers do insulate themselves from the impact of higher prices by adjusting their spending to favor relatively lower-priced goods. It is believed that expenditure weights estimator can better reflect the substitution effects of price changes in consumer spending than can the quantity weighted formula (US Bureau of Labor Statistics, 1998). Moreover, expenditure

[1] The CPI used to be constructed using a set of constant implicit quantity weights in a basket of goods and services. The possibility of using the geometric mean formula to calculate basic indexes in the CPI was first raised in 1993 and finally adopted in January 1999 by the US Bureau of Labor and Statistics after convincing results from several empirical studies.

weights are uniform for all food items and more convenient to estimate than quantity weights.

Therefore, the food security index (FSI_h) is calculated as a weighted-sum (or geometric mean) of the joint probability of availability and affordability of individual food items within the basket of food consumed by each household as follows:

$$FSI_h = \Sigma_i^J w_{hi}\, jp_{hi}$$

Where
$E_{hi} = P_i Q_{hi}$
$Y_h = \Sigma_i^J E_{hi}$
$w_{hi} = E_{hi} / Y_h$

E_{hi} is household (h)'s expenditure on the ith food product having a market price P_i, and Q_{hi} being the quantity consumed; Y_h, its total expenditure on all food items by the household and w_{hi}, the expenditure weight.

It is worth noting that the values of the unconditional probabilities (p_{ai} and p_{bi}), the joint probabilities (jp_{hi}), as well as the food security index (FSI_h) are comprised within the interval [0,1]. For the index, a small value is an indication that the overall basket of food products consumed by a household is both available and affordable during few months only over the period of one year that is studied. The closer is this index to one for a given household the better is its food security level in terms of joint availability and affordability. Alternatively, the above index can be transformed into food insecurity index as follows:

$$\text{Food Insecurity Index } (FII_h) = 1 - FSI_h$$

In order to facilitate analysis and comparison of food insecurity prevalence among households having different socio-economic characteristics, and along sectoral and agroecological parameters, three classification levels have been created. Households' food insecurity is classified as severe for $FII_h > 0.10$, mild for $0.05 < FII_h < 0.10$, and normal for $FII_h < 0.05$. These classifications correspond to situations where food was not simultaneously available and affordable for more than 1.2 months (1 month), between 0.6 (2 weeks) and 1.2 months (1 month), and less than 0.6 months over the 12 months period studied.

Results obtained from this procedure are shown in **Figures 16**. Across sectors and agro-ecological zone, higher availability and affordability of foods is associated with residents in the medium and urban areas, and in the humid forest as opposed to those in the rural sector, and the dry and moist savanna zones respectively. In decreasing order, households in the rural sector are relatively more food insecure, followed by those in the medium and urban sectors. Similarly, households in the moist savanna agroecological zone are more food insecure compared to households in the dry savanna and the humid forest respectively.

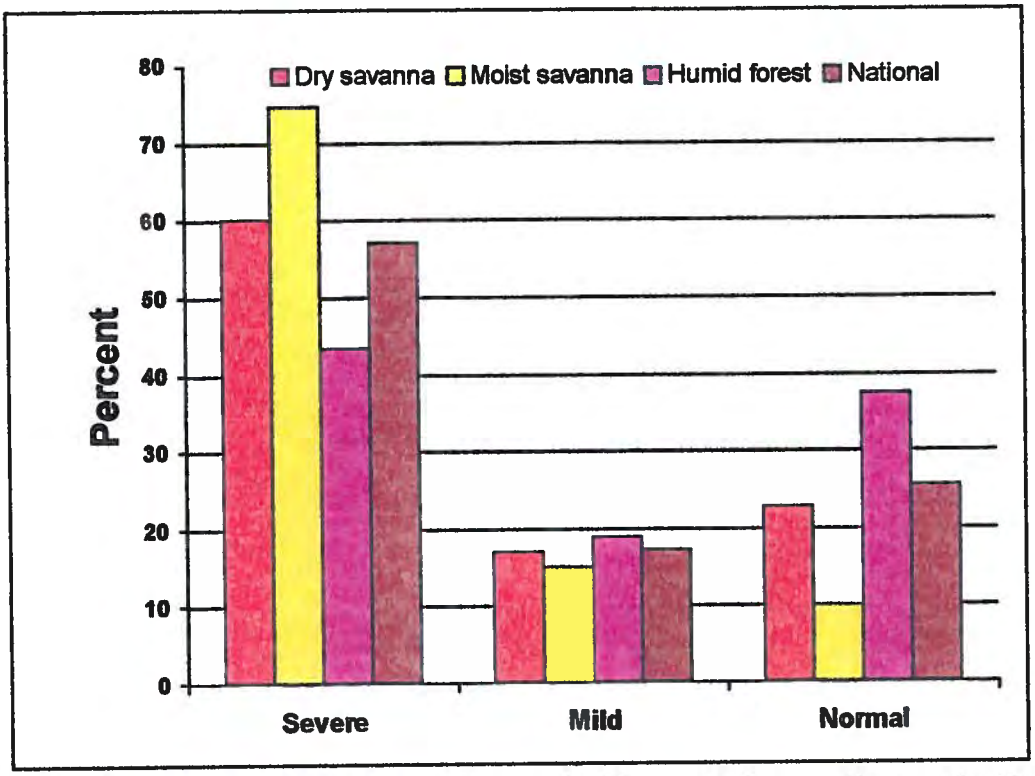


Figure 16. Percentage distribution of households according to the level of food insecurity by agroecological zone

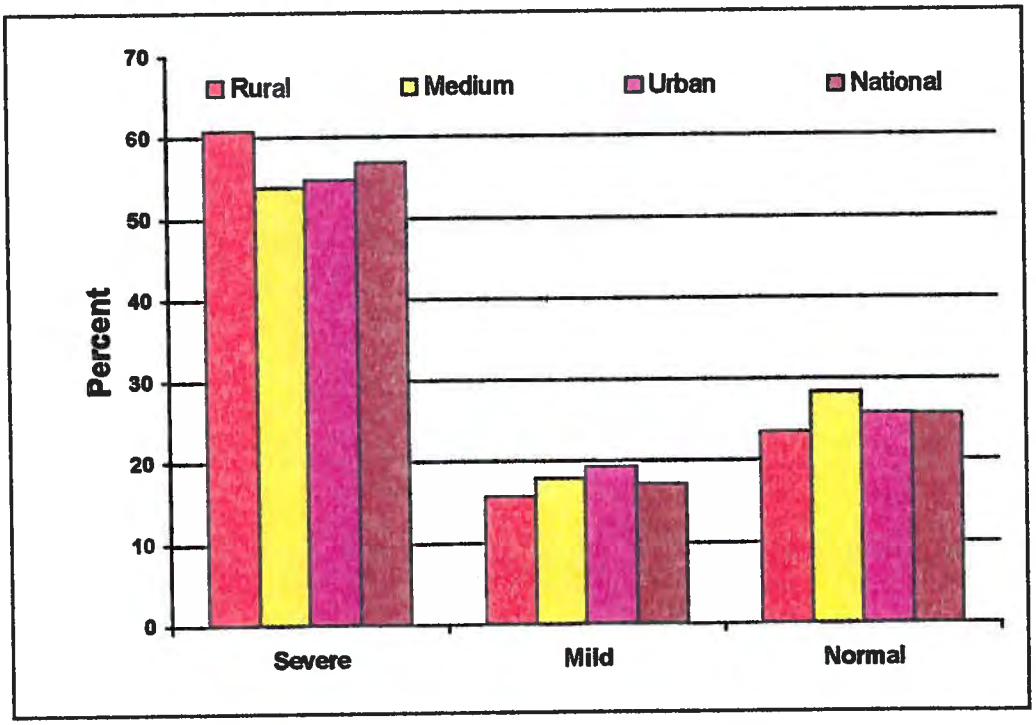


Figure 17. Percentage distribution of households according to the level of food insecurity by sector

Comparisons across primary occupations of household heads show that families headed by farmers are the most severely affected by food insecurity. The level of severity decreases as one moves from being a farmer to trader, artisan, civil servant, and fishermen-headed households **(Figure 18)**. At the same time, male-headed households show greater severity of insecurity compared to female-headed ones.

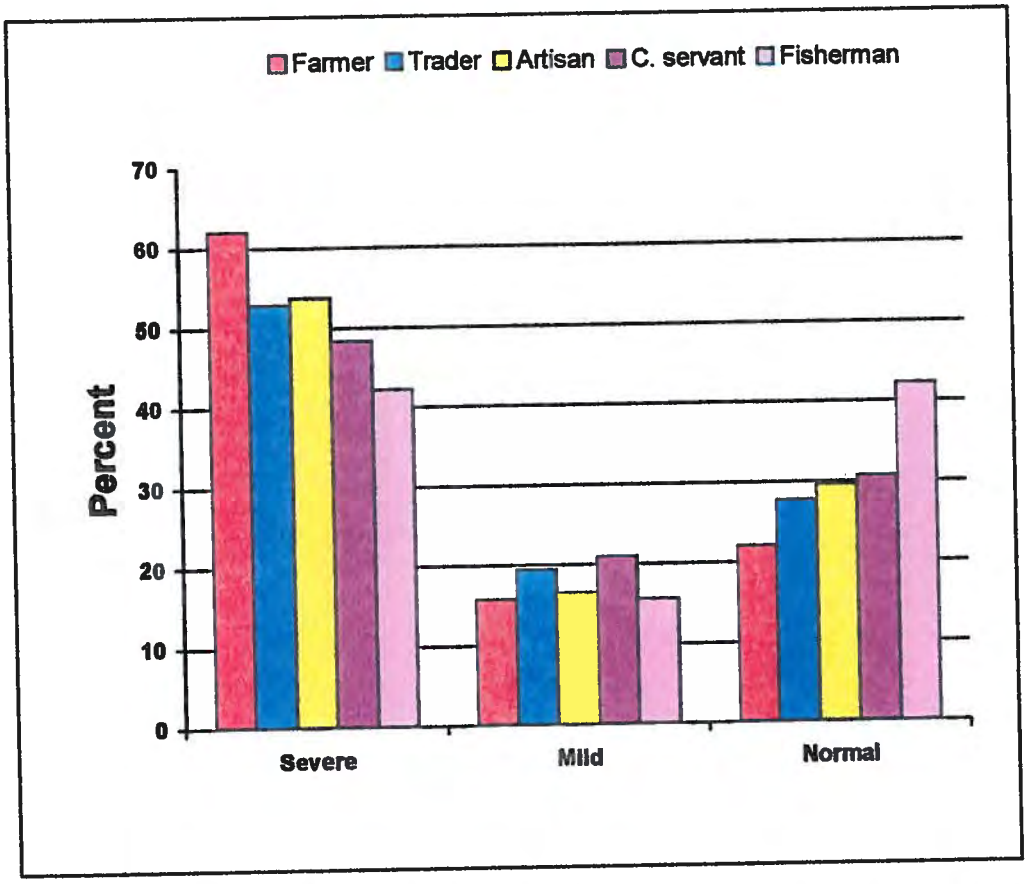


Figure 18. Percentage distribution of household's food insecurity by primary occupation

The following three income classes: (i) low for household annual income of less than Naira 35,000; (ii) medium for income between N 36,000 and N 55,000; and (iii) high for income higher than 55,000 were created and compared. Food insecurity is more prevalent in household that fall within the medium income category but there is no apparent difference between low and high-income classes **(Figure 19)**.

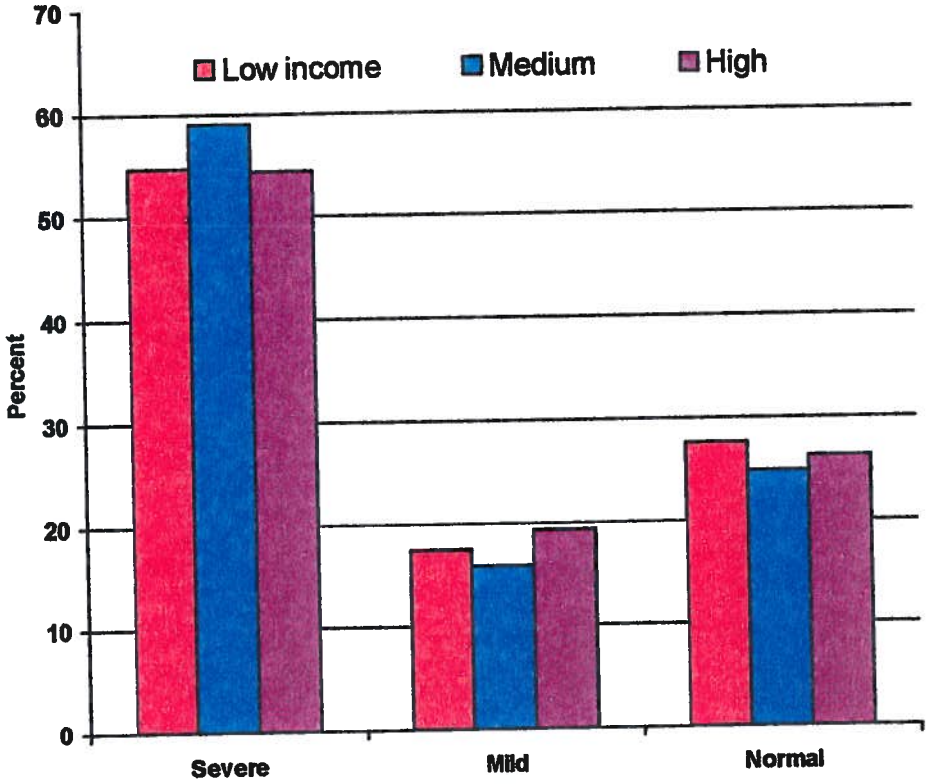


Figure 19. Percentage distribution of household's food insecurity by income classes

Households are also classified into low, medium, and high standard of living categories depending on their primary source of energy, drinking water, method of refuse disposal, and toilet system. The low standard corresponds to households environment without electricity and where pond, lake, spring, river or harvesting rain water is the main source of drinking water, bush is used for toilet or refuse disposal.

The medium standard refers to access to rural electrification, well or bore hole for drinking water, and refuse dump and VIP latrine for waste disposal. The high level includes households that possess their own electricity generator or have access to the NEPA (National Electrical power Authority), to organized refuse disposal services, and having water-flushing toilets. Food insecurity is relatively more severe within households in the low living standard category **(Figure 20)**, followed by those in the medium and high categories respectively. This suggests positive correlation between food security and living standards as measured in this study.

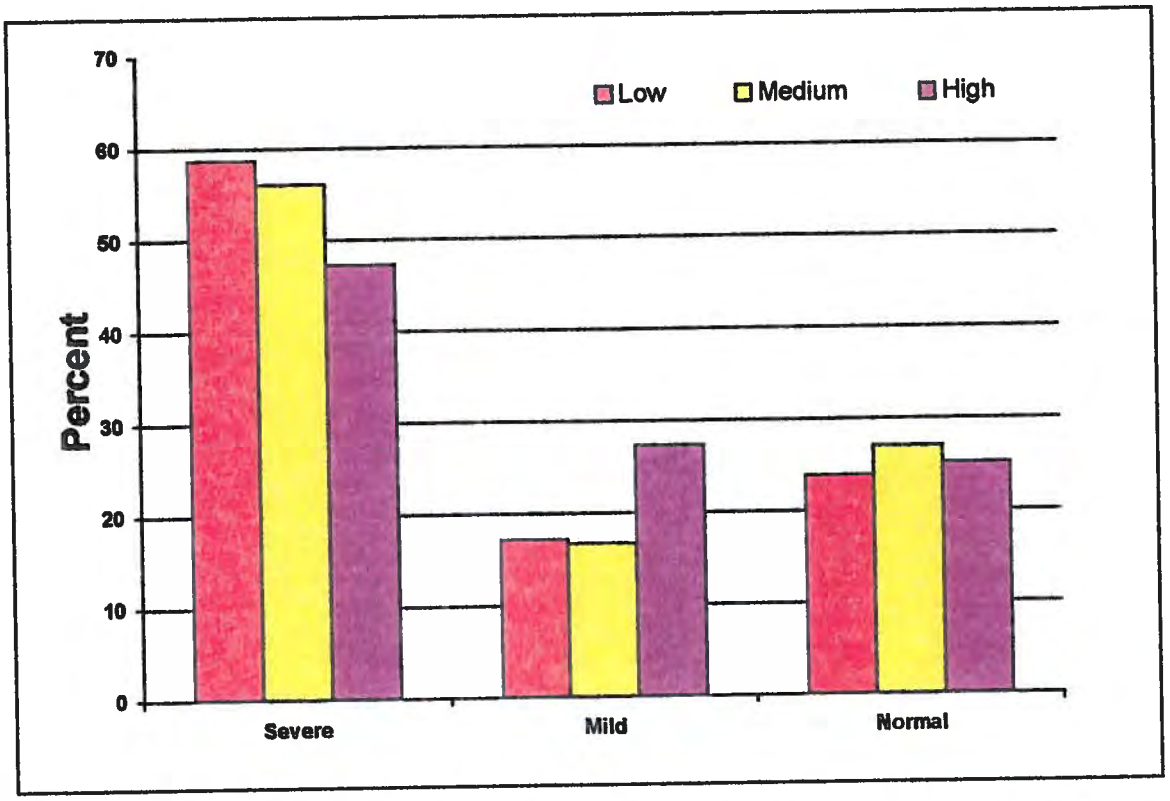


Figure 20. Percentage distribution of household's food insecurity by living standard

6.2 Estimated average household expenditure on major staples and non-staples per week

Tables' 34a, 34b, 35a, and 35b show the estimated values of major staples either purchased or produced at home in Naira value. The quantity of food produced by the household and food entitlement can provide considerable insight into household food security. At the national level there is evidence of high expenditure on staples with cereals attracting the highest expenditure of about N643.97 per week compared to average expenditure of N347.73 on roots and tubers. Results further reveal that respondents spent more on sorghum (N228.3) than on either rice (N215.6) or maize (N127.2). Other staples considered include cowpeas, groundnut and soybean, which attracted up to N232.37 per week. Sixty six percent of this was expended on Cowpeas alone. It is to be observed that main sources of the consumed calories were poor.

Across agroecological zones, while households in the moist and dry savanna spent as much as N833.48 and N770.51 respectively on cereals, households in the humid forest zones spent average of N311.06 per week. Reverse is the case with roots and tubers with decline in the average weekly expenditure on roots and tubers from the humid forest (N473.31) through the moist savanna (N284.86) to the dry savanna

zone (N154.78). This reflects the fact that food consumption patterns of households are influenced by the principal foods most available in their agroecological zone.

Further, while average household weekly expenditures on legumes were more in the moist savanna (N316.53) and dry savanna (N215.89) than in the humid forest (N192.66) expenditure on bakery products was higher in the humid forest zone (N111.10) than in either dry savanna (N82.37) or moist savanna (N78.89). Generally, respondents spent more on staples in the urban than in either medium or rural sector. Weekly expenditure on cereals is still the highest when compared to other staples across the sectors. Further, the results indiicates that average weekly expenditure on food across agroecological zones were N2263.98, N3237.94 and N2551.21 for the dry savanna, moist savanna and humid forest zone per week respectively.

Table 34a. Average household weekly expenditure on major staples per week in Naira by national and agroecological zone.

Food crop	National	Dry savanna	Moist savanna	Humid forest
Cassava products	173.32	51.31	106.50	273.10
Maize	127.19	172.97	210.06	42.11
Rice	215.63	257.27	311.29	145.33
Sorghum	228.63	270.91	227.97	34.00
Yam products	174.42	103.47	178.36	200.21
Plantain	66.16	43.33	39.62	73.74
Cowpea	152.93	132.32	215.86	131.54
Groundnut	49.81	51.08	63.00	40.74
Soybean	29.62	32.49	37.70	20.38

Nationally, average household expenditures on non-staples were highest on fish (N140.84) followed by meat products (N81.54). Here the least weekly expenditure was on the fruits (N13.62) followed by weekly expenditure on the leafy vegetables (N20.88) as presented in **Table 34b.** Relatively, the highest expenditure on major non-staples was recorded in moist savanna zone while the least was recorded in the dry savanna zone. Household expenditure on beverages was highest in the humid forest zone (N47.74), least in the dry savanna (N20.99) and about twice as much in the moist savanna (N49.80). Fish, meat, oils and fats attracted very high expenditure in all the zones and sectors.

Table 34b. Average household expenditure on some major non-staples per week in Naira by national and agroecological zone.

Food crop	National	Dry savanna	Moist savanna	Humid forest
Beverages	43.28	20.99	49.80	47.74
Diary products	59.37	57.21	62.55	58.75
Fats and oils	75.23	67.64	85.99	74.23
Fish products	140.89	78.59	128.10	171.29
Fruits	13.62	16.87	16.79	9.76
Leafy vegetables	20.88	16.12	23.23	22.17
Meat products	81.54	84.40	121.07	55.56
Non-leafy vegetable	33.63	35.62	35.70	30.68
Bakery	91.99	82.37	78.89	111.10
Wheat Flour	72.52	69.36	84.12	89.62
Banana	27.27	25.01	25.71	29.56

Table 35a. Average household expenditure on some major staples per week in Naira by national and sector.

Food crop	National	Rural	Medium	Urban
Cassava and Products	173.31	181.32	161.69	177.93
Maize	127.18	135.55	123.38	118.15
Rice	215.63	192.98	194.83	288.96
Sorghum	228.63	248.02	232.37	174.95
Yam and Products	174.42	156.40	170.79	206.65
Plantain	66.159	59.64	65.81	76.47
Cowpea grain	152.93	151.41	152.59	156.26
Groundnut	49.81	51.28	49.70	47.19
Soybean	29.61	28.99	29.07	31.36

Table 35b. Average household expenditure on some major non-staples per week in Naira by national and sector.

Food crop	National	Rural	Medium	Urban
Beverages	43.27	39.25	40.23	53.54
Dairy products	59.36	52.14	49.62	84.85
Fats and oils	75.23	71.99	72.36	85.24
Fish products	140.88	138.24	130.13	161.87
Fruits	13.61	12.12	11.26	19.78
Leafy vegetables	20.87	20.52	20.26	22.63
Meat products	81.53	68.27	73.60	116.67
Non leafy	33.62	33.48	29.16	40.44
Banana	27.27	26.14	25.00	32.64
Wheat	72.52	65.64	85.13	61.63
Bakery products	91.98	79.10	84.48	124.80

6.3 Food related coping strategies

One of the indirect methods for assessing household food security is through food related coping strategies, that is, the actions people take when they do not have enough food or money to buy food (Wolfe and Frongillo Jr, 2000). The approach used in this study was to analyze the use of, and reliance upon, strategies for dealing with insufficiency of food at the household level as direct indicator of food security. It is to be noted that the respondents often use these various strategies together.

The basic premise for measuring the frequency and severity of food-consumption-related coping strategies is often a simple set of questions which could be derived and agreed upon, representing the most common coping behaviours on which people in a given population rely, when insufficient food in the household and insufficient money to buy food. The combination of frequency and severity would result in a simple quantitative score, which could either be compared over time to capture changes or compared cross-sectionally to identify at-risk households. Based on the experience of the authors some categories of consumption-related-coping strategies questions were asked. In the short term, when there is insufficient food within the household for the people who have to be fed by that household, or insufficient money to buy food, the head of the family responsible for seeing to it that people are fed can do one or more of the following:

1. Rely on less preferred foods
2. Rely on less expensive foods
3. Borrow money to buy food stuffs
4. Borrow food stuffs

Table 37: Percentage distribution of household according to coping strategy in response to food insecurity by sector

Coping strategy	Rural	Medium	Urban
Rely on less preferred food	12.2	12.1	10.9
Rely on less expensive foods	12.1	12.1	11.9
Borrow money to buy food stuff	10.8	11.8	12.3
Borrow food stuffs	7.2	7.5	4.6
Purchase food on credit	13.4	13.2	13.4
Rely on help from relative or	11.0	10.8	11.0
Limit portions at meal times	9.7	9.5	9.9
Ration money to household	1.9	2.3	4.3
Limit your own intake	9.9	9.6	10.4
Reduce number of meals	8.4	8.4	8.8
Skip whole day without eating	1.3	1.2	0.6
Other	2.3	1.6	2.1

Higher number of respondents (1.3 per cent) used this strategy in the rural sector than in the other sectors (1.2 medium and 0.6 urban) as presented in **Table 37.** This again reflects differential levels of poverty and food insecurity in these sectors. Following Corbett, 1988, skipping of food for a whole day falls into the second stage of the four stages household food insecurity.

Other strategies considered include reliance on social-capital as a means to alleviate food insecurity in terms of possible assistance from friends and relatives. Up to 11 per cent of the respondents reported that they depended on friends and relatives for help to mitigate food insecurity.

Summary for food availability and affordability, frequency of consumption, food insecurity, and coping strategies

- It was observed that especially within the 9-12 months range, the percentage of households that could afford the foods available were usually less than the percentage that indicated availability. The most available staple foods that are major sources of energy (calories) were rice (14.8%), cassava (12.9%), maize (10.6%) and yam (10.1%).

- Cowpea, groundnut, and soybean are major source of plant proteins. Cowpea was the most available, followed by groundnuts, and soybean.

- The most available non-staple foods were meat products (14%), non-leafy vegetables (13%), leafy vegetables (9.5%) and fats and oils (8.9%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

- Within the 9-12months periods, rice was more available (16.4%) and affordable (13%) in the dry savanna zone, followed by maize at 12.7% and 10.5% for availability and affordability, and sorghum at 11.6% and 10.3% availability and affordability respectively. Cassava and yam were the least available and affordable

- In the dry savanna, the most available non-staple foods were meat products (12.4%), non-leafy vegetables (15.4%), dairy products (8.2%) and fats and oils (10.6%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and beverages.

- In the moist savanna for 9-12months periods rice was more available (12.%) and affordable (9%), followed by cassava and maize (11%) and yam (10.5%). Soybean, plantain, and sorghum are the least available and affordable. Among legumes, cowpea was the most available and affordable followed by groundnut, and soybean.

- The most available staple foods that are major sources of energy (calories) were rice (15.7%), cassava (18.0%), maize (9.3%) and yam (12%) in the humid forest. Cowpea, soybean and groundnut are major sources of plant proteins. Cowpea was the most available, followed by groundnuts. Soybean was the least available. For affordability, the same trends were observed. Cassava was the most affordable, followed by rice, yam, and maize. For legumes, cowpea was the most affordable followed by groundnuts.

- In the humid forest zone, the most available non-staple foods were meat products (15.2%), non-leafy vegetables (11.8%), leafy vegetables (10.8%) and fats and oils (8.0%) and fish (8.5%). The same trend was observed for affordability. The least available and affordable were banana, bakery products, fruits, and dairy product

- In the dry savanna, 59.4% consume sorghum more than 4 times a week, followed by maize at 39.7% and rice at 25.5%. Yam and cassava are the least consumed. In the moist savanna, more households consumed maize (63.5%) followed by sorghum at 42.7%, rice 30.3%, cassava 25%, and yam 22%. The least consumed staple is plantain. Among those who responded in the humid forest, 53.3% consume cassava more than 4 times a week, followed by maize 38.3%, rice 22.4%, and yam 22.1%.

- Among the non-staple foods, fats and oils showed the highest frequency of consumption across the agroecological zones, 75.4% in the dry savanna, 76.5% in the moist savanna, and 84.1% in the humid forest. The second most widely consumed non-staple was fish product 75.5% in the humid forest, non-leafy vegetables 69.7% in the moist savanna and 62.5% in the dry savanna.

- Meat products, green leafy vegetables, and banana were the least consumed across the zones.

- Across sectors and agro-ecological zone, higher availability and affordability of foods is associated with residents in the medium and urban areas, and in the humid forest as opposed to those in the rural sector, and the dry and moist savanna zones respectively. In decreasing order, households in the rural sector are relatively more food insecure, followed by those in the medium and urban sectors. Similarly, households in the moist savanna agroecological zone are more food insecure compared to households in the dry savanna and the humid forest respectively.

- Comparisons across primary occupations of household heads show that families headed by farmers are the most severely affected by food insecurity. The level of severity decreases as one moves from being a farmer to trader, artisan, civil servant, and fishermen-headed households.

- Food insecurity is relatively more severe within households in the low living standard category, followed by those in the medium and high categories respectively. This suggests positive correlation between food security and living standards as measured in this study.

- At the national level there is evidence of high expenditure on staples with cereals attracting the highest expenditure of about N643.97 per week compared to average expenditure of N347.73 on roots and tubers. Results further reveal that respondents spent more on sorghum (N228.3) than on either rice (N215.6) or maize (N127.2).

- Across agroecological zones, while households in the moist and dry savanna spent as much as N833.48 and N770.51 respectively on cereals, households in the humid forest zones spent average of N311.06 per week.

- Nationally, average household expenditures on non-staples were highest on fish (N140.84) followed by meat products (N81.54). Here the least weekly expenditure was on the fruits (N13.62) followed by weekly expenditure on the leafy vegetables (N20.88). Relatively, the highest expenditure on major non-staples was recorded in moist savanna zone while the least was recorded in the dry savanna zone.

- Nationally, over 13% of the population reported purchasing food on credit. Closely related to that is borrowing money to buy foodstuffs (11.5%) and borrowing foodstuffs (7.2%). More household heads in the humid forest (18.5%) purchased food on credit than in either moist (11%) or dry savanna zone (7.9 per cent) to cope with the situation of food insecurity.

- Other strategies considered include reliance on social-capital as a means to alleviate food insecurity in terms of possible assistance from friends and

relatives. Up to 11 per cent of the respondents reported that they depended on friends and relatives for help to mitigate food insecurity.

CHAPTER 7
NUTRITIONAL STATUS OF UNDER-5 CHILDREN AND MOTHERS

7.1 Anthropometry

Growth assessment is the single measurement that best defines the health and nutritional status of children, because disturbances in health and nutrition, regardless of their etiology, invariably affect child growth. Health and nutrition problems during childhood are the result of a wide range of factors, most of which, particularly in underprivileged populations relate to inadequate food intake or severe and repeated infections, or a combination of the two. These conditions, in turn, are closely linked to the general standard of living and whether a population is able to meet its basic needs such as food, housing and health care. Growth assessment thus serves as a means for evaluating the nutritional status of children, just as it also provides an indirect measurement of the quality of life of an entire population.

There is sufficiently good evidence to show that poor growth and smaller size in children is associated with impaired development, and a number of studies have demonstrated a relationship between growth status and school performance or intelligence. However, this cannot be regarded as a simple causal relationship between inadequacy of food, physical growth status and intellectual development. Complex environmental, sociocultural and economic factors affect both growth and development.

An important section of the present survey was the collection of anthropometric data in the children of respondents. These measurements (height and weight) were made only on children under-5. Along with the children's ages these measurements were then used to calculate the following indices of nutritional status:

- Height for Age
- Weight for Height
- Weight for Age

Height-for-age is an index of nutritional status of children that reflects linear growth. Children whose height-for-age fall below –2SD (Standard Deviation) from the median of internationally accepted standard set by the National Center for Health Statistics (NCHS, 1978) are said to be stunted or short for their age. They are considered to be chronically undernourished. Those children who are below –3SD of the same median are considered to be severely stunted.

The weight-for-height index on the other hand measures body mass in relation to body length. There are also three categories under this index. Children below –1SD of the median are considered wasted (mild) or thin. Those below –2SD of the median are moderately wasted while those below –3SD of the median are severely wasted. Ordinarily in a healthy/well nourished population, one would not expect to

find more than 2.5% of the children below the –2SD threshold. A prevalence of greater than 10% is considered an alert and a prevalence of 15% or more is considered serious.

The weight–for-age index reflects both acute and chronic under nutrition in children. It compares the weight of a child with those of his age mates in populations that are recognized to be well nourished (i.e. reference populations). Children with weight-for-age below –1SD of the median of this reference are said to be "Underweight" (Mild), while those between –2SD and –3SD are moderately underweight whereas children below –3SD are severely underweight.

Although the heights and weights of all the eligible children encountered were measured, the correct ages of some of these children could not be ascertained. For this and other reasons, the data used for calculating (using EPI-Info 6.1 software) the indices represent measurements from 4748 children under-5 for Wasting, 4954 children under-5 for Underweight and 5028 children under-5 for Stunting of all eligible children (5325).

In calculating HAZ (Height for age or stunting) 98 percent of the eligible children were used. In calculating WAZ (Weight for age or Underweight) 96 percent of the eligible children were used and for WHZ (Weight for Height) 93 percent of the eligible children were used.

The percentages of children under-5 thus classified as undernourished are presented in **Table 38**and illustrated in **Figure 21 and 22**.

Table 38. Percentage prevalence of malnutrition among children 0-59 months

Level	Stunting (Height for Age)	Wasting (Weight for Height)	Underweight (Weight for Age)
Mild (<-1SD)[1]	19.5	17.1	28.0
Moderate (<-2SD)	16.4	5.6	17.1
Severe (<-3SD)	25.1	3.5	8.3
National (<-2SD)	42.0	9.0	25.0

[1] The national coverage does not include the mild category.

The data show that 42% of these children are stunted, 25% are underweight and 9% are wasted **(Table 38 and Figure 21).** The percentages of the degree (mild, moderate and severe) of these forms of malnutrition are presented in **Figure 22.** Out of the 42% that are stunted, 25% are classified as severe. This is a particularly high level especially considering that another 35.9% are also classified as either mild (19.5%) or moderate (16.4%) respectively. Additionally of the 25% classified as

underweight, 8% are severe while more than double (17.1%) are moderately underweight **(Figure 22).**

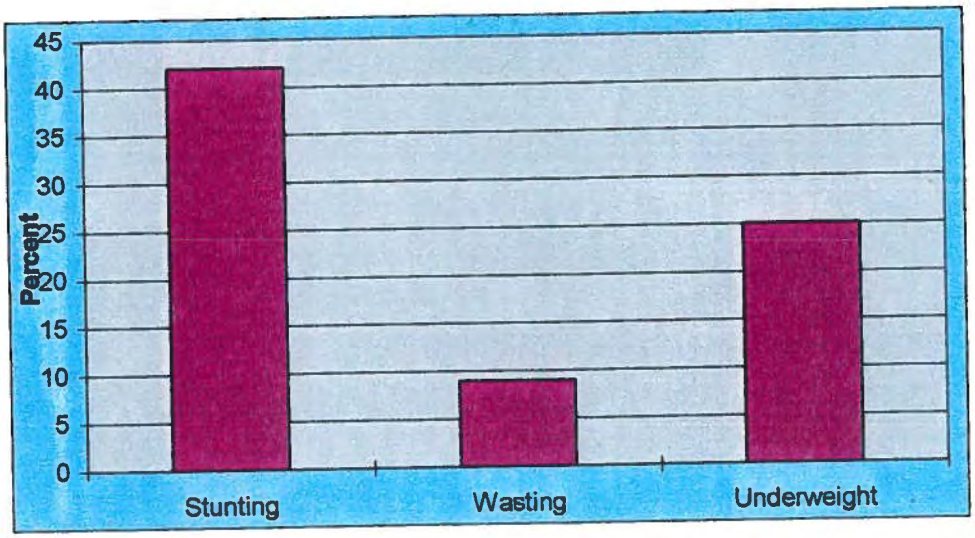


Figure 21. Percentage national prevalence of malnutrition in children under–5

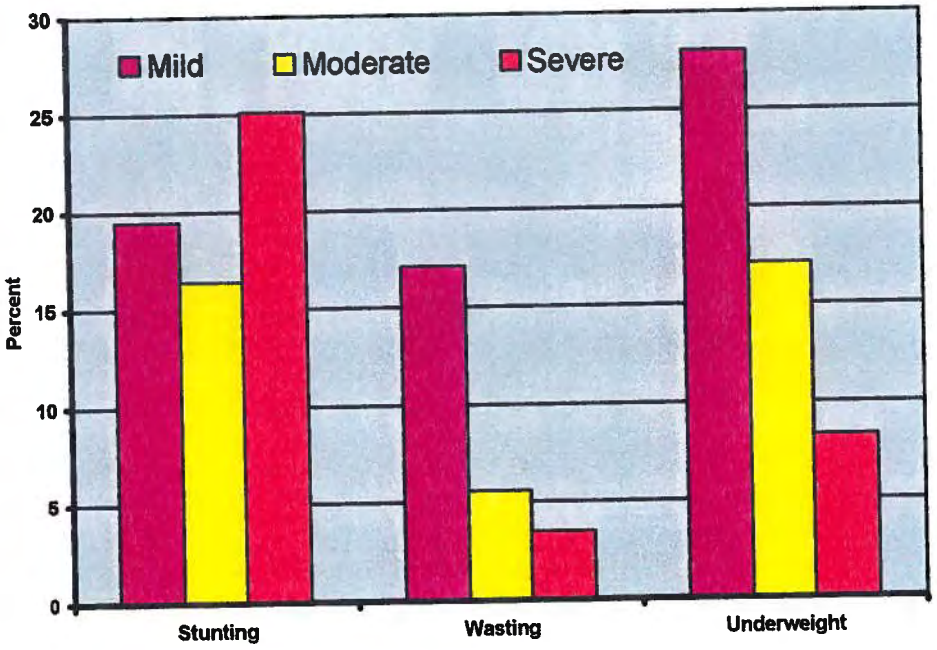


Figure 22. Profile of stunting wasting and underweight of children under–5

In disaggregating the prevalence of malnutrition by agroecological zones, sector, sex and other parameters, data was calculated such that the prevalence values were

derived from the total sample sizes of each of the segments considered. The average of the prevalence values obtained after disaggregating of data equals the national average for variables considered.

Figure 23 represents the percentage of children under-5 who are malnourished by agro-ecological zone. The data show that the prevalence of stunting was lowest (27%) in the humid forest zone and highest in the dry savanna zone (58%). Indeed the dry savanna zone has the highest prevalence not only of stunting (58%), but wasting (13%) and underweight (38%).

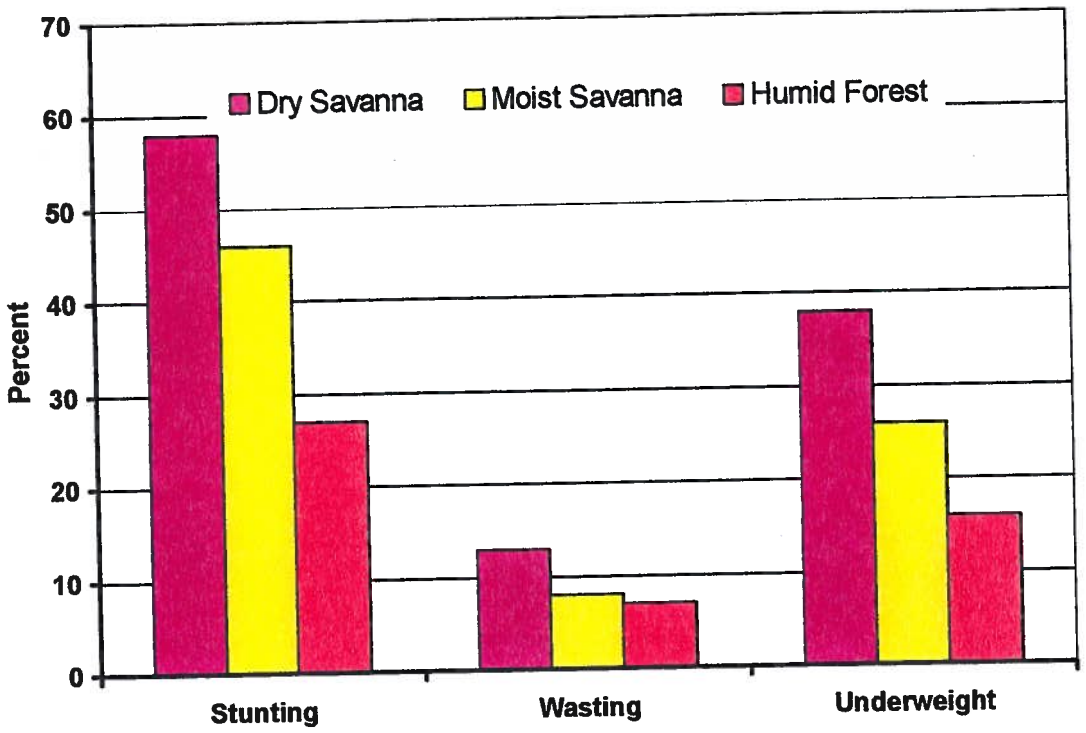


Figure 23. Percentage prevalence of malnutrition among children 0-59 months in the humid forest, dry and moist savanna agroecological zones

When the data was disaggregated by sector, the urban sector has the lowest prevalence of all forms of malnutrition as shown in **Figure 24** (36.3%, 8.4%, and 21.1% for stunting, wasting, and underweight respectively). The rural sector has the highest level of malnutrition (44.3%, 9.5% and 27.7% for stunting, wasting and underweight respectively). Malnutrition was 42%, 9%, and 25% in the medium sector **(Figure 24).**

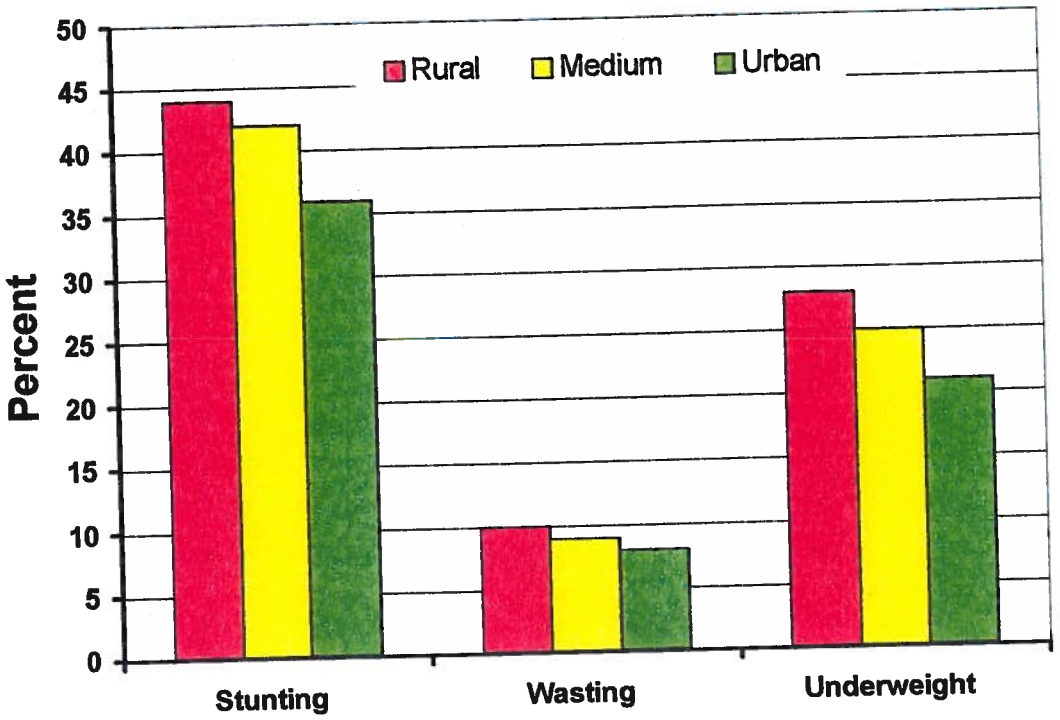


Figure 24. Percentage prevalence of malnutrition among children of 0-59 months by sector

The percentage prevalence of malnutrition of children under-5 by sex is presented in **Table 39.** For the 3 indices (stunting, wasting, and underweight), the prevalence is slightly higher in boys than in girls. Stunting is 43.8% in boys and 39.3% in girls, while wasting is 9.3% in boys and 8.9 in girls and underweight is 26.5% and 24.4% in boys and girls respectively.

Table 39. Percentage prevalence of malnutrition among children 0-59 months by sex.

Indicator and Level	National	Sex	
		Boys	Girls
Stunting			
Mild (<-1SD)	19.5	18.7	20.4
Moderate (<-2SD)	16.4	17.7	15.1
Severe (<-3SD)	25.1	26.1	24.2
Total[1]	41.5	43.8	39.3
Wasting			
Mild (<-1SD)	17.1	16.9	17.4
Moderate (<-2SD)	5.6	6.1	5.1
Severe (<-3SD)	3.5	3.2	3.8
Total[1]	9.1	9.3	8.9
Under Weight			
Mild (<-1SD)	28.0	26.9	29.0
Moderate (<-2SD)	17.1	16.9	17.4
Severe (<-3SD)	8.3	9.6	7.0
Total[1]	25.4	26.5	24.4

[1] The total does not include the mild category.

Overall, the percentage of stunting appears to increase with increasing age of the children as shown in **Figure 25** and **Table 40** up to 24 months after which there is a gradual decrease.

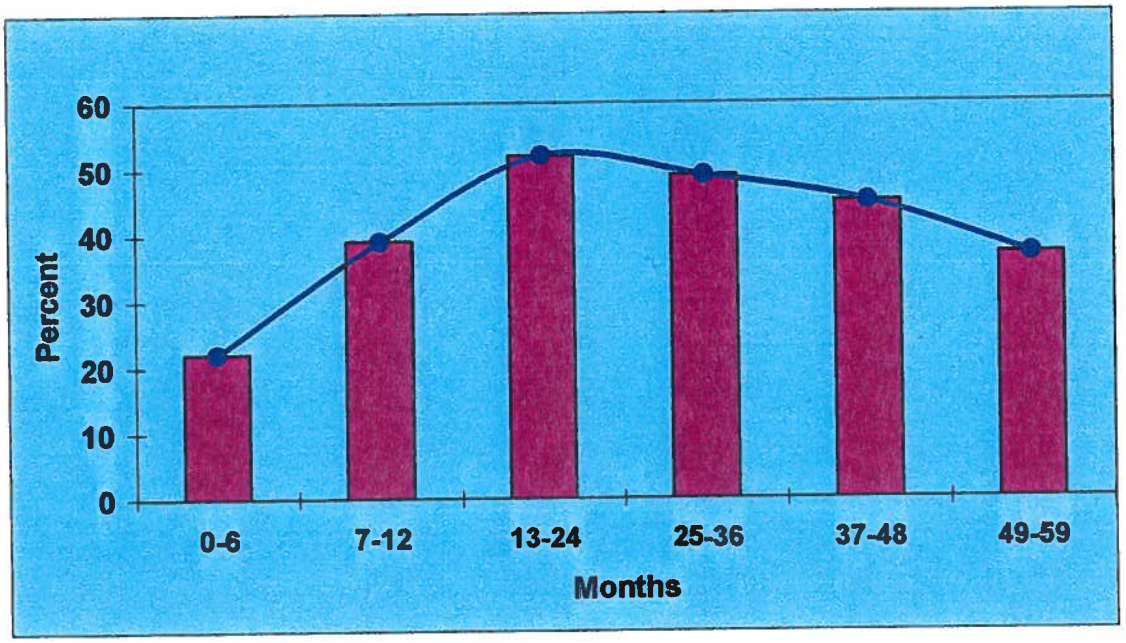


Figure 25. Percentage prevalence of stunting among children 0-59months

The results show a very steep increase in the percentage of wasting between 6 to 12 months **(Table 40 and Figure 26)**, which is also significant as these periods correspond to the time of breastfeeding, and introduction of complementary foods for most children.

Table 40. Percentage prevalence of malnutrition among children 0-59 months by age group

Indicators	Age Group					
Stunting						
	0-6	**7-12**	**13-24**	**25-36**	**37-48**	**49-59**
Mild (<-1SD)	17.0	19.8	20.0	19.6	21.3	24.6
Moderate (<-2SD)	9.2	15.8	19.1	18.7	20.0	16.4
Severe (<-3SD)	12.4	22.7	32.9	30.0	25.2	20.9
Wasting						
Mild (<-1SD)	9.5	17.9	23.0	14.5	15.5	2.8
Moderate (<-2SD)	3.3	10.8	5.9	2.9	2.6	1.1
Severe (<-3SD)	3.0	5.8	4.0	2.3	0.4	1.2
Under Weight						
Mild (<-1SD)	15.0	29.9	31.4	30.9	30.3	41.4
Moderate (<-2SD)	4.9	19.0	23.6	18.9	16.1	12.0
Severe (<-3SD)	1.6	10.6	12.4	8.1	5.3	2.3
National						
Stunting (<-2SD)	22.0	39.0	52.0	49.0	45.0	37.0
Wasting (<-2SD)	6.0	17.0	10.0	5.0	3.0	4.0
Underweight (<-2SD)	7.0	30.0	36.0	27.0	21.0	14.0

Although there is a sharp decrease in wasting in children above 12 months, this was not true for underweight. As shown in **Figure 27** there is an increase in underweight from 6 to 24 months after which, there is a gradual decrease.

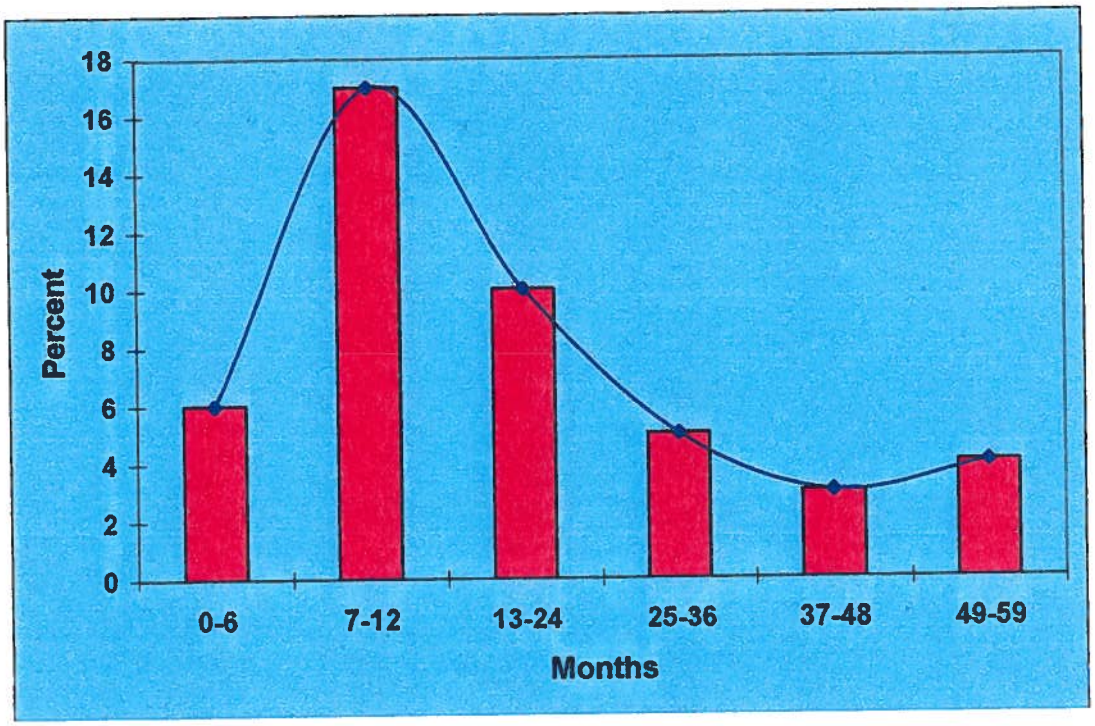


Figure 26. Percentage prevalence of wasting among children 0-59 months

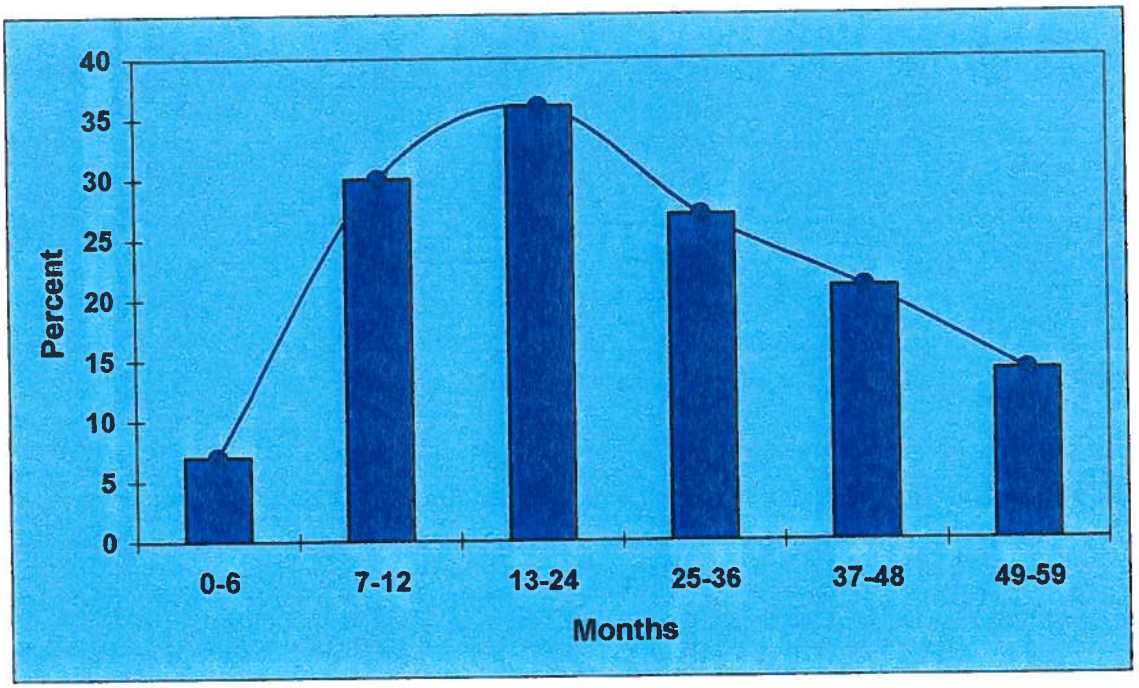


Figure 27. Percentage prevalence of underweight among children 0-59months

Taken together with the high level (20%) of Underweight, these suggest poor long term as well as short-term nutritional status. The profile of the three forms of malnutrition in the children under-5 is illustrated in **Figure 28.** It is obvious from this profile therefore that the critical period for these entire conditions together lie between 6 to 24 months of age.

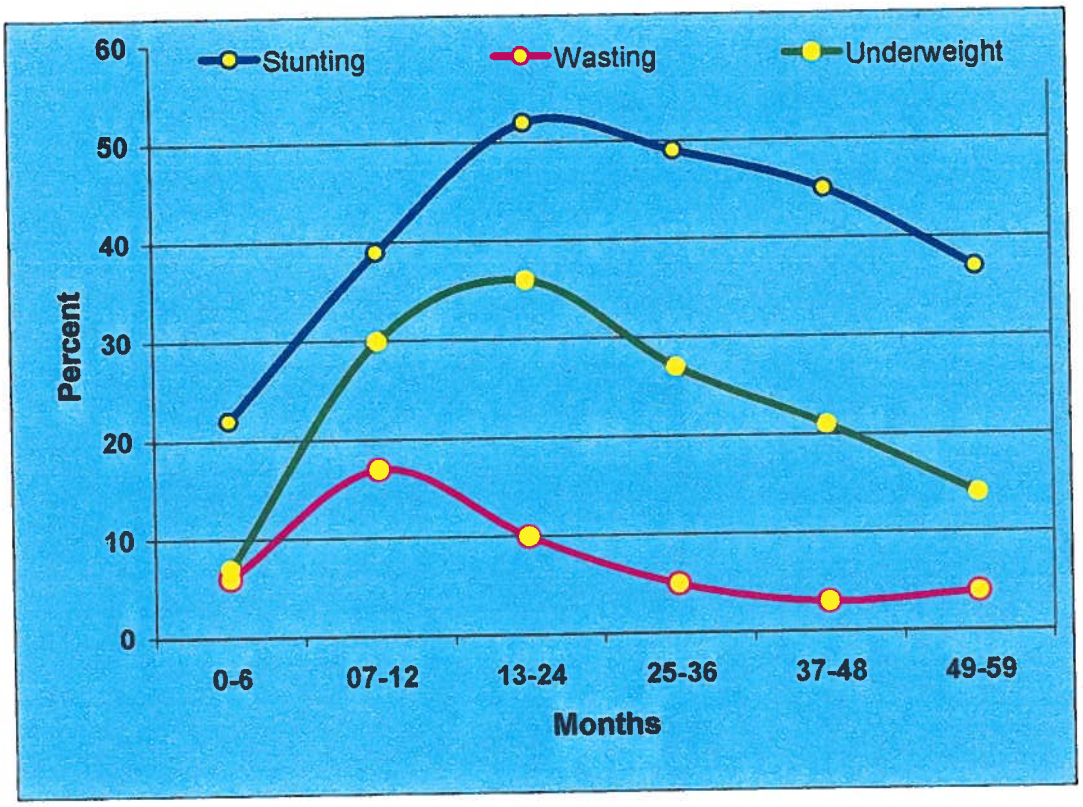


Figure 28. Percentage prevalence malnutrition among children of 0-59months

Information on states for stunting, wasting and underweight is presented in **Appendix 8.**

Summary on nutritional status of children under-5

In infants and children under-5 years of age, assessment of growth has been the single most important measurement that defines their nutritional status. Disturbances in nutrition as a result of inadequacy of food intake, severe and repeated infections or a combination of both, operating very often as a vicious spiral, invariably affect the growth of a child. These adverse conditions are closely linked to the general standard of living and the population's ability to meet its basic needs for nutritious food, safe water, good housing, acceptable levels of environmental sanitation, and ready and easy access to health care.

- Nationally, 42% of children under-5 surveyed are stunted indicating long-standing dietary inadequacy or malnutrition.

- There are major agroecological zone differences in stunting. More children under-5 is stunted in the dry savanna (58%), which is more than twice the rate in the humid forest (27%). Stunting is equally high (46%) in the moist savanna.

- Except in the urban sector (36%) where slightly less children under-5 are stunted when compared to the national level, the rates of stunting in the rural sector are high at 44%.

- The dry savanna has the highest (13%) prevalence of wasting in children under-5 when compared to the national prevalence of 9%. In the moist savanna and humid forest zones and in the sectors the rate of wasting is less than 10%.

- Nationally a quarter (25%), of the children surveyed are underweight. The highest proportion (38%) is in the dry savanna and lowest (16%) in the humid forest. The variation of underweight across sector though differing is about 20%.

- The results show a very steep increase in the percentage of wasting between 6 to 12 months, which is also significant as these periods correspond to the time of breastfeeding, and introduction of complementary foods for most children. This may be the result of sub-optimal infant feeding practices and high rates of infectious morbidity.

- The critical period when all three forms of malnutrition (stunting, wasting, and underweight) are present is 6-24 months.

7.2 Nutritional status of mothers

The lack of a true definition for the assessment of adult undernutrition is due to the difficulty in establishing satisfactory reference standards for normality and in delineating cutoffs to help distinguish between well-nourished and under-nourished adults in population groups (FAO, 2003). A chronic state of under nutrition in the adult has its cost in terms of risk to health and impairment of function, which may

include a lowered work capacity, a reduced ability to sustain economically productive work or even socially desirable physical activities and possibly an impaired immune function with a predisposition to repeated infections (FAO, 1994).

The Body Mass Index (BMI) is considered to be the most suitable, objective anthropometric indicator of nutritional status of the adult. It was chosen because it is derived from measures of weight and height of individuals of both sexes, is consistently and highly correlated with body weight (or energy stores within the body) and is relatively independent of the height of the adult (James et al, 1988). BMI is thus a simple but objective anthropometric indicator of the nutritional status of the adult population and is closely related to food consumption and the prevalence of inadequacy of food in the community (FAO, 1994).

This survey has employed Body Mass Index (BMI) as a simple and objective anthropometric indicator of the nutritional status of mothers. This simple index has now been recognized as an objective indicator of Chronic Energy Deficiency (CED) in adult populations. It is the recommended method of choice (FAO, 1994) to assess the number of people who are undernourished in the community.

Data on heights and weights were collected from eligible mothers and these were used to construct Body Mass Index (BMI). BMI classification has been done according to WHO recommendations (WHO, 2000):

< 18.5	=	Undernutrition
18.5 – 24.99	=	Normal
25.0 – 29.99	=	Overweight (Obesity Grade I)
30.0 and above	=	Obese (Obesity Grade II)

The percentage distribution of BMI in women of childbearing age into these different classes at the national level, agroecological zone and sector are presented in **Table 41.** The majority (68.5%) of the subjects fall within the normal range of BMI. Similar percentages were encountered in the dry savanna (67.7%), moist savanna (67.1%) and humid forest (70%). Nationally, 11.6% of women are suffering from chronic undernutrition **(Table 41).**

Chronic undernutrition (<18.5%) is more prevalent in the dry savanna (16.4%) than in the moist (9.9%) savanna and humid (9%) forest zone **(Table 41).** Only between 4.3% and 6.6% in the dry savanna and moist savanna, respectively fall into the obese category. Within the different sectors, chronic undernutrition range from 10.3 to 12.7%.

Table 41. Percentage distribution of Body Mass Index of women at the national, agroecological zone and sector level

	Body Mass Index Classification			
Category	**<18.5**	**18.5-24.99**	**25.0-29.9**	**30 and above**
National	11.6	68.5	14.2	5.7
Agroecological Zone				
Dry savanna	16.4	67.7	11.6	4.3
Moist savanna	9.9	67.1	16.4	6.6
Humid Forest	9.0	70.0	14.8	6.1
Sector				
Rural	12.7	70.1	12.6	4.6
Medium	10.3	71.5	13.4	4.8
Urban	11.5	60.9	18.6	9.0

Nationally, 14.2% of women of childbearing age are overweight and 5.7% are obese. The figures for overweight observed for the moist savanna (16.4%) zone and urban sector (18%) are higher than the national prevalence figure for overweight.

Obesity (BMI of 30 and above) is more prevalent in the urban sector (9%) than in the medium (4.8%) and rural (4.6%) sector. The prevalence in the agroecological zones range from 4.3% in the dry savanna to 6.6% in the moist savanna. The total percentage of women who are overweight is higher (19.9%) than that of women suffering from undernutrition (11.6%) **(Table 41).**

Body Mass Index below 18.4 is usually classified according to the degree of energy deficiency (FAO, 1994) as follows:

< 16.0	Chronic Energy Deficiency (CED) Grade III
16.0 – 16.9	Chronic Energy Deficiency (CED) Grade II
17.0 – 18.4	Chronic Energy Deficiency (CED) Grade I

When the 11.6% of mothers with BMI below 18.4 were further classified according to the different levels of Chronic Energy Deficiency, only 8.4% nationally fall in the Chronic Energy Deficiency Grade III **(Table 42)**.

When the data was disaggregated by agroecological zone and sector, the majority (70-80%) falls into Grade I of Chronic Energy Deficiency. The highest percentage (12.1%) of Grade III Chronic Energy Deficiency is found in the moist savanna zone. This is about the same percentage (13.3%) found in the urban area, which is twice as much as that found in both the rural (7.6%) and medium (6.3%) sectors **(Table 42).** Chronic energy deficiency has serious implications for morbidity and low productivity of women. This condition is associated with a higher prevalence of low birth weight pre-disposing to a higher infant mortality.

Table 42. Percentage distribution of Chronic Energy Deficient women by agroecological zone and sector

		Agroecological Zone			Sector		
Category	**National**	**Dry Savanna**	**Moist Savanna**	**Humid Forest**	**Rural**	**Medium**	**Urban**
< 16.0	8.4	9.6	12.1	4.2	7.6	6.3	13.3
16.0-16.9	15.3	14.6	18.9	13.7	15.6	15.7	14.1
17.0-18.4	76.3	75.8	68.9	82.1	76.8	78.0	72.7

Information on states for stunting, wasting and underweight is presented in **Appendix 9.**

Summary on the nutritional status of mothers

- Nationally 69% of all mothers surveyed had a normal range of BMI. The proportions in the dry savanna and moist savanna are close to the national average but higher (71%) in the humid forest. Paradoxically, a higher proportion of this group is in the rural (70.8%), medium (72.3%) than the urban (61.8%) sector.

- Nationally, 11.6% of women are suffering from chronic undernutrition. The condition is more prevalent in the dry savanna (16.4%) than in the moist (9.9%) savanna and humid (9%) forest zone. Within the different sectors, chronic undernutrition range from 10.3 to 12.7%.

- Further classification of the 11.6% undernourished mothers (BMI below 18.4) to the different levels of Chronic Energy Deficiency, showed that only 8.4% nationally fall in the Chronic Energy Deficiency Grade III.

- The highest percentage (12.1%) of Grade III Chronic Energy Deficiency is found in the moist savanna zone. This is about the same percentage (13.3%) found in the urban area, which is twice as much as that found in both the rural (7.6%) and medium (6.3%) sectors. Chronic energy deficiency has serious implications for morbidity and low productivity of women. This condition is associated with a higher prevalence of low birth weight pre-disposing to a higher infant mortality.

- Overweight (BMI 25.0-29.9)) is 14.2% nationally. It is higher in the moist savanna (16.4%) than in the dry savanna (11.6%) and humid forest (14.8%). In addition, the prevalence of overweight is higher in the urban (18.6%) sector when compared to the medium (13.4%) and rural (12.6%) sectors.

- Obesity (BMI>30) has a national prevalence of 5.7%. The moist savanna zone has slightly more obese women of childbearing age (6.6%), than the humid forest (4.3%) zone.

- The prevalence of obesity rate in the urban (9%) is twice that of the rural (4.6%) and medium (4.8%) sectors.

- The total percentage of women who are overweight is higher 19.9% than that of women suffering from undernutrition (11.6%).

- It is important to note that both conditions (undernutrition and overweight/obese) have serious implications for the health of women and their newborns. Chronic energy deficiency has serious implications for morbidity and low productivity of women. This condition is associated with a higher prevalence of low birth weight pre-disposing to a higher infant mortality. Obesity is significant as a risk factor for serious noncommunicable diseases, including cardiovascular disease, hypertension and stroke, diabetes mellitus, and various forms of cancer.

CHAPTER 8
MICRONUTRIENT STATUS OF CHILDREN UNDER-5, MOTHERS, AND PREGNANT WOMEN

8.1 Vitamin A status

Vitamin A Deficiency (VAD) is a major public health problem, and the most vulnerable are preschool children and pregnant women in low-income countries. In children, VAD is the leading cause of preventable visual impairment and blindness. An estimated 250,000 to 500,000 VAD children become blind every year, and about half of them die within a year of becoming blind (FAO/WHO, 1992). In addition VAD significantly increases the risk of severe illness and death from common childhood infections, particularly diarrhoeal diseases and measles. In communities where VAD exist, children are, on the average, 23% more likely to die and 50% more likely to suffer acute measles. In women, in addition to ocular lesions, VAD may be an important factor contributing to maternal mortality and poor pregnancy and lactation outcomes. VAD is also likely to increase vulnerability to other disorders, such as iron-deficiency anemia, for both women and children, and growth deficits in children (WHO, 2000).

In VAD-prevalent countries, pregnant women often experience deficiency symptoms, such as night blindness, that continue into the early period of lactation. For infants, the breast milk they receive from deficient mothers is likely to provide insufficient vitamin A to build or even maintain vitamin A stores. Among the children under-5 years of age affected by VAD, some 3 million have sign of xerophthalmia. Nevertheless, most of the children affected by VAD – between 140 and 250 million – present only sub clinical manifestations, yet live with greater risk of mortality and the risk of developing severe infections (WHO 2000).

The adequacy or otherwise of Vitamin A in children, their mothers and pregnant women was determined through measurements of the serum retinol levels. In children, values equal to or greater than 20 ug/dl are considered as being adequate. Values less than 20 ug/dl indicate marginal deficient, while values less than 10 ug/dl are considered as clinical vitamin A deficiency. However, it has been recommended (WHO, 1996) that several threshold values may be used to express the magnitude of the problem occurring at different points of the distribution to reflect different levels of risk.

For example, serum distributions lower cut-off point (e.g. <10 µg/l) may be selected to highlight the most extreme cases, while higher cut-off points (e.g. <20 µg/l or <30 µg/l) may be more useful in identifying that proportion of the population possibly at risk of inadequate vitamin A status even if it is not necessarily severely deficient. For adults the corresponding cut off points is 30 ug/dl and below that value is considered as being at risk of vitamin A deficiency while a cutoff point of <20 ug/dl is considered as being deficient. Values greater than 100 ug/dl are considered as excessive (hyper vitaminosis A).

Vitamin A deficiency (VAD) have been implicated in restricted growth, impaired immune response and hence increased susceptibility to infections. The best-known effect of VAD is the spectrum of eye problems, which includes night blindness that may progress to total nutritional blindness (Mclaren and Frigg, 2001). A comprehensive review of recommendations for the control of Vitamin A Deficiency has recently been outlined by IVACG (Bloem, Kiess and Moench-Pfanner, 2002). This includes an extensive review of terminologies and cut off points. These new recommendations have not been adopted in the present report.

Tables 43 and Figures 28, 29, and 30 show the concentration of serum retinol for all children under-5 surveyed as well as the distribution of the vitamin A status into normal, marginal, and clinical deficient children.

Table 43. Serum retinol concentration in children under-5 at the national, agroecological zone, and sector levels.

Category	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
National	3099	25.9	27.2	0.20
Agroecological zones				
Dry savanna	787	24.7	26.4	0.40
Moist Savanna	928	25.4	28.9	0.40
Humid forest	1384	25.8	26.6	0.26
Sector				
Rural	1267	26.5	27.7	0.31
Medium	1152	24.7	26.3	0.32
Urban	680	26.6	27.9	0.41

The median serum retinol concentration for all children surveyed was found to be 25.9 ug/dl at the national level. Further disaggregating the data by agroecological zones showed the median concentrations to be 24.7 ug/dl for dry savanna, 25.4 ug/dl for the moist savanna, and 25.8% for the humid forest **(Table 43).**

At the sector level, the median concentrations for both the rural and urban sectors were similar (26.5 ug/dl vs 26.6 ug/dl) **(Table 43).** The medium sector was slightly lower with a median serum retinol concentration of 24.7 ug/dl.

The vitamin A status of all children surveyed is presented in **Figure 29.** At the national level, 24.8% of children under-5 suffer from marginal deficiency (serum retinol concentration <20 ug/dl) and therefore are vitamin A deficient, 4.7% have serum retinol concentration <10 ug/dl and hence are suffering from severe vitamin A (clinical deficiency) deficiency, and 71.5% of children being normal. If we combine those who are marginally deficient with those who are clinically deficient, 29.5% of children-under 5 are suffering from vitamin A deficiency.

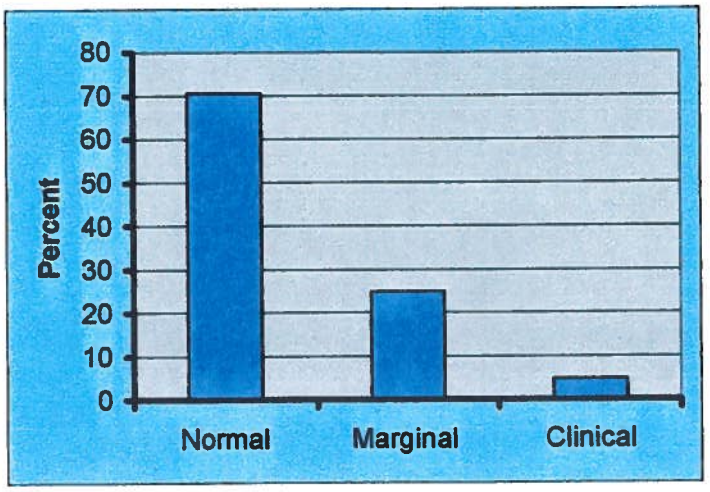


Figure 29. Vitamin A status of all surveyed children under-5 at the national level

The levels of marginal deficiencies were 28.2% in the dry savanna, 21.6 in the moist savanna and 22.8% in the humid forest. The clinically deficient were more in the humid forest (7.1%) than in the dry savanna (3.1%) and moist savanna (2.4%) **(Figure 30).**

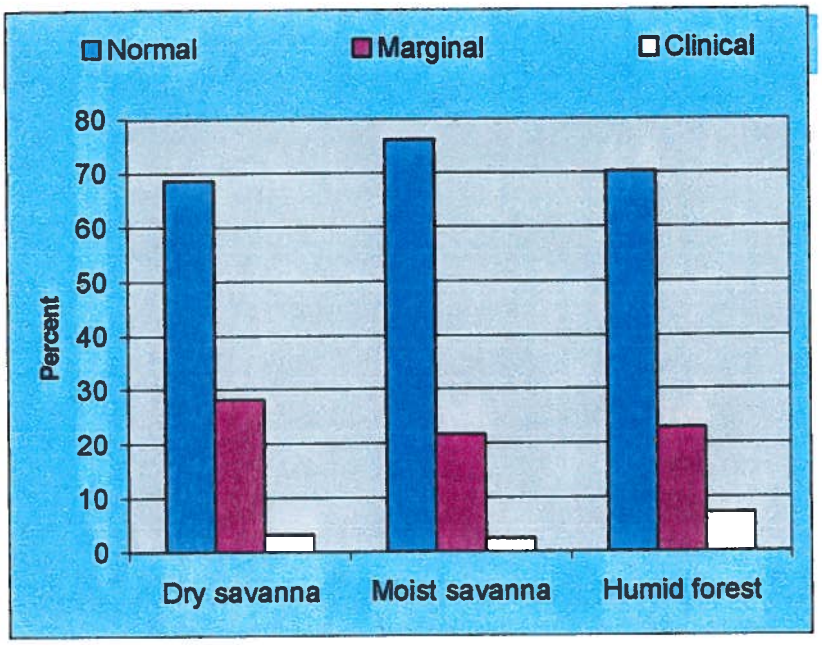


Figure 30. Vitamin A status of all surveyed children under-5 by agroecological zone

The distribution of the marginally deficient was 23.4% for rural, 25.1% for medium and 22.5% for the urban sector. The clinical deficiencies were 7.5% in the medium sector while the urban and rural sectors were much lower having 3.4% and 2.2% respectively **(Figure 31)**.

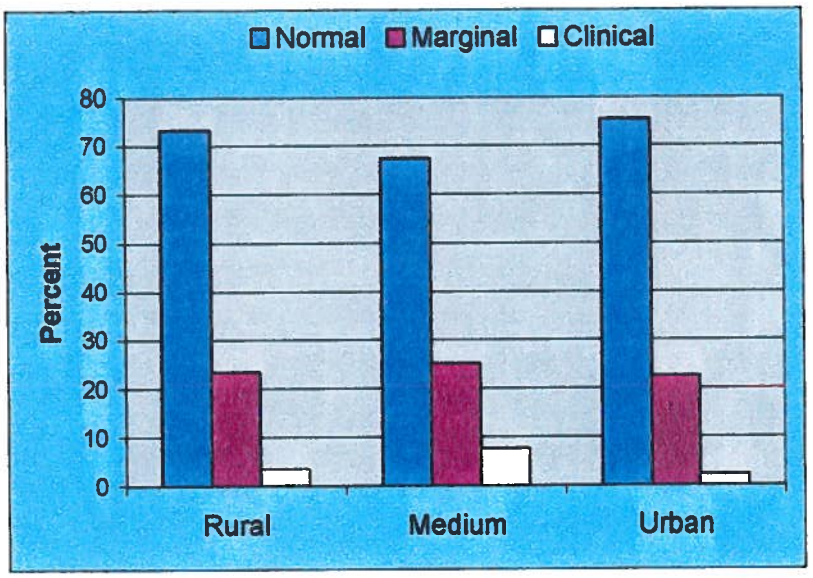


Figure 31. Vitamin A status of all surveyed children under-5 by sector

During the determination of serum ferritin concentration in children under-5, it was observed that 20% of the surveyed children had serum ferritin concentration above 100 ng/ml. A simultaneous though non-specific analysis of the C-reactive protein (which indicate the presence of infection) was carried out on a sub-sample of the children with serum ferritin levels greater than 100 ng/ml. Sixty percent of the children sampled had elevated levels of CRP indicating presence of inflammation and possible infection. It has been documented that the presence of infection reduces the concentration of serum retinol, therefore, all samples with serum ferritin greater than 100 ng/ml were removed and the data reanalyzed. The results are presented in **Table 44.**

The median serum retinol concentration was found to be 22.6 ug/dl at the national level. Further disaggregating the data by agroecological zones showed the median concentrations to be 24.9 ug/dl for dry savanna, 28.8 ug/dl for the moist savanna, and 26.6% for the humid forest **(Table 44).**

At the sector level, the serum retinol concentrations for both the rural and urban sector were similar (27.5 ug/dl) **(Table 44).** The medium sector was slightly lower with a median serum retinol concentration of 25.7 ug/dl.

Table 44. Serum retinol concentration of children under-5 after removal of children with possible infection

Category	Number of observatons	Median ug/dl	Mean ug/dl	Std. Err.
National	2214	22.6	27.8	0.23
Agroecological zones				
Dry savanna	576	24.9	26.4	0.45
Moist Savanna	620	28.8	30.3	0.49
Humid forest	891	26.6	27.3	0.31
Sector				
Rural	828	27.5	28.5	0.38
Medium	789	25.7	26.9	0.38
Urban	470	27.5	28.7	0.48

The results indicate that at the national level, 22.5% of children under-5 suffers from marginal deficiency (serum retinol concentration <20 ug/dl) and therefore are vitamin A deficient, 4.0% have serum retinol concentration <10 ug/dl and hence are suffering from severe vitamin A (clinical deficiency) deficiency, and 73.5% are normal. When combining those who are marginally deficient and those who are clinically deficient, 26.5% of children under-5 is vitamin A deficient **(Figure 32).**

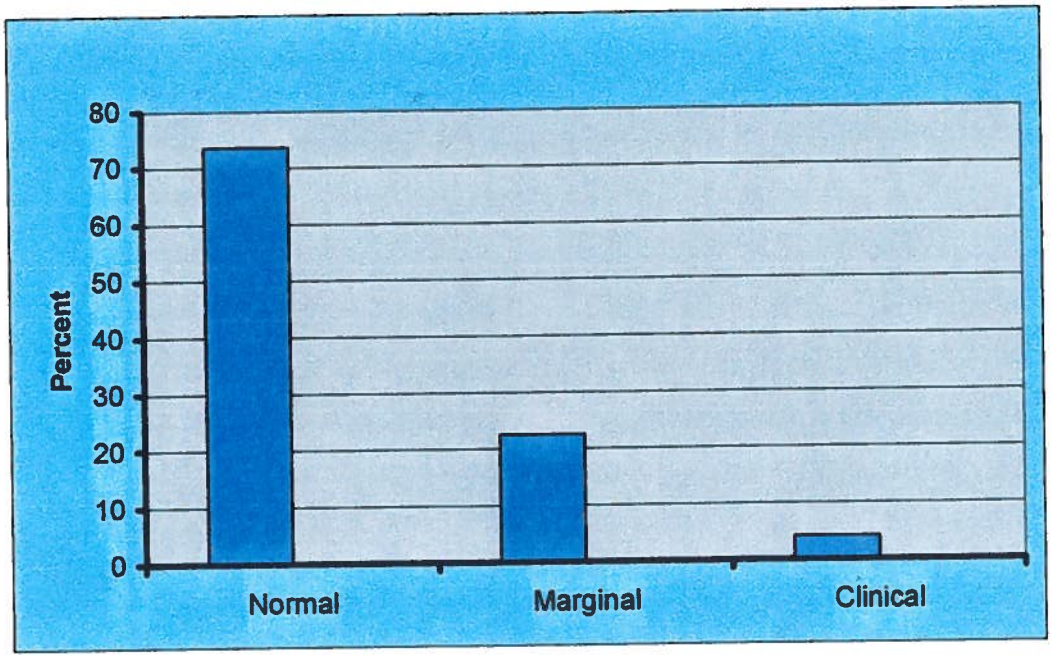


Figure 32. Vitamin A status in children under-5 with those children with possible infection removed at the national level

Disaggregating the data by agroecological zones **(Figure 33)** indicated that more children in the dry savanna were marginally deficient (27.8%) than in moist savanna (18.2%) and in the humid forest (21.3%). The clinical deficiencies (serum retinol concentration <10 µg/dl) observed were 2.4% in the dry savanna, 1.8% in moist savanna and were highest in the humid forest at 5.6%.

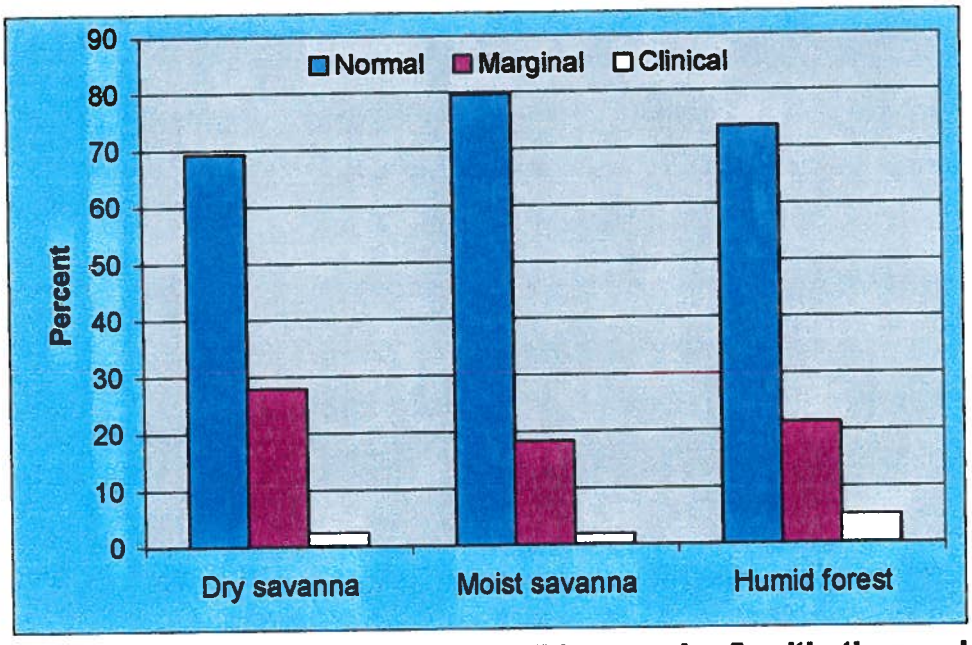


Figure 33. Vitamin A status in children under-5 with those children with possible infection removed by agroecological zone

When those children with possible infection were removed, nationally, 22.5% of the children under-5 are marginally deficient. Those living in urban areas were least marginally deficient (20.0%) whilst the medium sized areas were most marginally deficient (24.6%). This trend was also observed for clinical deficiencies, as 3.9% of the children were deficient nationally, 2.4% in rural areas and 1.0% in urban areas. The highest clinical deficiency was among children from the medium areas (6.3%) **(Figure 34).**

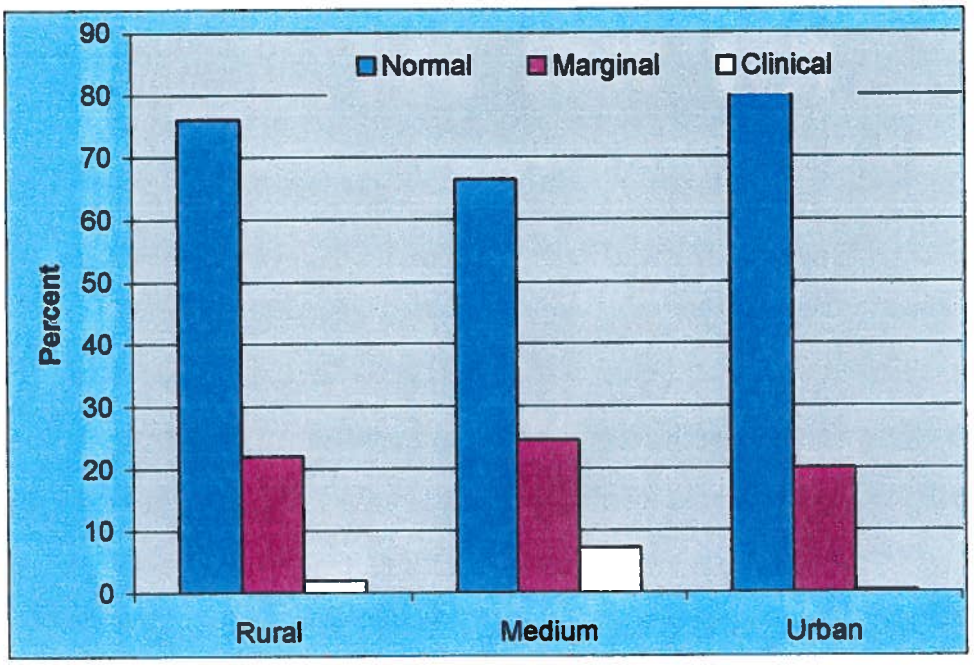


Figure 34. Vitamin A status in children under-5 with those children with possible infection removed by sector.

Figure 35 presents the vitamin A status of two groups of children under-5; namely all children under-5 (n=3099) eligible subjects and secondly the children under-5 (n=2214) remaining when those with possible infection have been removed. The percentage of normal children was slightly higher when those with possible children were removed. Marginal vitamin A deficiency ranged from 22.5-24.8% and clinical deficiency from 3.9-4.7% nationally. In the humid forest, clinical deficiency decreased from 7.1% to 5.5% when values of children with possible infection were removed. This trend was also observed for the sector level.

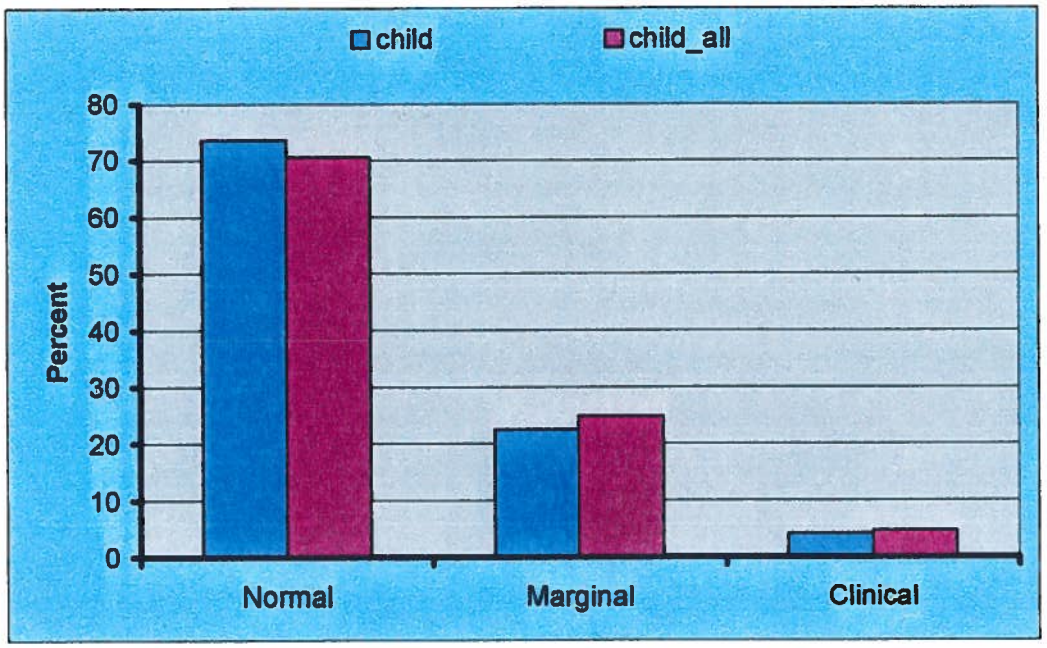


Figure 35. Comparison of vitamin A status of all children under-5 surveyed and those with possible infection removed.

When the number of children suspected to be infected were analyzed separately, the median retinol concentration was 22.8 ug/dl. When disaggregated by agroecological zones, the median serum retinol concentration was 20.0 ug/dl, 23.0 ug/dl, and 23.6 ug/dl in the dry savanna, moist savanna, and humid forest zone respectively **(Table 45).** In addition, the median serum retinol concentration of children under-5 was high in urban (25.0 ug/dl) than in rural (23.1 ug/dl) and medium (22.1 ug/dl) areas.

Table 45. Serum retinol concentration for children under-5 with possible infection.

Category	Number of observatons	Median ug/dl	Mean ug/dl	Std. Err.
National	674	22.8	24.6	0.38
Agroecological zones				
Dry savanna	72	20.0	22.2	1.38
Moist Savanna	232	23.0	24.7	0.66
Humid forest	370	23.6	25.2	0.52
Sector				
Rural	325	23.1	24.8	0.55
Medium	241	22.1	23.5	0.64
Urban	108	25.0	27.2	1.12

Results obtained indicate that 29.2% of the children are marginally deficient and 7.4% are clinically deficient resulting in 36.6% children being vitamin A deficient **(Figure 36).**

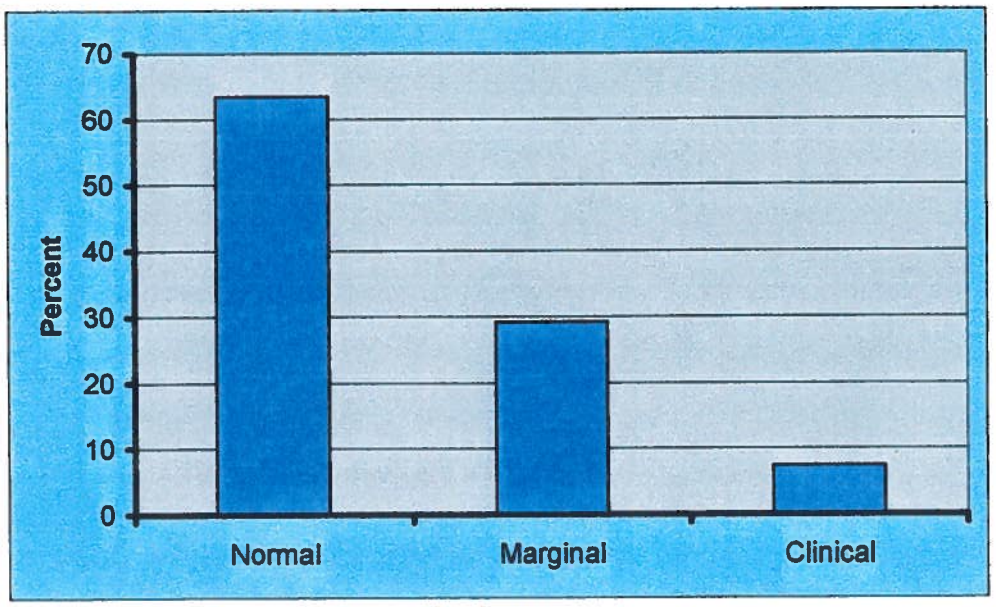


Figure 36. Vitamin A status of children under-5 with possible infection.

When disaggregated by agroecological zones, the marginal deficiency was highest in the dry savanna at 38.9% followed by the moist savanna at 29.7% and the humid forest at 27.3%. There are more clinically deficient (11.1%) children in the dry savanna than those in the humid forest (8.7%) and moist savanna (3.4%). Vitamin A deficiency is 50.0% in the dry savanna, 33.1% in the moist savanna, and 36.0% in the humid forest **(Figure 37).**

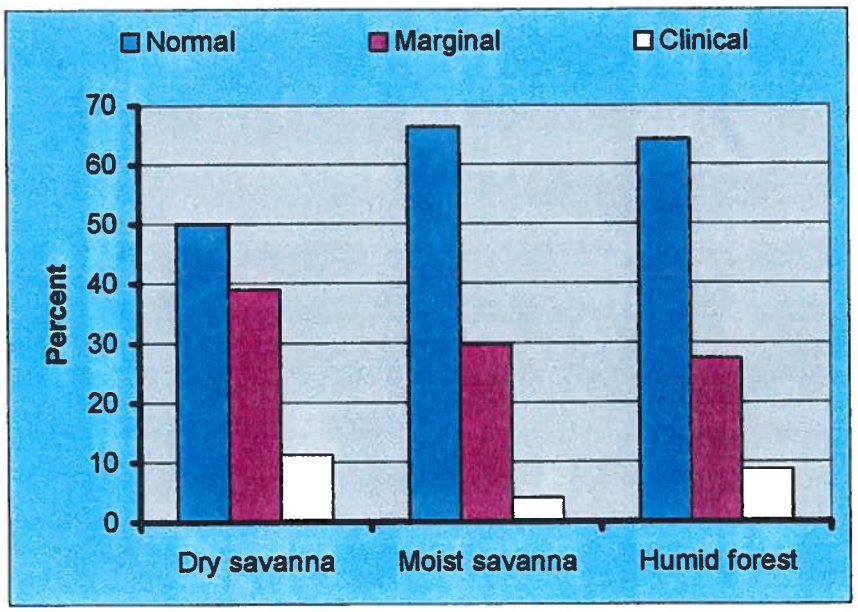


Figure 37. Vitamin A status of children under-5 with possible infection by agroecological zone.

When the data was disaggregated by sector, 29.5% children under-5 are suffering from marginal vitamin A deficiency and 4.3% are clinically deficient in the rural sector, 29.9% and 13.3% are marginal and clinical deficient respectively in the medium sector, 27.8% marginal deficient and 2.8 clinically in the urban areas **(Figure 38).** Those children under-5 who are deficient in vitamin A are more in the medium sector (43.2%) than in the rural (33.8%) and urban (30.1%) sectors.

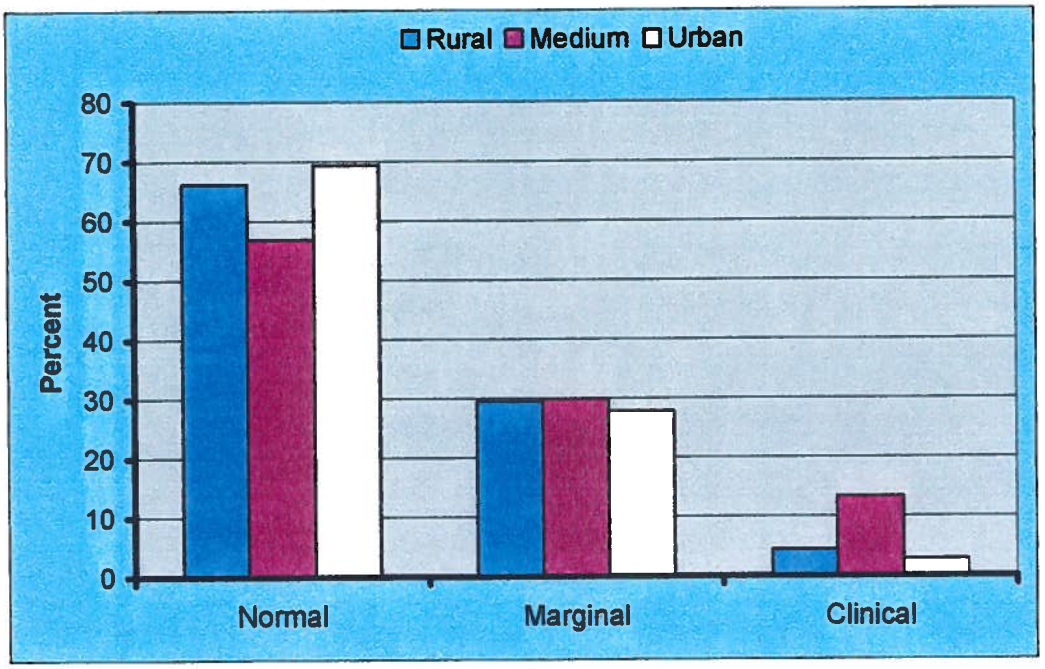


Figure 38. Vitamin A status of children under-5 with possible infection by sector.

The serum retinol concentrations for mothers and pregnant women using WHO cutoff points are presented in **Table 46.** The median serum retinol concentration for mothers was 45.4 ug/dl and 37.7 ug/dl for pregnant women.

Table 46. Serum retinol concentration in mothers and pregnant women at the national level.

Group	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
Mother	3148	45.40	47.89	0.31
Pregnant women	684	37.70	39.07	0.53

The results of the vitamin A status for both mother and pregnant women are presented in **Figures 39 and 40** respectively. In adults, mothers with serum retinol concentration <30 ug/dl considered as being at risk of vitamin A deficiency were 13.1% of the national sample population whilst 19.2% were at risk of vitamin A deficiency amongst pregnant women. A few of the subjects had high vitamin A levels with 1% in mothers and 0.21% in pregnant women. Mothers with

Mothers with serum retinol concentration <20 ug/dl considered as being vitamin A deficient. From those mothers who are at risk of vitamin A deficiency, only 4.1% were vitamin A deficient whilst 8.8% were vitamin A deficiency amongst pregnant women.

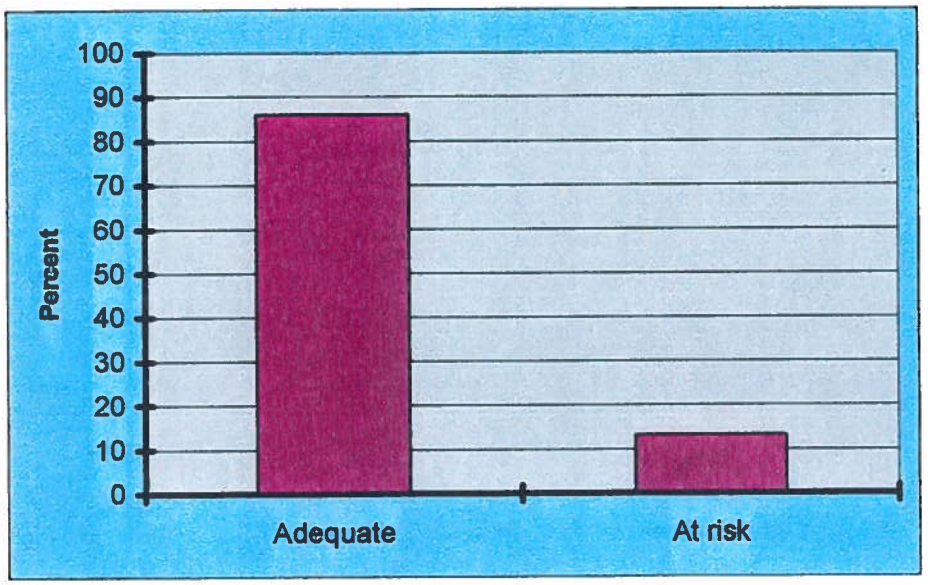


Figure 39. Vitamin A status of mothers

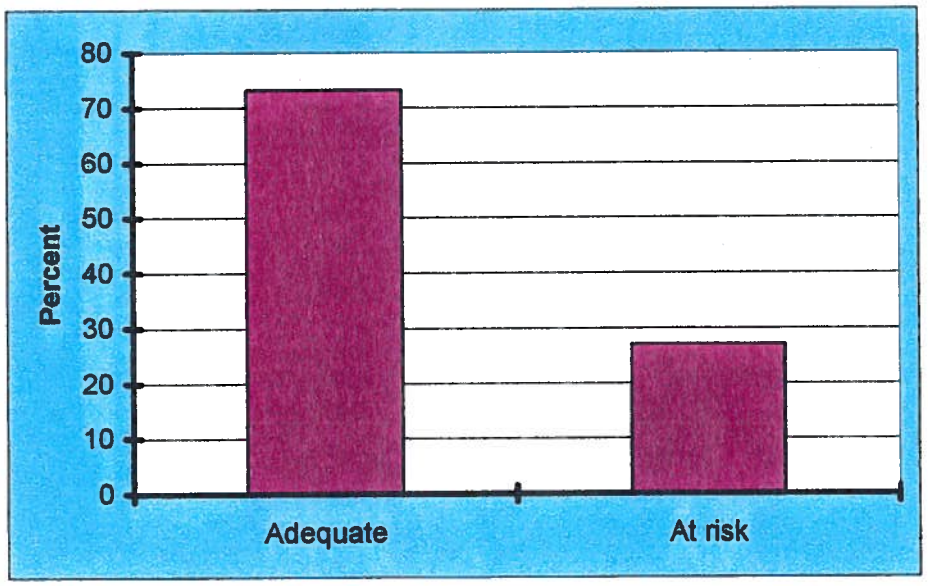


Figure 40. Vitamin A status of pregnant women.

When disaggregated by agroecological zones, results of the serum retinol concentration obtained show median concentrations of 39.2 ug/dl for mothers and 34.1 ug/dl for pregnant women in the dry savanna zone. The median concentration in the moist savanna zone was 45.1 ug/dl for mother and 35.3 ug/dl for pregnant women. For the humid forest the values were 50.5 ug/dl for mothers and 41.6 ug/dl for pregnant women **(Table 47)**

Table 47. Serum retinol concentration in mothers and pregnant women disaggregated by agroecological zone

Agroecological zone	Group	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
Dry savanna	Mother	950	39.15	40.62	0.51
	Pregnant	210	34.10	34.65	0.79
Moist savanna	Mother	634	45.05	46.71	0.65
	Pregnant	145	35.30	37.83	1.12
Humid forest	Mother	1564	50.45	52.78	0.44
	Pregnant	329	41.60	42.44	0.80

For mothers **(Figure 41)**, the same pattern emerged with the dry savanna having the highest mothers at risk for vitamin A deficiency at 19.6%, moist savanna 14.5% and humid forest 8.8%. A few of the mothers also had elevated vitamin A levels, 0.2% in the dry savanna, 0.8% in the moist savanna and 1.5% in the humid forest.

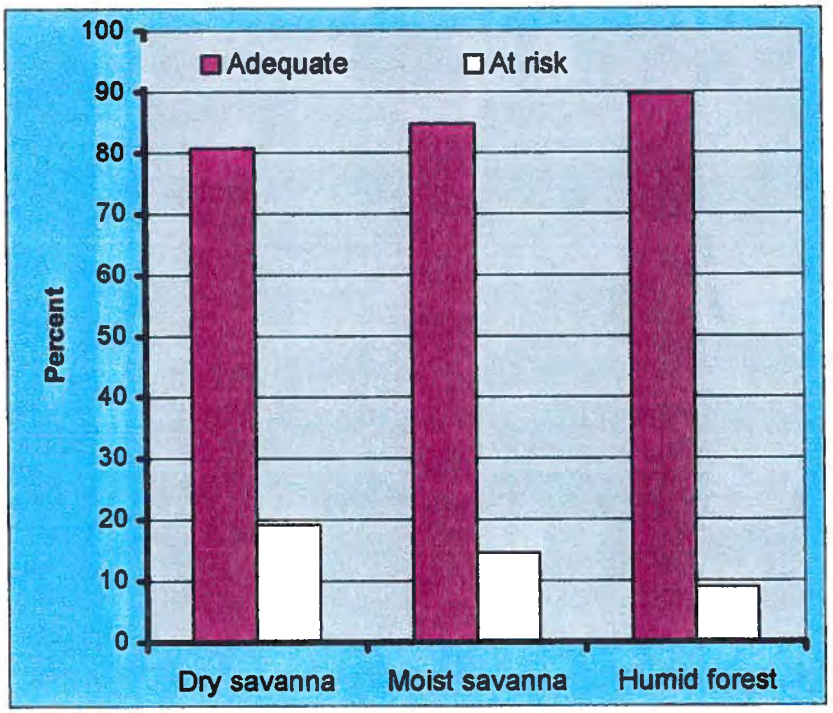


Figure 41. Vitamin A status of mothers by agroecological zone

In pregnant women, over 70% had adequate serum retinol concentrations in all the agroecological zones. The percentage of pregnant women at risk of vitamin A deficiency was higher in the dry savanna (34.3%) than in the moist savanna (28.3%) and humid forest (21.6%) **(Figure 42).**

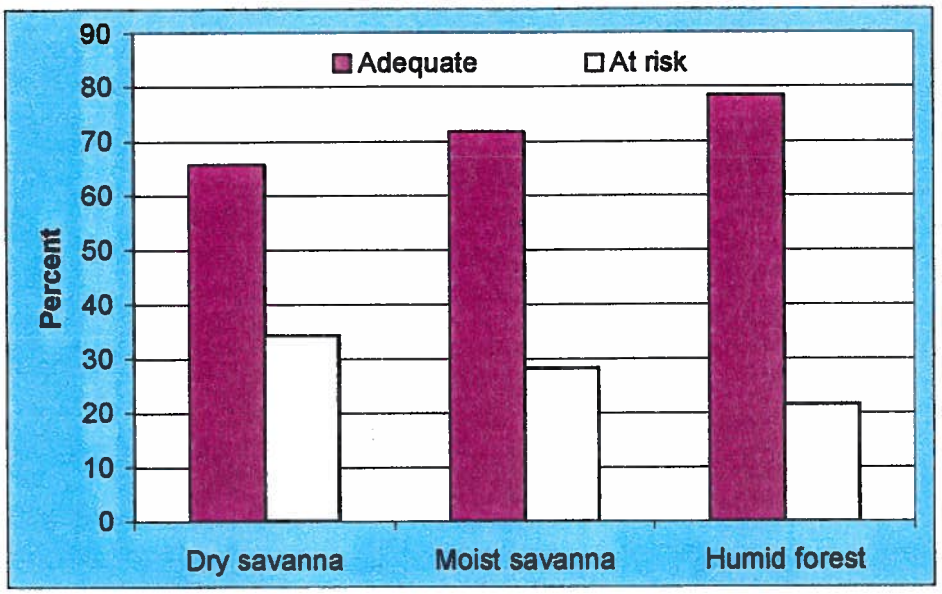


Figure 42. Vitamin A status of pregnant women by agroecological zone

Disaggregating by sector **(Table 48)** shows that in the rural areas the median retinol concentration for mothers was 45.2 ug/dl and for pregnant women 37.8 ug/dl. In medium areas, the levels were 44.8 ug/dl for mothers and 35.8 ug/dl for pregnant women. In urban areas the concentration were 47.8 ug/dl for mothers and 39.5 ug/dl for pregnant women.

Table 48. Serum retinol concentration mothers and pregnant women disaggregated by sector

Sector	Group	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
Rural	Mother	1276	45.20	47.38	0.44
	Pregnant	279	37.80	39.47	0.80
Medium	Mother	1194	44.80	47.26	0.54
	Pregnant	254	35.80	37.90	0.85
Urban	Mother	678	47.80	49.94	0.70
	Pregnant	151	39.50	40.32	1.24

The highest prevalence of mothers at risk of vitamin A deficiency was observed among mothers living in medium areas (30.7%), which was almost three times the prevalence in both rural (11.2%) and urban areas (11.0%) **(Figure 43).**

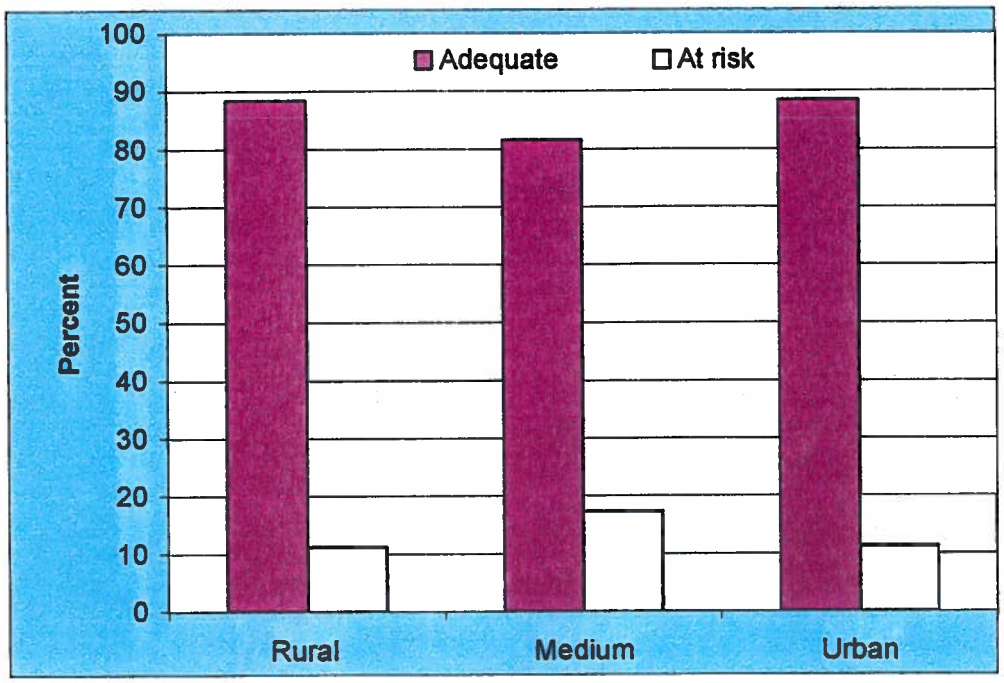


Figure 43. Vitamin A status of mothers by sector

For pregnant women, those living in urban (25.2%) and rural areas (24.4%) were more at risk of suffering from vitamin A deficiency than those living in the medium areas (17.3%) **(Figure 44).**

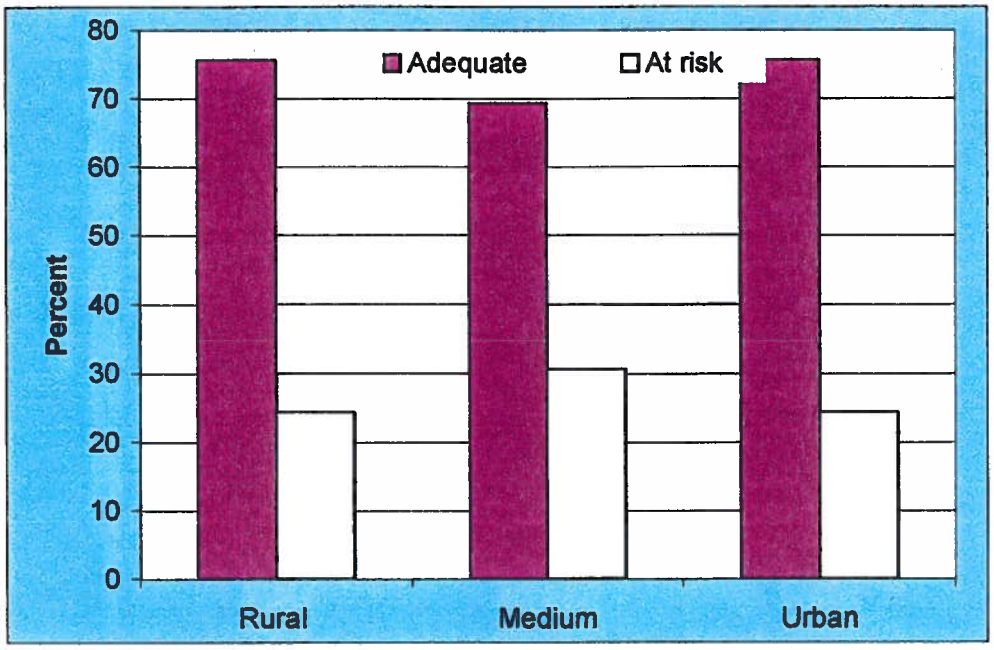


Figure 44. Vitamin A status of pregnant women by sector

Information on states for vitamin A status of children under-5, mothers, and pregnant women is presented in is presented in **Appendix 10.**

Summary on Vitamin A status of children under-5, mothers, and pregnant women

Vitamin A status of children under-5

- At the national level, 24.8% of children under-5 suffers from marginal deficiency and therefore are vitamin A deficient and 4.7% are suffering from severe vitamin A deficiency (clinical deficiency). If those who are marginally deficient and those who are clinically deficient are merged, 29.5% of children-under 5 are vitamin A deficient.

- The level of vitamin A deficiency is high in the dry savanna at 31.3%, 24.0% in the moist savanna and 29.9% in the humid forest. More children with clinical deficiency live in the humid forest (7.1%) than in the dry savanna (3.1%) and moist savanna (2.4%).

- The distribution of vitamin A deficient children under-5 is 25.6% in rural, 32.6% in medium and 25.9% in the urban sector. Partitioning the observed deficiency levels showed that 7.5% of the children in the medium sector are clinically deficient and 3.4% and 2.2% in urban and rural sectors respectively.

- For the sub-sample of children with possible infection, results obtained indicate that 29.2% of the children are marginally deficient and 7.4% are clinically deficient resulting in 36.6% children being vitamin A deficient.

- When the sub-sample was disaggregated by agroecological zones, vitamin A deficiency (marginal plus clinical) is 50.0% in the dry savanna, 33.1% in the moist savanna, and 36.0% in the humid forest. At the sector level, vitamin A deficiency rates are 43.2% in the medium sector, 33.8% in the rural and 30.1% in the urban sector.

Vitamin A status of mothers

- Thirteen percent of mothers are at risk of vitamin A deficiency.
- At the agroecological zone level, there was a decrease in the percentage of mothers at risk for vitamin A deficiency from 19.6% in the dry savanna to 14.5% in the moist savanna and 8.8% in the humid forest.
- Mothers at risk of vitamin A deficiency were more in the medium (30.7%) sector than in the rural (11.2%) and urban (10.0%).

Vitamin A status of pregnant women

- At the national level, 19.2% of pregnant women are at risk of vitamin A deficiency.
- The possibility of pregnant women being at risk of vitamin A deficiency shows a gradual decrease from the dry savanna (34.3%) through the moist savanna (28.3%) to the humid forest (21.6%).
- More pregnant women living in urban (25.2%) and rural areas (24.4%) are at risk of vitamin A deficiency than those living in the medium areas (17.3%).

8.2 Vitamin E status

Although vitamin E status of children under-5, mothers and pregnant women was not originally included in the objectives of the survey, however, the analytical procedure used for determining serum retinol allowed for simultaneous determination of vitamin E from the same sample. Vitamin E is recognized as an important antioxidant. In addition, it also has a role in reproductive physiology.

For an individual to be considered of adequate vitamin E status, the cut off points are between 4 and 14 µg/dl from 0 to 6 months, 4.4 and 13.8 µg/dl from the age of 12 months and between 5 and 18 µg/l for adults.

The results of the serum Vitamin E concentration for all children surveyed are shown in **Table 49** while the percentage distribution of normal and Vitamin E deficient children are presented in **Figure 45 and 46.**

The median serum vitamin E concentration for all children surveyed was found to be 6.2 ug/dl at the national level. Further disaggregating the data by agroecological zones showed the median concentrations to be 6.3 ug/dl for dry savanna, 6.1 ug/dl for the moist savanna and humid forest **(Table 49)** zone.

At the sector level, the concentrations for both the rural and urban sectors were similar (6.4 ug/dl vs 6.5 ug/dl) **(Table 49).** The medium sector was slightly lower with a median serum vitamin E concentration of 5.9 ug/dl.

Table 49. Serum vitamin E concentration for children under-5 at the national level and by agroecological zone and sector

Category	Number of observations	Median ug/dl	Mean ug/dl	Std. Err.
National	3099	6.2	6.3	0.05
Agroecological zones				
Dry Savanna	787	6.3	6.4	0.09
Moist Savanna	928	6.1	6.3	0.14
Humid Savanna	1384	6.1	6.3	0.09
Sector				
Rural	1267	6.4	6.5	0.09
Medium	1152	5.9	6.1	0.09
Urban	680	6.5	6.4	0.11

The vitamin E status of all children surveyed is presented in **Figure 45 and 46.** At the national level, 22.6% of children under-5 suffers from vitamin E deficiency (serum vitamin E concentration between 4 and 14 ug/dl) and 77.4% of children being normal.

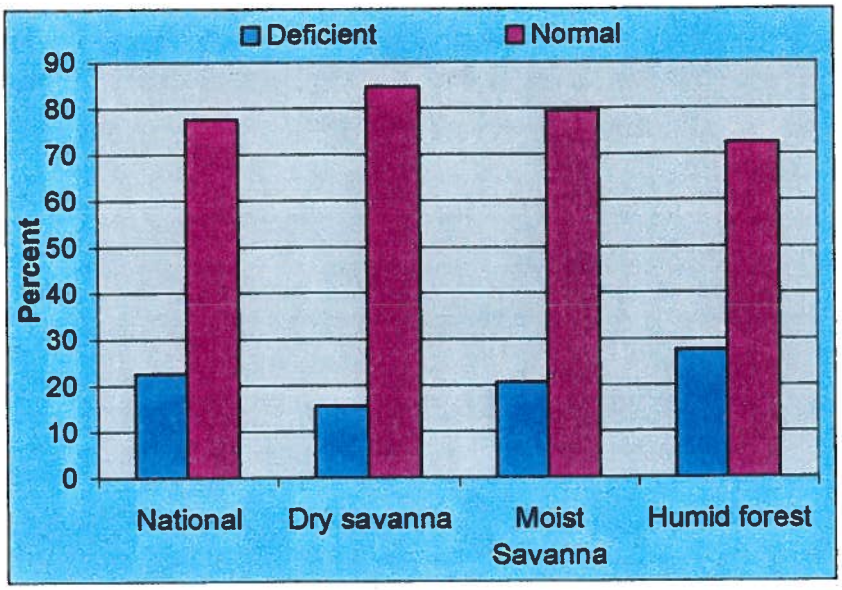


Figure 45. Percent distribution of normal and vitamin E deficient children at the national level and by agroecological zones

The levels of vitamin E deficiency are 15.5% for the dry savanna, 20.7% for the moist savanna and 27.6% for the humid forest. This is an indication that there are more conditions in the humid forest, which predispose children to Vitamin E deficiency **(Figure 45).**

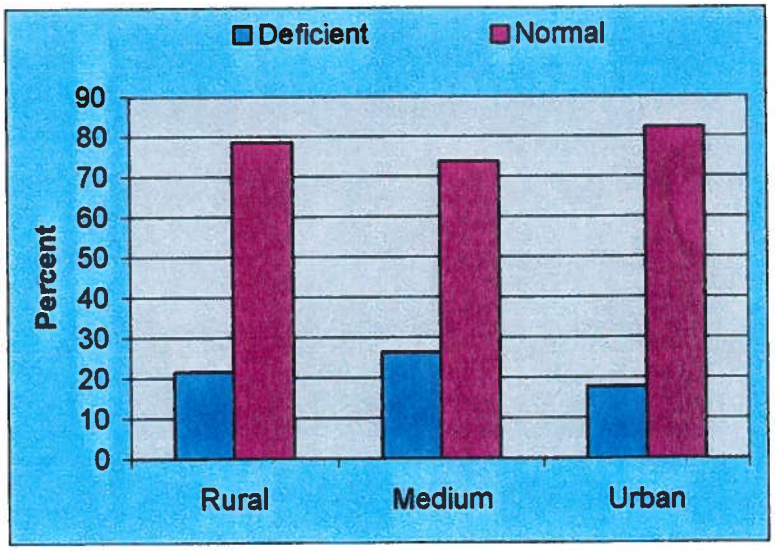


Figure 46. Percent distribution of normal and vitamin E deficient children disaggregated by sector.

When disaggregating by sector, vitamin E deficiency is highest in the medium sector at 26.3% followed by the rural sector at 21.5% and urban sector at 17.8% **(Figure 46).**

When values for children with possible infection were removed from the data set and the data was reanalyzed, the vitamin E concentration in children under-5 did not change significantly (from 6.2 µg/dl to 6.3 µg/dl) as shown in **Table 49 and 50.**

Table 50. Serum vitamin E concentration in children under-5 at the national level and by agroecological zone and sector with those with possible infection removed.

Category	Number of observatons	Median µg/dl	Mean µg/dl	Std. Err.
National	2214	6.3	6.39	0.06
Agroecological zones				
Dry savanna	576	6.4	6.4	0.10
Moist Savanna	620	6.4	6.6	0.12
Humid forest	891	6.3	6.38	0.11
Sector				
Rural	828	6.5	6.6	0.10
Medium	789	6.0	6.2	0.11
Urban	470	6.7	6.7	0.12

Further disaggregating the data by agroecological zones showed the median concentrations to be the same for the dry and moist savanna (6.4 ug/dl) zones and was 6.3 ug/dl in the humid forest **(Table 50)**.

At the sector level, the median serum vitamin E concentrations were 6.5 ug/dl for the rural 6.0 ug/dl and urban sectors **(Table 50).** The medium sector was had a median serum vitamin E concentration of 6.7 ug/dl.

The levels of vitamin E deficiencies at the national and by agroecological zone are presented in **Figure 47.** The data indicate that 20.3% of children under-5 is vitamin A deficient at the national level. More children under-5 with vitamin E deficiency is in the humid forest (25.1%) when compared with dry savanna (15.1%) and moist savanna (16.1%) **(Figure 47)** when the data was disaggregated by agroecological zones.

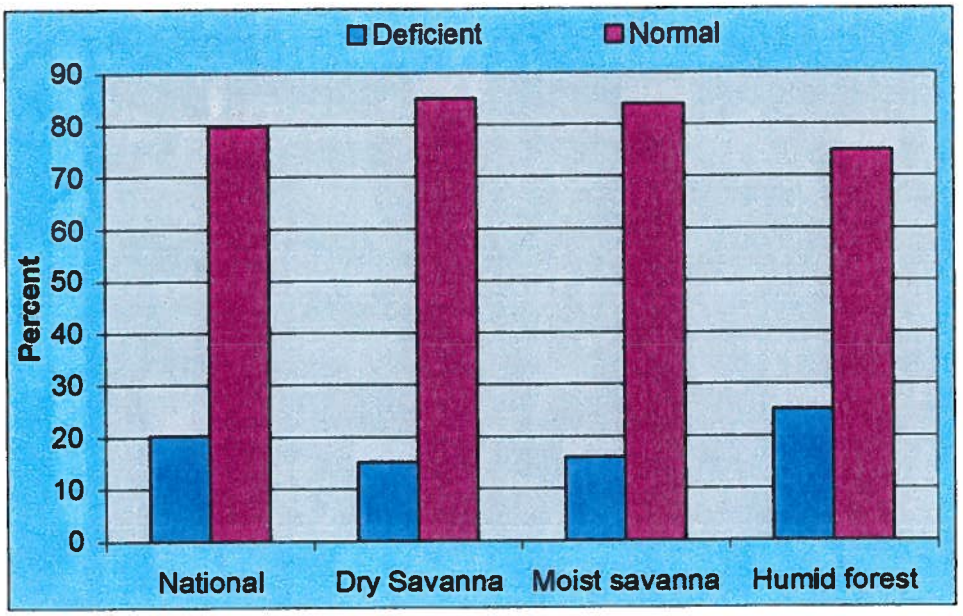


Figure 47. Vitamin E status of children under-5 by agroecological zone when those with possible infection are removed

When disaggregated by sector, the vitamin E deficiency amongst children under-5 were 20.3% nationally, with urban areas having lower numbers of Vitamin E deficient children under-5 (13.6%) and medium areas having a higher number (25.4%) of children deficient in vitamin E as presented in **Figure 48.**

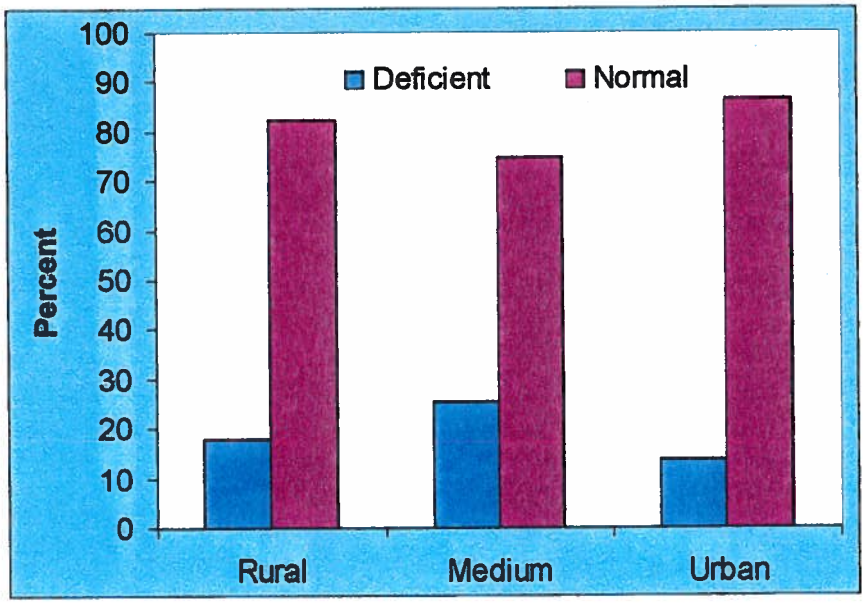


Figure 48. Vitamin E status of children under-5 by sector when those with possible infection are removed.

When the number of children suspected to be infected were analyzed separately, the median serum vitamin E concentration was 5.5 ug/dl. When disaggregated by agroecological zones, the median serum concentration was 6.0 ug/dl, 5.6 ug/dl, and 5.5 ug/dl in the dry savanna, moist savanna, and humid forest zone respectively **(Table 51).** In addition, the median serum vitamin E concentration of children under-5 was slightly higher in urban (5.9 ug/dl) than in the medium (5.4 ug/dl) and rural (5.2 ug/dl) areas.

Table 51. Serum vitamin E concentration of children with possible infection by national, agroecological zone, and sector level.

Category	Number of observatons	Median ug/dl	Mean ug/dl	Std. Err.
National	674	5.5	5.8	0.12
Agroecological				
Dry savanna	72	6.0	6.2	0.33
Moist Savanna	232	5.6	5.8	0.23
Humid forest	370	5.5	5.8	0.16
Sector				
Rural	325	5.9	6.1	0.18
Medium	241	5.4	5.6	0.19
Urban	108	5.2	5.8	0.30

Results obtained indicate that 30.6% of the children are vitamin E deficient **(Figure 49).** When disaggregated by agroecological zones, vitamin E deficiency was similar and higher in the moist savanna at 31.1% and the humid forest at 31.1% and lower in the dry savanna at 16.7%.

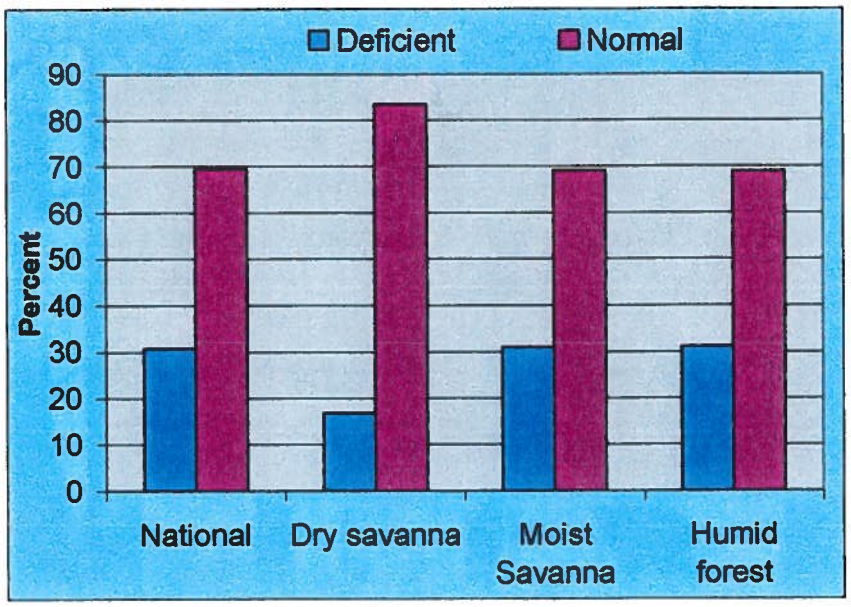


Figure 49. Serum vitamin E concentration of children with possible infection by national and agroecological zone

When the data was disaggregated by sector, 29.2% and 29.1% of children under-5 in the rural and medium sector respectively are suffering from vitamin E deficiency. Vitamin E deficiency is slightly higher in the urban areas at 31.5% **(Figure 50).**

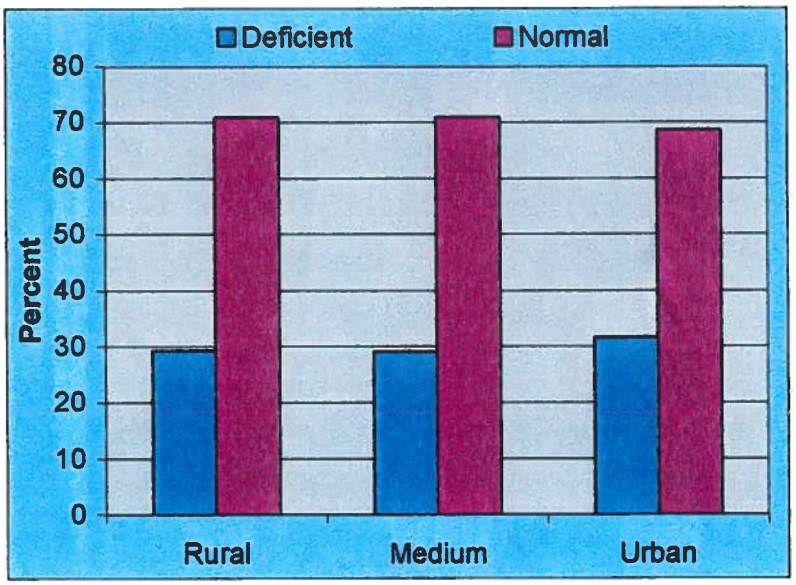


Figure 50. Serum vitamin E concentration of children with possible infection by sector

The results of the vitamin E mean and median concentrations of mothers and pregnant women are presented in **Tables 52**. The results show that at the national level, the median vitamin E concentration is 7.3 µg/dl amongst mothers and 8.5 µg/dl amongst pregnant women **(Table 52).**

Table 52. Serum vitamin E concentration in mothers and pregnant women at the national level.

Category	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
Mother	3148	7.30	7.63	0.06
Pregnant women	684	8.50	8.48	0.12

When disaggregated by agroecological zones the data showed that median the serum vitamin E concentration in mothers was 7.0 µg/dl in the dry and moist savanna and 7.7 µg/dl in the humid forest (7.7%) zone **(Table 53).** The median concentrations of vitamin E in pregnant women across agroecological zones were similar to the national median concentration except for pregnant women in the dry savanna. They had a median concentration slightly higher (8.9 µg/dl) than the national level (8.5 µg/dl).

Table 53. Serum vitamin E concentration in mothers and pregnant women disaggregated by agroecological zones

Agroecological zone	Group	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
Dry savanna	Mother	950	7.00	7.31	0.07
	Pregnant	210	8.85	8.75	0.20
Moist savanna	Mother	634	7.00	7.24	0.10
	Pregnant	145	8.20	8.10	0.24
Humid forest	Mother	1564	7.70	7.98	0.10
	Pregnant	329	8.60	8.47	0.18

The values obtained in this survey indicated that while nationally, there appears to be adequacy of vitamin E, the levels are not close to the maximum level desired for effective functioning for vitamin E in the human body.

Disaggregating by sector also shows that in the rural areas, the median concentration of vitamin E was 7.1 µg/dl and 8.1 µg/dl for mothers and pregnant women respectively **(Table 54).** The concentrations for medium areas were 7.3 µg/dl

for mothers and 8.3 µg/dl for pregnant women while in the urban area the levels were for mothers 7.7 µg/dl and 9.6 µg/dl for pregnant women **(Table 54).**

Table 54. Serum vitamin E concentration in mothers and pregnant women disaggregated by sector

Sector	Group	Number of observations	Median µg/dl	Mean µg/dl	Std. Err.
Rural	Mother	1276	7.10	7.43	0.07
	Pregnant	279	8.10	8.05	0.18
Medium	Mother	1194	7.30	7.63	0.11
	Pregnant	254	8.30	8.34	0.20
Urban	Mother	678	7.70	8.00	0.10
	Pregnant	151	9.60	9.50	0.25

The levels of vitamin E deficiency at the national level are presented in **Figure 51.** The observed data indicate that 13.1% of mothers and 12% of pregnant women are vitamin E deficient nationally **(Figure 51).**

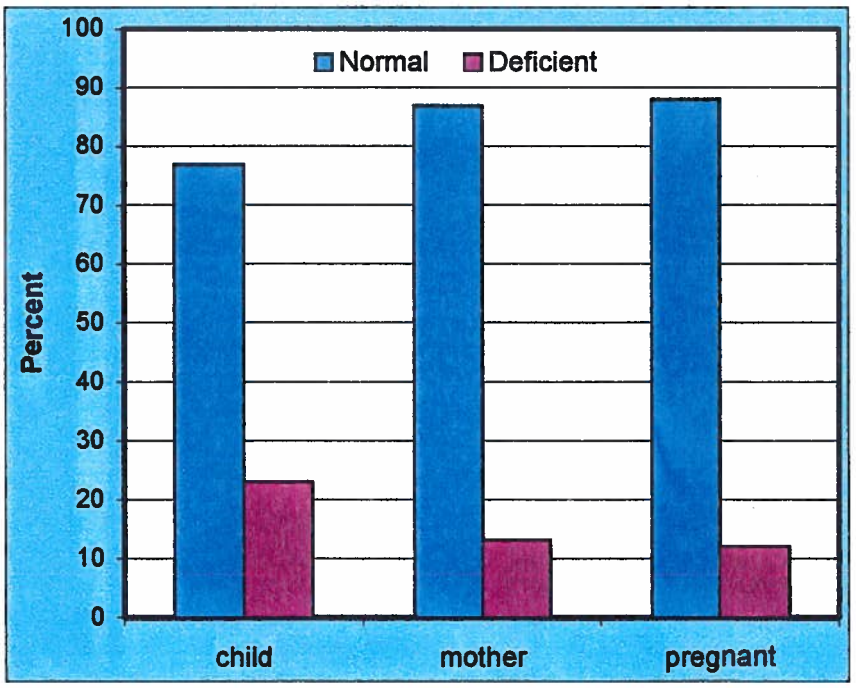


Figure 51. National distribution of Vitamin E status in mothers and pregnant women.

For mothers, the vitamin E deficiency levels were similar in the moist savanna (13.9%) and the humid forest (13.6%). The least deficient mothers were found in the dry savanna at 11.9% **(Figure 52).**

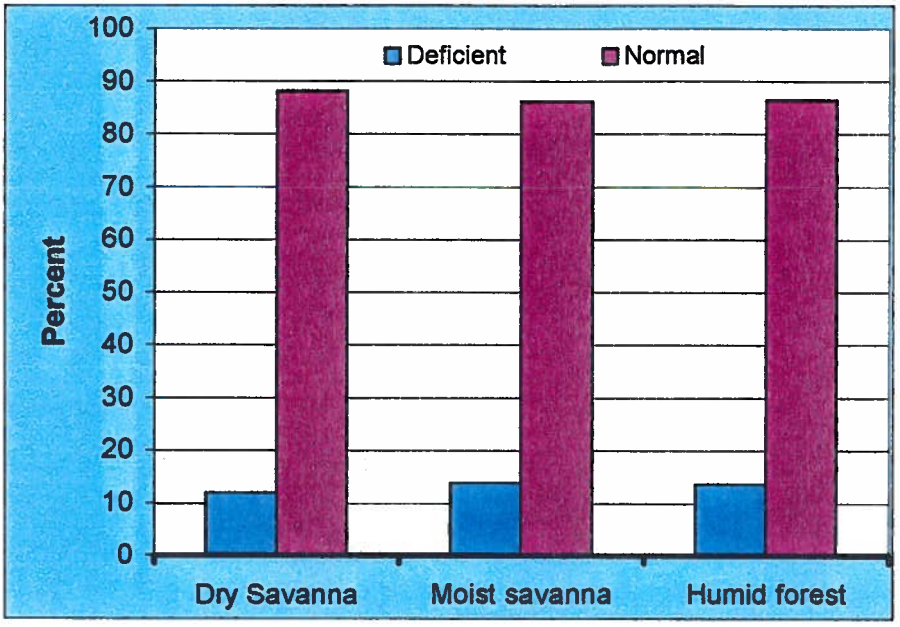


Figure 52. Vitamin E status of mothers by agroecological zone

For pregnant women, the humid forest zone has the largest number of deficient pregnant women at 14.6% and the dry savanna had the lowest number at 7.6% **(Figure 53).**

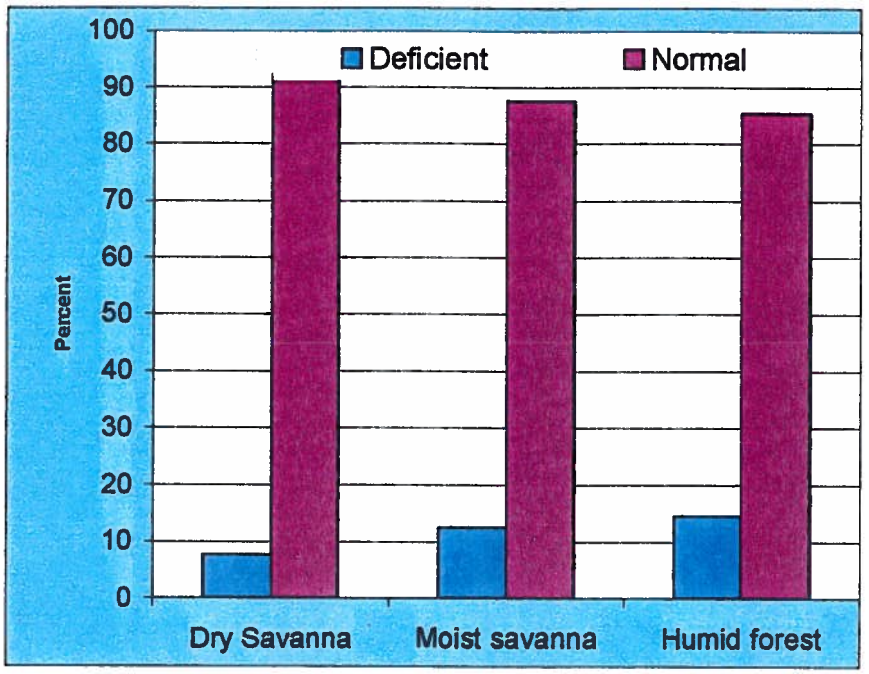


Figure 53. Vitamin E status of pregnant women by agroecological zone

With mothers, the pattern of deficiencies was similar to those observed in children under-5. Urban areas had lower vitamin E deficient mothers (7.9%) followed by rural areas (13.0%) and medium areas (16.2%) **(Figure 54).**

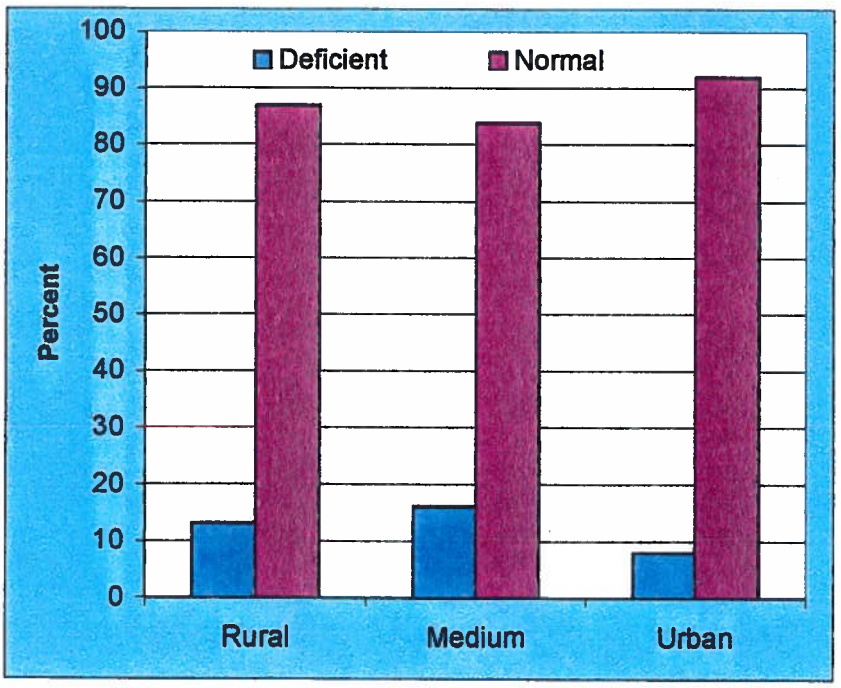


Figure 54. Vitamin E status of mothers by sector

Data for pregnant women show that the largest numbers of vitamin E deficient pregnant women are in the rural areas (14.7%), while the lowest were in urban areas (5.3%) **(Figure 55).**

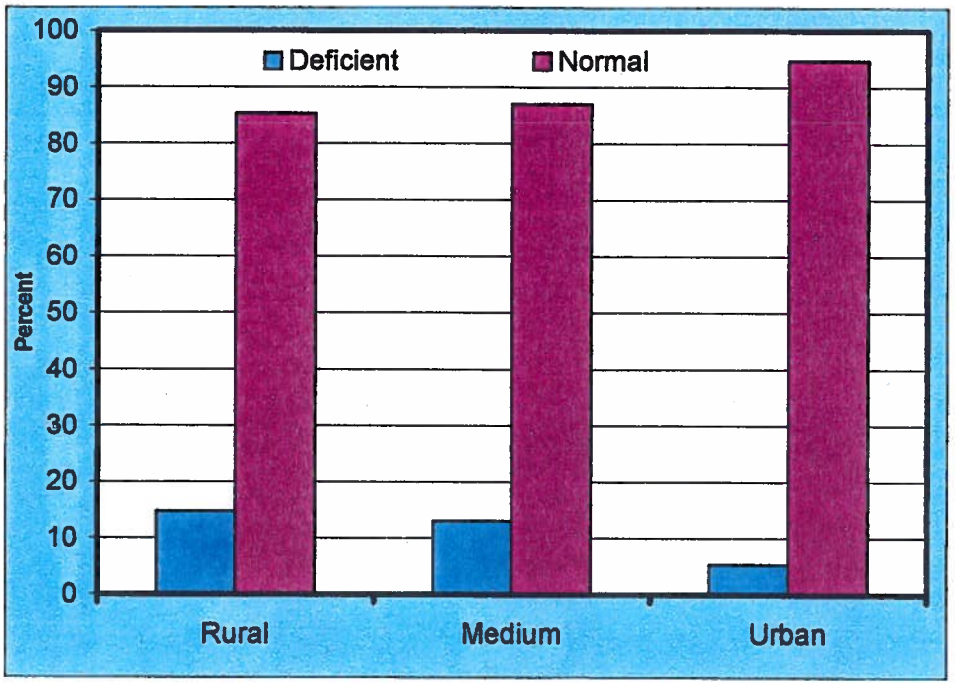


Figure 55. Vitamin E status of pregnant women by sector

Information on states for vitamin E status of children under-5, mothers, and pregnant women is presented in **Appendix 11.**

Summary on Vitamin E status of children under-5, mothers, and pregnant women

Vitamin E status of children under-5

- At the national level, 22.3% of children under-5 suffers from vitamin E deficiency.
- The level of vitamin E deficiency is high in the humid forest at 27.6%, 20.7% in the moist savanna and 15.5% in the dry savanna zone.
- The distribution of vitamin E deficient children under-5 is 21.5% in rural, 26.3% in medium and 17.8% in the urban sector.
- For the sub-sample of children with possible infection, results obtained indicate that 30.6% of the children are vitamin E deficient.

- When the sub-sample was disaggregated by agroecological zones, vitamin E deficiency was 16.7% in the dry savanna, 31.0% in the moist savanna, and 31.1% in the humid forest. At the sector level, vitamin E deficiency rates were 31.5% in urban, 29.1% in the medium sector, and 29.2% in rural areas.

Vitamin E status of mothers

- Nationally, 13.0% of mothers are vitamin E deficient.

- At the agroecological zone level, vitamin E deficiency levels were similar in the moist savanna (13.9%) and the humid forest (13.6%). The least deficient mothers were found in the dry savanna at 11.9%.

- In urban areas, mothers suffering from vitamin E deficiency are lower (7.9%) followed by those in the rural sector (13.0%) and medium areas at 16.2%.

Vitamin E status of pregnant women

- At the national level, 12% of pregnant women are vitamin E deficient.

- The humid forest zone has the largest number of vitamin E deficient pregnant women at 14.6% almost double that of the dry savanna at 7.6%.

- More deficient pregnant women live in the rural area (15.0%) than the urban (5.3%) area.

8.3 Iron status

Iron deficiency is one of the most common nutritional deficiencies worldwide. The risk of iron deficiency increases as the body's stores are depleted and it occurs in three stages. The first stage of Iron depletion refers to a decrease in iron stores without any effect on essential body iron. This is usually characterized by low serum ferritin levels, but it usually progress to the second stage of iron deficient erythropoiesis sometimes identified as functional iron deficiency (Expert Scientific Working Group, 1985). This occurs when inadequate iron is available to the erythroid marrow and to tissues for normal function. Abnormalities in physical functions, like reduced work capacity can occur at this stage. The last and most severe stage is iron deficiency anaemia.

A diet deficiency in iron results in a gradual depletion of Iron stores. During this initial period of gradual depletion of iron stores, haemoglobin, red cell iron, transferring saturation, and free Erytholyte Protoporphynin remain normal, while transferin decline. Transferin is therefore the best indicator of Iron stores, however this level is increased in the presence of infections and inflammations. While infections and malaria is common in this enviroment, ferritin was the choice because the goal was to quantify/measure Iron deficiency, not Iron deficiency anaemia (INACG guidelines for the eradication of Iron deficiency anaemia, 1977).

In this survey, iron status was assessed using serum ferritin (SF) level of the serum samples collected from the children under-5, their mothers and pregnant women. Serum ferritin is a reliable and sensitive parameter for assessment of Iron stores in healthy subjects. Quantitative phlebotomy has shown a close relationship between serum ferritin concentration and mobilisable iron stores and demonstrated that 1ng/ml of serum ferritin corresponds to 8–10 mg of storage iron; hence serum ferritin is widely used in clinical practice and population screening (Lee and Nieman, 1996).

Serum ferritin levels below 12 ng/ml are highly specific for Iron deficiency and denote complete exhaustion of Iron stores in adults. Cook et al (1974) selected a ferritin concentration below 12ng/ml as diagnostic for Iron deficiency after a comprehensive population survey in the USA. The observed central 95% interval of serum ferritin in the Iron replete sample was 12-302 ng/ml. This cut-off value has been widely employed. In children, a cut-off value of 10ng/ml was suggested. In this survey, as in the NHANES II survey, the following cut off points were used:

Serum Ferritin Level	**Iron status**
< 10 ng/ml (0 – 15 years)	Iron Deficiency
< 12 ng/ml (16 – 74 years)	Iron Deficiency
< 20 ng/ml	Iron Store Depletion
20 – 100 ng/ml	Normal Range
101 – 300 ng/ml	Slightly above normal
>300 ng/ml	Iron Overload

Source: MRC (2001).

The risk of iron deficiency increases during periods of rapid growth,\notably in infancy, adolescence, and pregnancy (Lee and Nieman, 1985). The consequences of iron deficiency include reduced work capacity, impaired body temperature and regulation, impairments in behavior and intellectual performance and decreased resistance to infections. Iron deficiency results when ingestion or absorption of dietary iron is inadequate to meet iron losses or iron requirements imposed by growth or pregnancy.

A classification of countries with respect to the degree of public-health significance of anemia has been proposed (WHO/UNICEF/UNU, 1996) in which countries or population groups with anemia prevalence of at least 40% are categorized as high, 15 – 40% as medium and under 15% as low.

In most individuals the concentration of serum ferritin parallels the total amount of storage iron; and serum ferritin it is the only iron status index that can reflect a deficient, excess, and normal iron status (Gibson, 1993). The mean and median concentrations of serum ferritin for children under-5 at the national, agroecological

zone, and sector are presented in **Table 55.** The median value of serum ferritin for children under-5 is within the normal (20 – 100 ng/ml) cut off range at 50.2 ng/ml. A serum ferritin median range of 28.2 to 61.0 ng/ml was observed for the different agroecological zones indicating adequate iron nutrition. Serum ferritin concentration in children under-5 was 28.2% in the dry savanna, 57.7% in humid forest, and 61.0% in the moist savanna. It was 59.4% in rural, 46.5% in medium, and 38.5% in urban areas **(Table 55).**

Table 55. Serum ferritin concentration in children under-5 at the national, agroecological zone, and sector level.

Category	Number of observatons	Median ng/ml	Mean ng/ml	Std. Err.
National	2863	50.15	78.9	2.03
Agroecological zone				
Dry savanna	663	28.2	46.4	2.87
Moist Savanna	881	61.0	89.5	4.13
Humid forest	1319	57.7	89.4	3.34
Sector				
Rural	1204	59.4	89.1	3.48
Medium	1076	46.5	77.0	3.47
Urban	583	38.5	64.1	3.98

The iron status profile of children under-5 is illustrated in **Figure 56**. At the national level, 27.5% of children under-5 is at different stages of iron deficiency, with 8.1% of children under-5 already with iron stores (serum ferritin value of less than 20 ng/ml) and 19.4% (serum ferritin value of less than 10 ng/ml) suggestive of iron deficiency. A range of 20 ng/ml to 100ng/ml had been taken as normal. In this sample 48.9% had this range of serum ferritin indicating adequate iron nutrition.

One of the limitations of serum ferritin is the increase in serum ferritin concentrations in acute state of infections, infestations and inflammations. A 'higher than normal' level of serum ferritin could therefore imply increase total body iron or an acute phase situation like infection or both. A simultaneous though non-specific analysis/estimation of the C-reactive protein (which can identify this acute phase situation) on the same sample can identify those who are likely due to acute phase reactions in this group. Of the 2863 children surveyed, 20% had serum ferritin concentration between 101ug/dl and 300ug/dl at the national level.

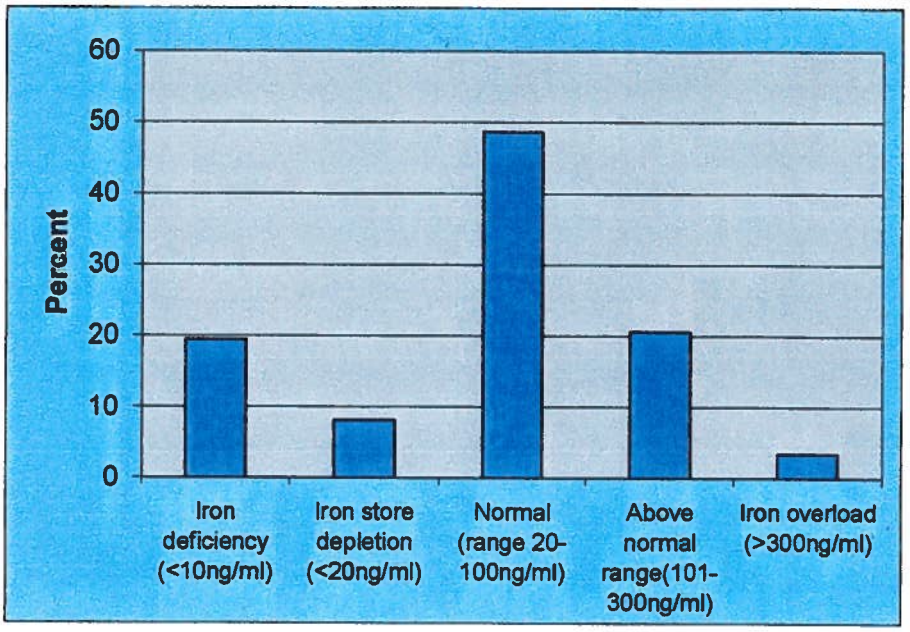


Figure 56. Profile of national iron status in all surveyed children under-5 at the national

The results of disaggregating by agroecological zones **(Figure 57)** indicate that the proportion of children with varying degrees of iron deficiency is 42.2% for dry savanna, 68.2% for moist savanna and 21.8% for the humid forest. Iron deficiency is high in the moist savanna (37.6%) followed by the dry savanna (31.5%) and humid forest (14.8%). The same trend was observed for those with depleted iron store (<20 ng/ml), they were more in the moist savanna (30.6%) than in the dry savanna (10.7%) and humid forest (7.0%). Children under-5 with adequate iron nutrition varied widely within the agroecological zones. They were 50.9% in the humid forest, 47.2% in the dry savanna and 22.5% in the moist savanna. The distribution of children under-5 who had serum ferritin concentration above the normal range in the agroecological zones showed that 9.8% were in the dry savanna, 11% in the moist savanna while 23.4% were in the humid forest.

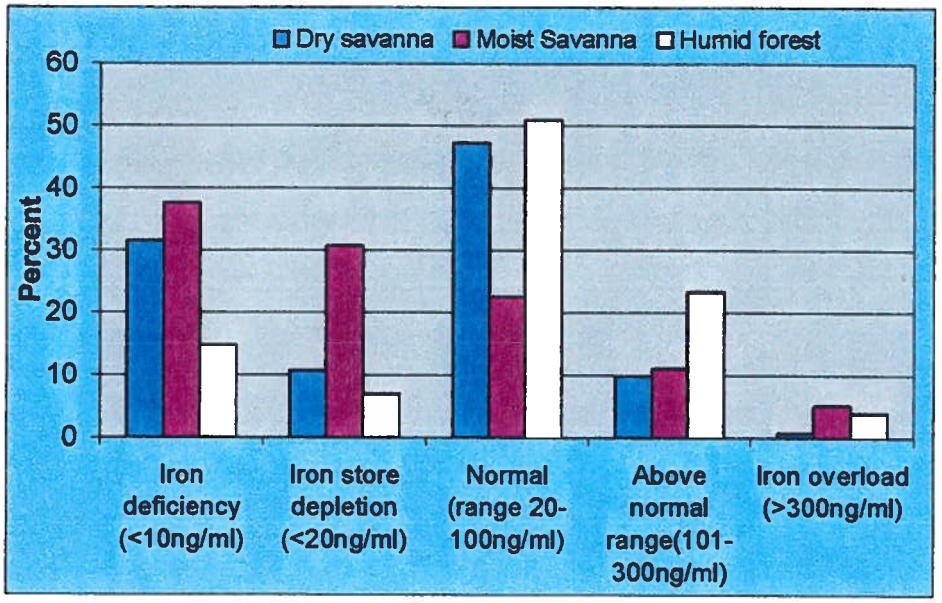


Figure 57. Profile of iron status of all surveyed children under-5 by agroecological zone

When disaggregating by sector **(Figure 58),** the results show that the proportion of children with varying degrees of iron deficiency is 24.4% for rural, 27.9% for medium and 33.1% for urban. Iron deficiency (serum ferritin concentration <10 ng/ml) is high in urban (22.6%) followed by medium (17.8%) and rural (13.5%) areas. Children under-5 with depleted iron store (serum ferritin concentration <20 ng/ml), were similar in the different sectors 10.9%, 10.5%, and 10.2% in rural, urban, and medium sector respectively. The percentages of the children with normal iron status (serum ferritin concentration 20-100 ng/ml) did not vary much in the sectors, being 47.8% in the rural, 49.4% in the medium and 48.7% in the urban. The distribution by sector of children under-5 who had serum ferritin concentration above the normal range showed that 27.8% were in the rural, 22.7% n the medium while 18.2% were in the urban sector.

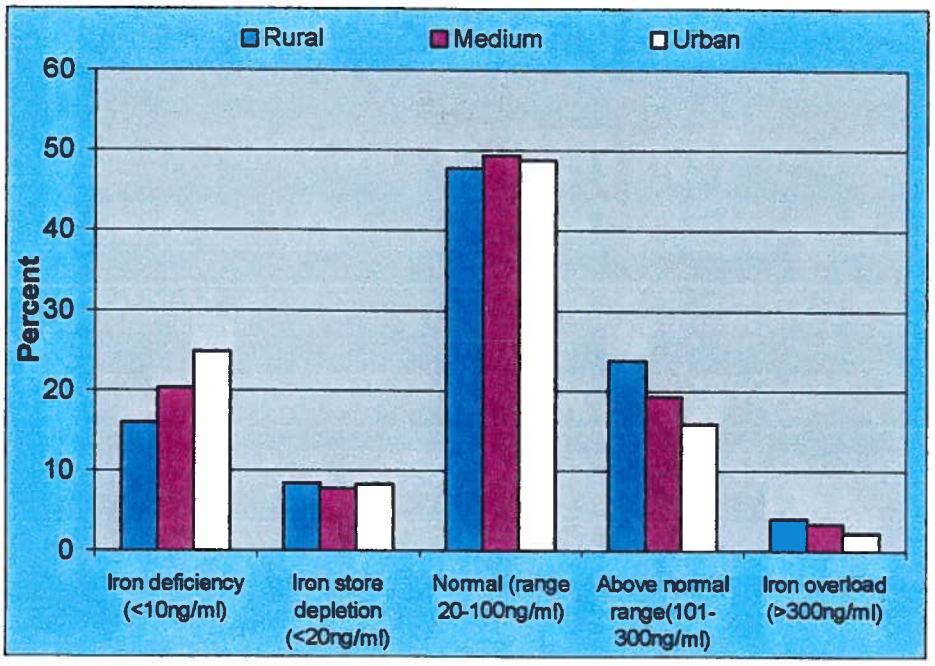


Figure 58. Profile of iron status of all surveyed children under-5 by sector

When the children under-5 were disaggregated by age group **(Appendix xx),** the following results were observed: 1) iron deficiency was highest among two age groups: 7-12 months (23.2%) and 13-24months (18.9%), followed closely is the 0-6 months age group (16.7%) and falls to 12% amongst 24-60months; 2) except in the 49-60months age group where about 60% have normal serum ferritin concentration, all other groups have about 45-60% in the same category; and 3) the highest prevalence of iron stores depletion (12.6%) is amongst the 13-24 month age group, while it is less in 25-36 months (9.4%), 37-48 months (10.1%) and 0-6 months (8.3%).

We were interested to know what would the data indicate if those samples of children with serum ferritin concentration levels greater than 100 ng/ml were excluded from the analysis. This leads to the generation of results presented below. The mean and median concentrations of serum ferritin for children under-5 are presented in **Table 56**.

The mean and median concentrations of serum ferritin for children under-5 at the national, agroecological zone, and sector are presented in **Table 56.** Although the median value of serum ferritin for children under-5 is within the normal (20 – 100 ng/ml) cut off range at 33.9 ng/ml, it is on the lower side. A serum ferritin median range of 22.2 to 40.9 ng/ml was observed for the different agroecological zones. Serum ferritin concentration in children under-5 was 22.2% in the dry savanna, 35.6% in humid forest, and 40.9% in the moist savanna. It was 39.4% in rural, 33.4% in medium, and 28.9% in urban areas **(Table 56).**

Table 56. Serum ferritin concentration in children under-5 with those with possible infection removed at the national, agroecological zone, and sector level.

Category	No of observatons	Median ng/ml	Mean ng/ml	Std. Err.
National	2193	33.82	38.12	0.61
Agroecological zone				
Dry savanna	596	22.16	29.57	1.06
Moist Savanna	642	40.96	43.31	1.17
Humid forest	955	35.55	39.96	0.92
Sector				
Rural	875	39.43	41.35	1.00
Medium	839	33.39	37.25	0.97
Urban	479	28.94	33.72	1.26

The iron status profile of children under-5 with serum ferritin concentration greater that 100 ng/ml removed is shown in **Figure 59**. At the national level, approximately 36.3% of children under-5 is at different stages of iron deficiency, with 13.4% of children under-5 already with iron stores (serum ferritin value of less than 20 ng/ml) and 22.3% (serum ferritin value of less than 10 ng/ml) suggestive of iron deficiency. A range of 20 ng/ml to 100ng/ml had been taken as normal. In this sample 63.7% had this range of serum ferritin indicating adequate iron nutrition.

As indicated earlier, a limitation of serum ferritin is the increase in serum ferritin concentrations in acute state of infections, infestations and inflammations. A 'higher than normal' level of serum ferritin could therefore imply increase total body iron or an acute phase situation like infection or both. Of the 2863 children, slightly over 20% had serum ferritin concentration between 101ug/dl and 300ug/dl at the national level.

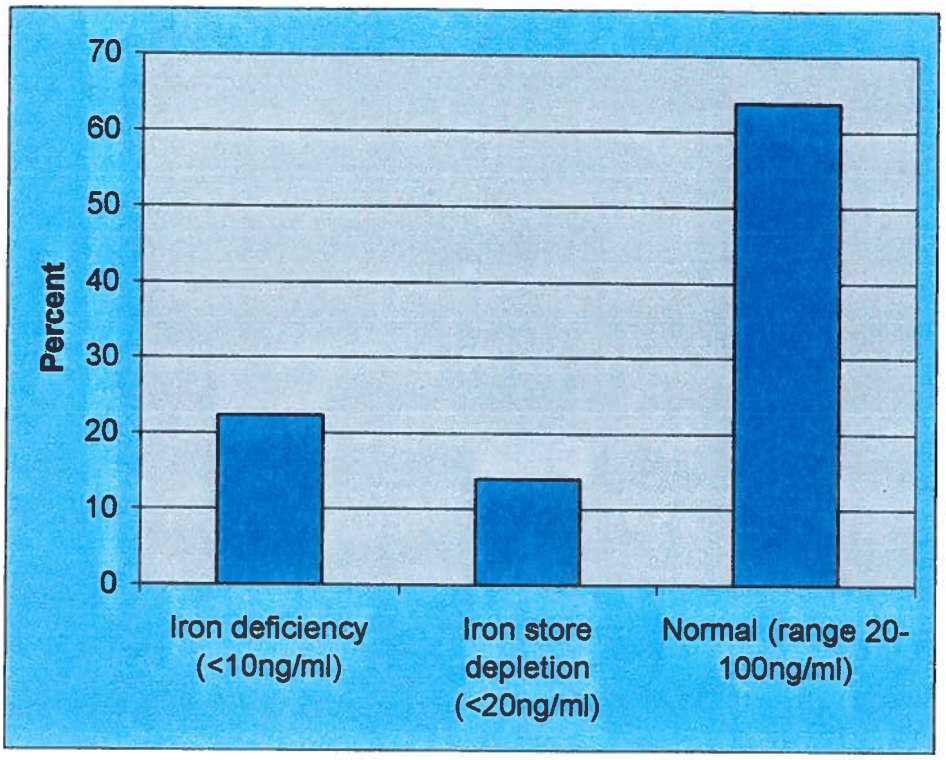


Figure 59. Profile of national iron status of children when those with serum concentration values of greater than 100 removed.

The results of disaggregating by agroecological zones **(Figure 60)** indicate that the proportion of children with varying degrees of iron deficiency is 47.3% for dry savanna, 30.4% for moist savanna and 33.4% for the humid forest. Iron deficiency is high in the dry savanna (32.2%) followed by the moist savanna (18.5%) and humid forest (18.7%). The same trend was observed for those with depleted iron store (<20 ng/ml), they were more in the dry savanna (15.1%) than in the moist savanna (11.8%) and humid forest (14.7%). Children under-5 with adequate iron nutrition varied widely within the agroecological zones. They were (66.6%) in the humid forest, (52.7%) in the dry savanna and (69.6%) in the moist savanna.

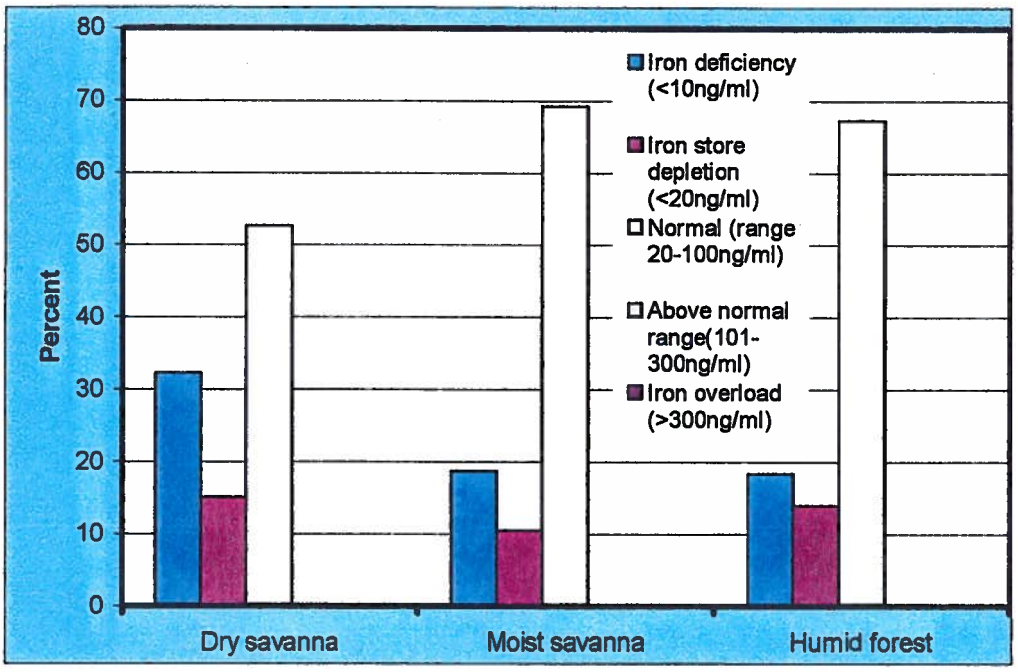


Figure 60. Profile of national iron status of children under-5 when those with serum ferritin concentration greater than 100 ng/ml were removed by agroecological zones.

When disaggregating by sector **(Figure 61),** the results show that the proportion of children with varying degrees of iron deficiency is 34.1% for rural, 36.2% for medium and 40.5% for urban. Iron deficiency (serum ferritin concentration <10 ng/ml) is high in urban (27.8%) followed by medium (23.0%) and rural (18.7%) areas. Children under-5 with depleted iron store (serum ferritin concentration <20 ng/ml), were similar in the different sectors 15.3%, 12.7% and 13.2%, in rural, urban, and medium sector respectively. The percentages of the children with normal iron status (serum ferritin concentration 20-100 ng/ml) did not vary much within the sectors, being 65.9% in the rural, 63.7% in the medium and 59.5% in the urban.

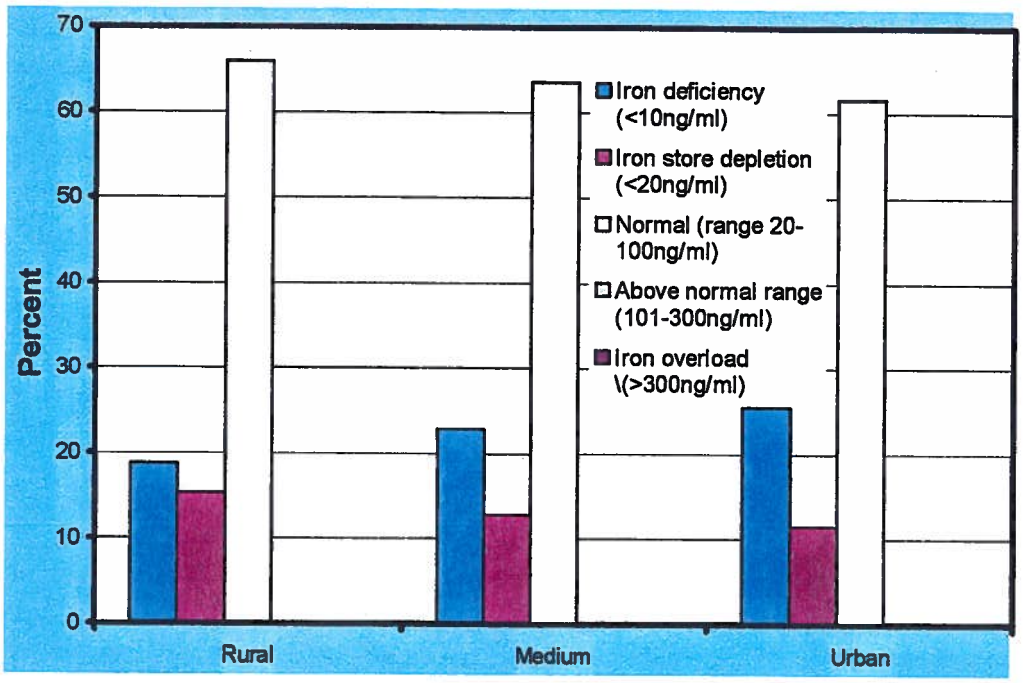


Figure 61. Profile of national iron status for children under-5 by sector

The comparison of results of the iron status of children aged from birth to 59 months of both sample sizes (all surveyed children under-5children and those children whose serum ferritin concentration was greater than 100 ng/ml and hence were removed from the data set is presented in **Figure 62.**

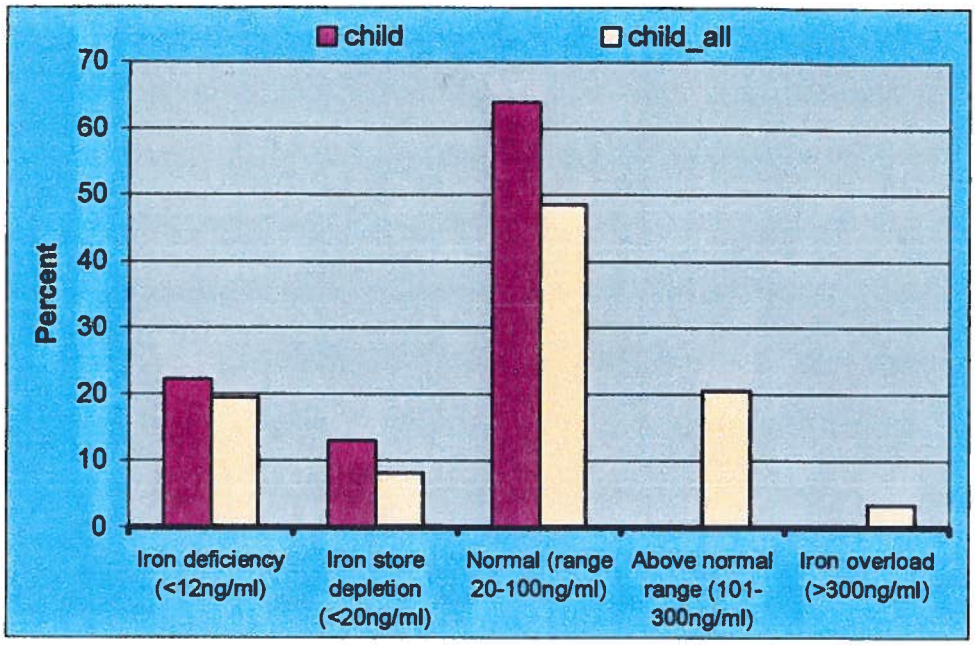


Figure 62. Comparison of iron status of all surveyed children under-5 and those children whose serum ferritin concentration greater than 100 ng/ml removed.

The mean and median concentrations of serum ferritin for mothers and pregnant women at the national level are presented in **Table 57.** While the mean and median values of serum ferritin for both mothers and pregnant women are within the normal cut off range of 20-100 ng/ml, they are close to the lower end of the normal limit.

Table 57. Serum ferritin concentration of mothers and pregnant women.

Group	Number of observations	Median ng/ml	Mean ng/ml	Std. Err.
Mother	3949	42.3	54.0	0.96
Pregnant women	829	33.0	49.9	2.34

Approximately 24.3% and 35.3% of mothers and pregnant women respectively are at different stages of iron deficiency, with 12.7% of mothers and 19.9% of pregnant women already with iron stores (serum ferritin <12 ng/ml) suggestive of iron deficiency **(Figure 63).**

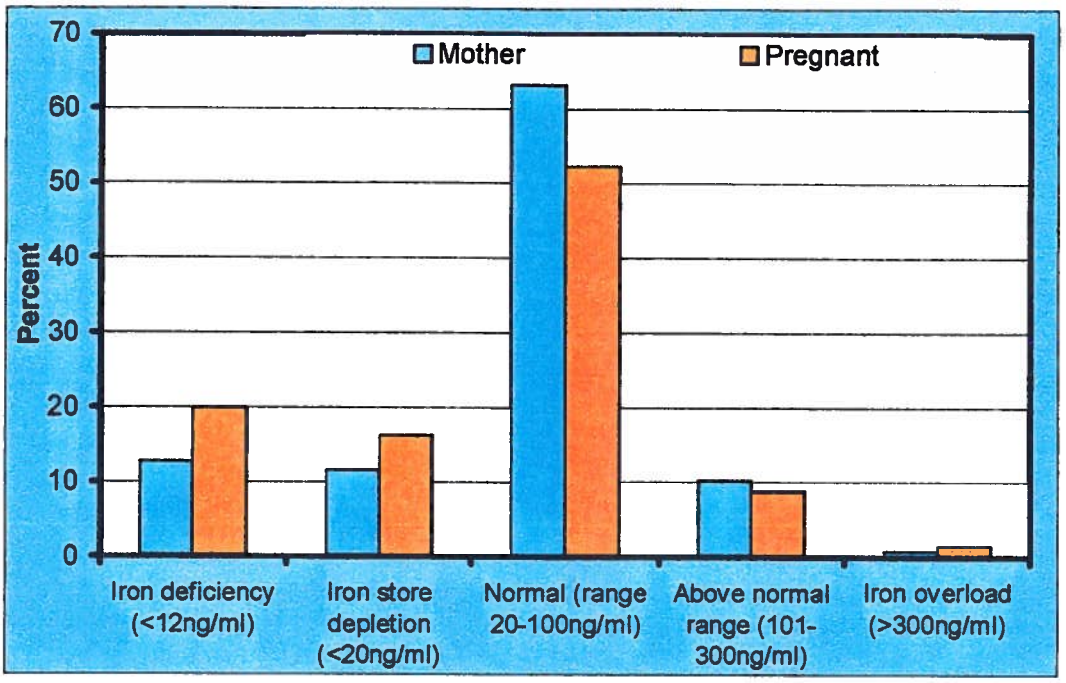


Figure 63. Profile of national iron status for mothers and pregnant women

The mean and median concentrations of serum ferritin for mothers and pregnant women disaggregated by agroecological zone are presented in **Table 58.** Although the mean and median values of serum ferritin indicate that they are within the normal cut off point, the value for mothers in the moist savanna (47.8 ng/ml) is close to the mid point of recommended cut off points.

Table 58. Serum ferritin concentration in children under-5, mothers, and pregnant women disaggregated by agroecological zones

Agroecological zone	Group	Number of observations	Median ng/ml	Mean ng/ml	Std. Err.
Dry savanna	Mother	1005	33.5	42.7	1.41
	Pregnant	218	27.2	38.3	3.01
Moist savanna	Mother	1144	47.9	59.9	1.85
	Pregnant	248	39.4	60.7	5.61
Humid forest	Mother	1800	43.9	56.6	1.53
	Pregnant	363	33.0	49.7	3.20

The percentage distribution of iron status for mothers and pregnant women are shown in **Figures 64 and 65** respectively. Also 63.2% of mothers are within the normal serum ferritin level range of 20-100 ng/ml, whereas only about half of the pregnant women (52.4%) fall within the normal range. Iron overload (serum ferritin concentration level >300 µg/l) are beginning to occur among the pregnant women (1.5%) as against the prevalence of 0.8% in mothers. As presented in **Figure 64**, the corresponding values for mothers are 33.2% for dry savanna, 18.4% for moist savanna and 24.1% for the humid forest. Pregnant women on the other hand had high prevalence of 43.1% in the dry savanna, 31.5% in moist savanna and 35.0% in the humid forest **(Figure 65)**. The prevalence of iron store depletion is highest in the dry savanna and lowest in the moist savanna.

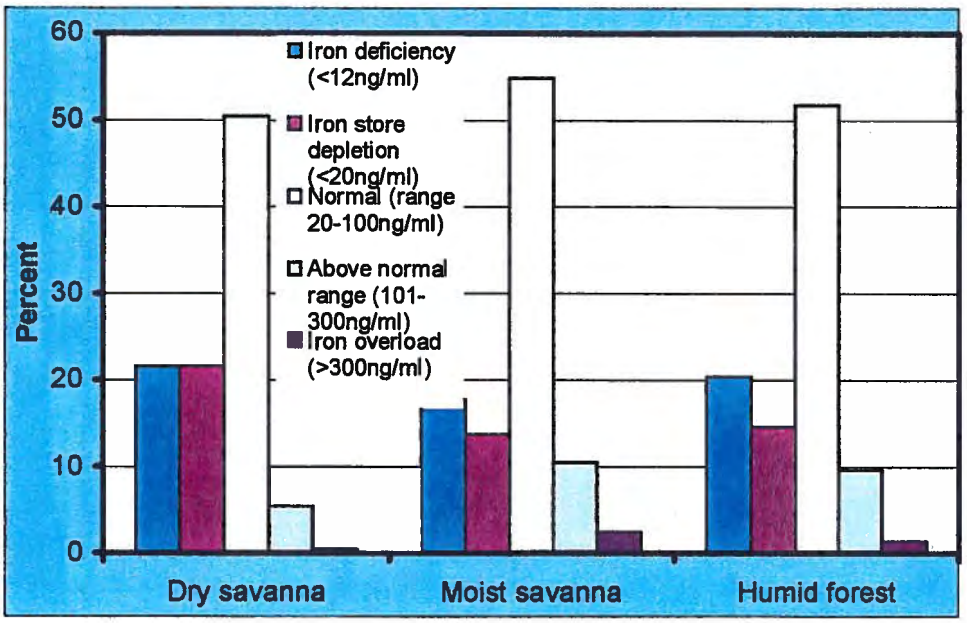


Figure 64. Profile of iron status of mothers by agroecological zones

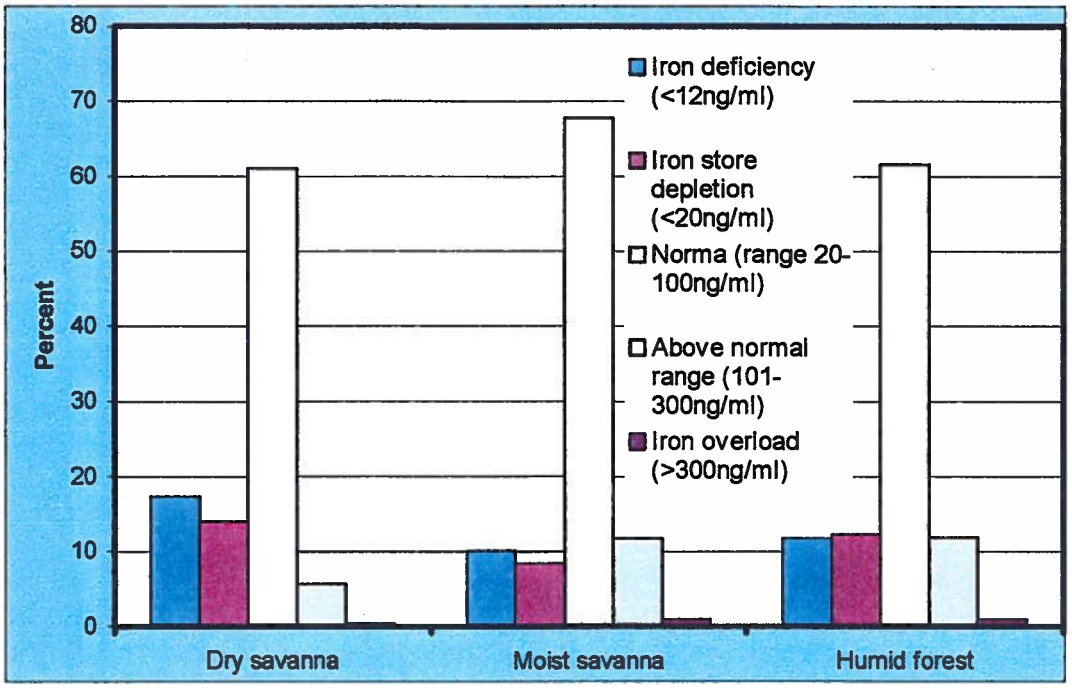


Figure 65. Profile of iron status for pregnant women by agroecological zones

The mean and median concentrations of serum ferritin for mothers and pregnant women disaggregated by sector are presented in **Table 59.** Although the values for serum ferrittin concentration for mothers and pregnant women in the urban areas were the lowest, 37.7 ng/ml and 26.1 ng/ml respectively, there are still within the normal range.

Table 59. Serum ferritin concentration in mothers and pregnant women disaggregated by sector

Agroecological zone	Group	Number of observations	Median ng/ml	Mean ng/ml	Std. Err.
Rural	Mother	1579	45.8	57.4	1.45
	Pregnant	342	37.3	54.5	3.96
Medium	Mother	1489	41.7	54.7	1.77
	Pregnant	300	32.1	49.2	3.70
Urban	Mother	881	37.7	46.8	1.60
	Pregnant	187	26.1	43.1	4.44

The prevalence of various degree of iron deficiency is common in the urban areas than the medium and rural areas. Percentage distributions of mothers and pregnant women as disaggregated by sector are shown in **Figure 66 and 67.** For mothers, the

prevalence of various degrees of iron deficiency is more common in the urban areas than in the medium and rural areas. The corresponding percentage distribution of iron deficiency for mothers is highest in urban areas (26.9%) followed by the medium areas (24.7%) and least in rural (22.4%) areas **(Figures 66).**

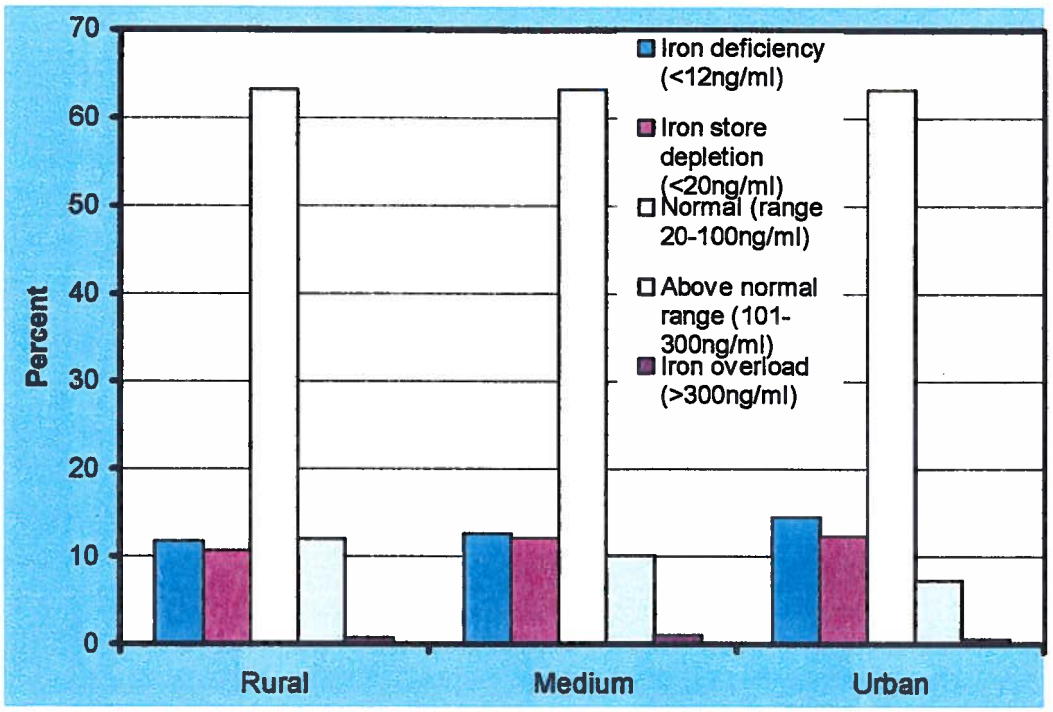


Figure 66. Profile of iron status for mother by sector

In pregnant women, the prevalence of various degrees of iron deficiency is presented in **Figure 67.** About four out of every ten pregnant women (43.8%) in the urban areas are iron deficient, compared to slightly over a third (33.6%) in both rural and medium (34.0%) areas. The prevalence of iron overload is higher in the medium sector (2%) than in the rural and urban sectors with 1.1% respectively.

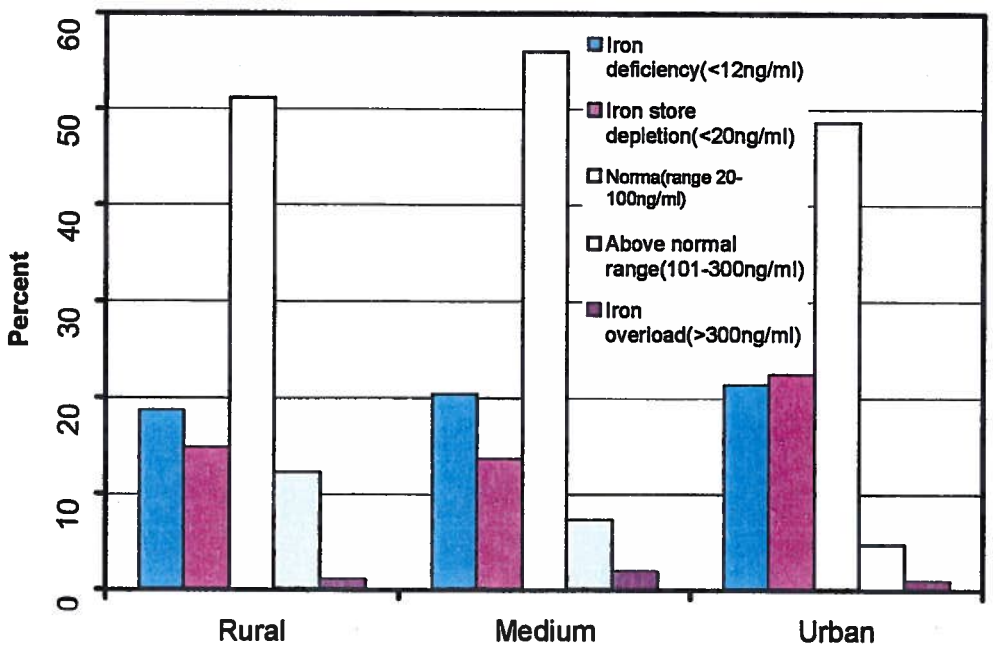


Figure 67. Profile of national iron status for pregnant women by sector

Information on states for iron status of children under-5, mothers, and pregnant women is presented in **Appendix 12.**

Summary on iron status in children under-5, mothers, and pregnant women

Iron status of children under-5

- At the national level, approximately 36.3% of children under-5 is at different stages of iron deficiency, with 13.4% of children under-5 already with iron stores (serum ferritin value of less than 20 ng/ml) and 22.3% (serum ferritin value of less than 10 ng/ml) suggestive of iron deficiency.

- A limitation of serum ferritin is the increase in serum ferritin concentrations in acute state of infections, infestations and inflammations. A 'higher than normal' level of serum ferritin could therefore imply increase total body iron or an acute phase situation like infection or both. Of the surveyed children, slightly over 20% had serum ferritin concentration between 101ug/dl and 300ug/dl at the national level.

- The proportion of children with varying degrees of iron deficiency is 47.3% for dry savanna, 30.4% for moist savanna and 33.4% for the humid forest. Iron deficiency is high in the dry savanna (32.2%) followed by the moist savanna (18.5%) and humid forest (18.7%). The same trend was observed for those

- About four out of every ten pregnant women (43.8%) in the urban areas are iron deficient, compared to slightly a third (33.6) in both rural and medium (34.0%) areas.

8.4 Zinc status

Zinc is now recognized as an essential micronutrient (trace elements) critical in human nutrition. This was not always so, for although its essentiality for plants and mammalian nutrition had long been well known, it was not until the early 1960's that its real importance in human nutrition was appreciated. Clinical syndrome associated with zinc deficiency includes growth retardation, male hypogonadism, skin changes, mental lethargy, hepatosplenomegaly, iron deficiency anemia and geophagia. Apart from low zinc occasioned by rapid growth, pregnancy and lactation can also lead to zinc deficiency if these increased needs are not met.

Measurements of serum zinc concentration maybe a useful indicator of the size of the body's exchangeable zinc pool bone and liver). Because of the body's ability to conserve zinc when intake is low and ability to redistribute zinc, measurements of serum zinc are not a reliable indicator of dietary zinc intake or changes in the whole-body zinc status. Despite this limitation there appears to be a consensus that the plasma/serum zinc concentration represents the best indicator of the zinc status of a population (Brown and Wuehler, 2000).

Presently no cut-off points for serum/plasma zinc levels have been recommended, to classify zinc deficiency, however, plasma zinc concentration of 80 µg/dl has been established as a threshold beyond which no response to zinc supplementation is observed. Consequently in assessing zinc nutrition of subjects in this survey 80µg/dl has been used as the cut-off value for determining zinc deficiency.

The median serum zinc concentration was found to be 103.5 ng/ml at the national level. Further disaggregating the data by agroecological zones showed the median concentrations to be 102.4 ng/ml for dry savanna, 86.6 ng/ml for the moist savanna, and 115.4 ng/ml for the humid forest **(Table 60).**

At the sector level, the serum zinc concentrations were 99.6 ng/ml for rural, for 105.0 ng/ml for medium and 107.1 ng/ml for urban sector **(Table 60).**

Table 60. Serum zinc concentration in children under-5 by national, agroecological zone, and sector.

Category	Number of observatons	Median ng/ml	Mean ng/ml	Std. Err.
National	2725	103.5	106.8	0.87
Agroecological zone				
Dry savanna	603	102.4	104.2	1.47
Moist Savanna	908	86.6	89.7	0.91
Humid forest	1214	115.4	120.8	1.57
Sector				
Rural	1030	99.6	103.2	1.84
Medium	1084	105.0	108.8	1.07
Urban	611	107.1	109.3	1.34

At the national level, 20% of children under-5 are zinc deficient. Among the under five children, zinc deficiency was highest in the moist savanna zone (36.5%) intermediate in the dry savanna (26.0%) and lowest in the humid forest (6.3%). This is illustrated in **Figure 68.**

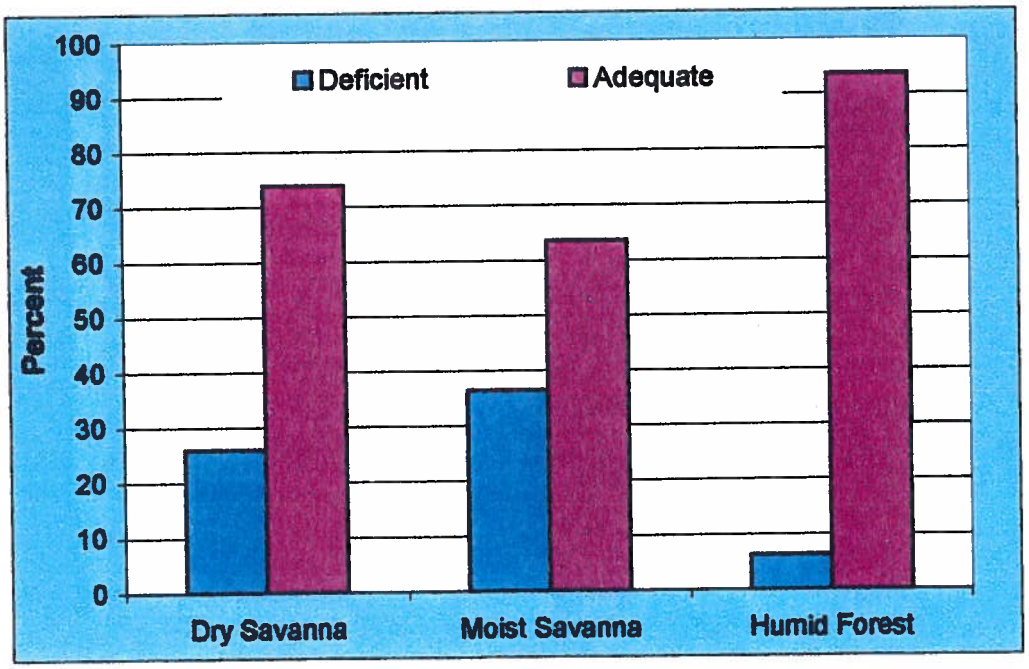


Figure 68. Zinc status of children under-5 by national and agroecological zones.

The prevalence of zinc deficiency in children under-5 is illustrated in **Figure 69**. The deficiency is higher (26.0%) in the rural than in each of the other two sectors (17%).

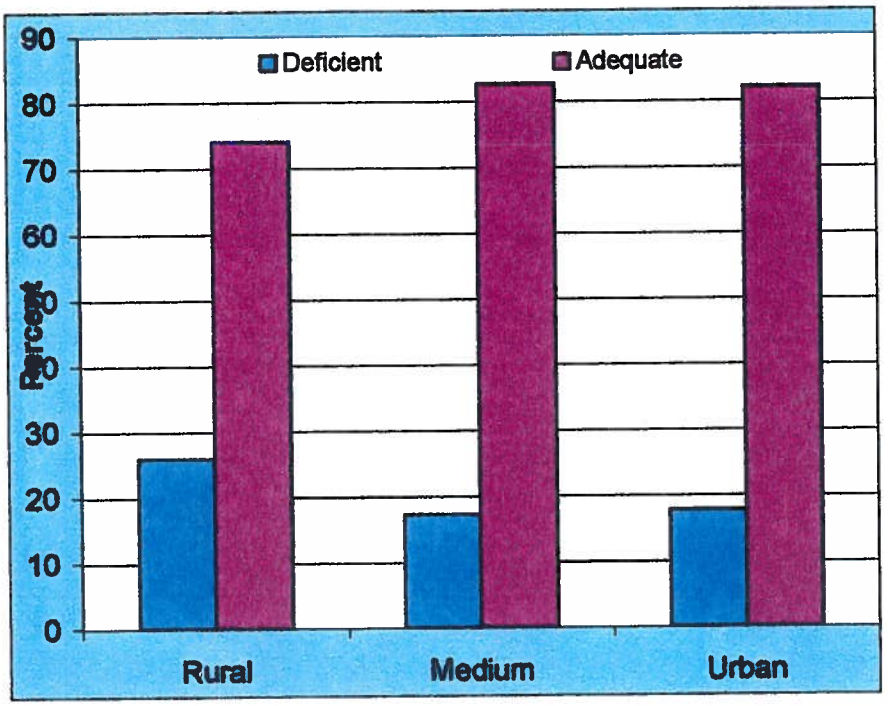


Figure 69. Zinc status of children under-5 by sector

When the number of children suspected to be infected were analysed separately, the median serum zinc concentration was 100.9 ng/ml at the national level. When disaggregated by agroecological zones, the median serum concentration was 100.2 ng/ml, 85.6 ng/ml, and 113.1 ng/ml in the dry savanna, moist savanna, and humid forest zone respectively **(Table 61)**. In addition, the median serum zinc concentration of children under-5 was slightly higher in medium (105.0 ng/ml) than in the urban (103.5 ng/ml) and rural (98.8 ng/ml) areas.

Table 61. Serum zinc concentration of children with possible infection by national, agroecological zone, and sector level.

Category	Number of observatons	Median ng/ml	Mean ng/ml	Std. Err.
National	307	100.9	103.4	1.81
Agroecological zones				
Dry savanna	25	100.2	111.9	7.40
Moist Savanna	112	85.6	89.6	2.67
Humid forest	150	107.1	113.1	2.47
Sector				
Rural	142	98.8	99.4	2.25
Medium	95	105.0	109.3	3.39
Urban	50	103.5	106.1	4.94

Results obtained indicate that 22.5% of the children are zinc deficient **(Figure 70).** When disaggregated by agroecological zones, zinc deficiency was higher in the moist savanna at 41.1% and the dry savanna at 12.0% and lower in the humid forest at 8.7% **(Figure 71).**

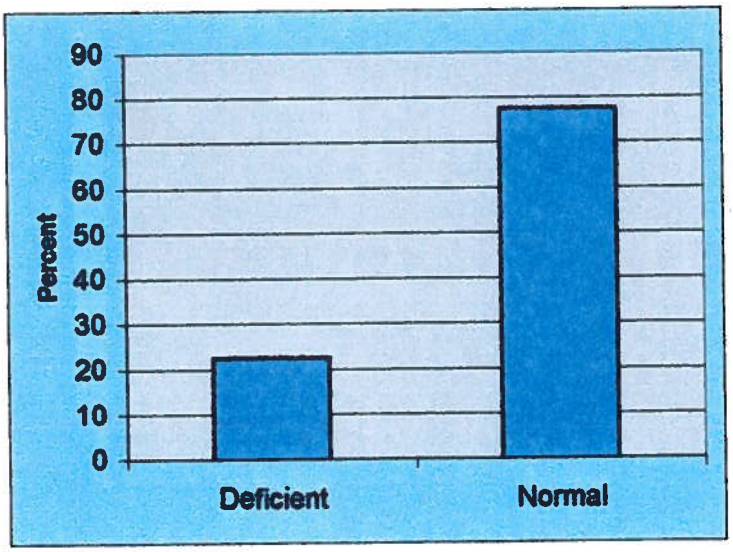


Figure 70. Zinc status of children under-5 with possible infection

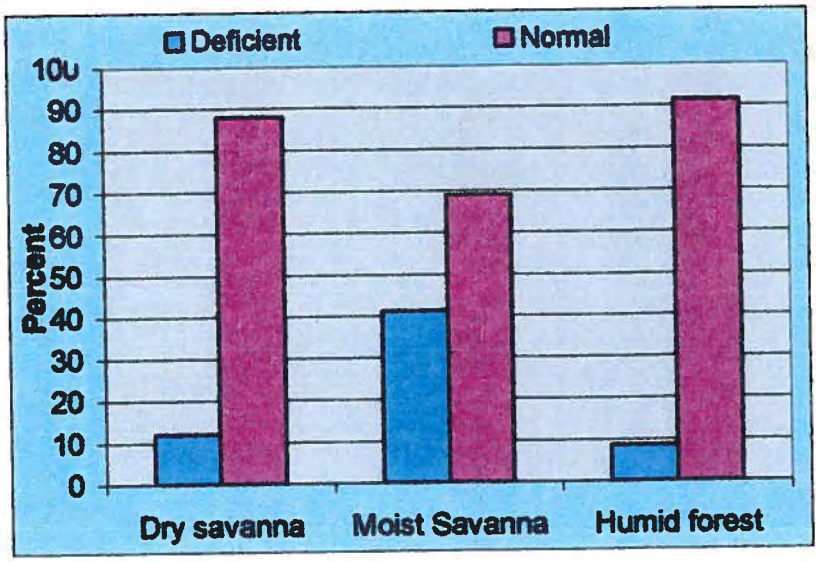


Figure 71. Zinc status in children under-5 with possible infection by agroecological zones

When the data was disaggregated by sector, 26.1% and 24.0% of children under-5 in the rural and urban sector respectively are suffering from zinc deficiency. Zinc deficiency is slightly lower in the medium area at 13.7% **(Figure 72).**

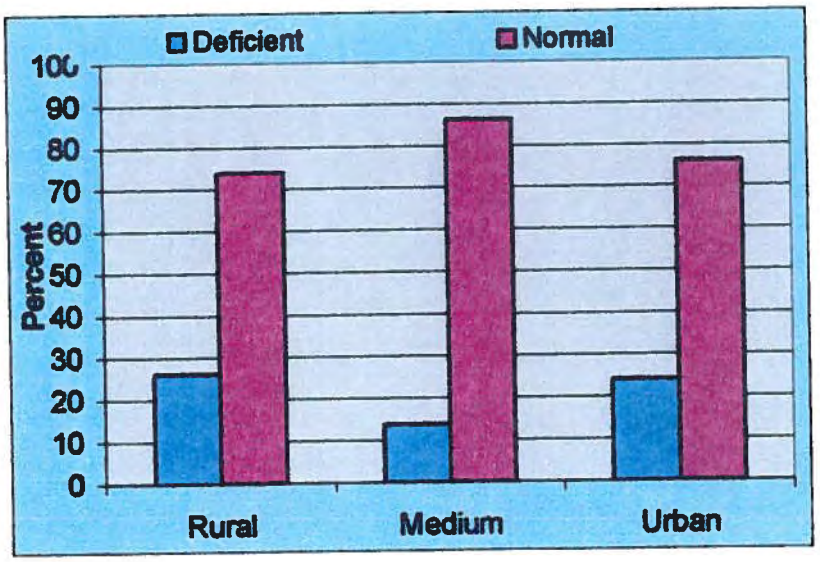


Figure 72. Zinc status in of children under-5 with possible infection by sector

The median serum zinc concentration in mothers and pregnant women obtained nationally from the survey is 94.6 ng/ml and 83.2 ng/ml respectively as presented in

Table 62. The cut-off value used is <80ng/ml. The national zinc profile is illustrated in **Figure 73.**

Table 62. Serum zinc concentration in mothers and pregnant women

Group	Number of observations	Median ng/ml	Mean ng/ml	Std. Err.
Mother	3779	94.6	95.9	0.42
Pregnant women	795	83.2	86.2	0.87

Zinc deficiency was highest in pregnant women (43.8%). One quarter (28.1%) of the mothers are zinc deficient.

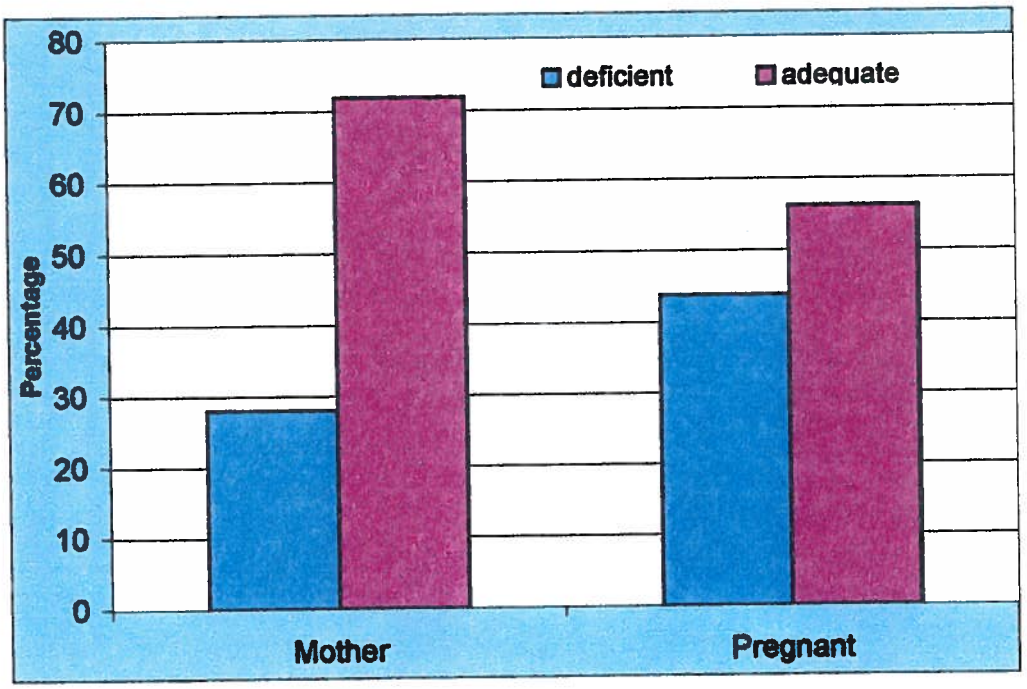


Figure 73. National zinc status of mothers and pregnant women

The median serum zinc concentration by agroecological zones is presented in **Table 63** with zinc concentration of 90.5 ng/ml, 80.6 ng/ml, and 105.6 ng/ml for mothers in the dry savanna, moist savanna, and humid forest zone respectively. For pregnant women, serum zinc concentration was 83.2 ng/ml, 69.2 ng/ml, and 96.2 ng/ml in the dry savanna, moist savanna, and humid forest zone.

Table 63. Serum zinc concentration in mothers and pregnant women disaggregated by agroecological zones

Agroecological zone	Group	Number of observations	Median ng/ml	Mean ng/ml	Std. Err.
Dry savanna	Mother	945	90.5	91.9	0.90
	Pregnant	209	83.2	85.2	1.77
Moist savanna	Mother	1141	80.6	83.4	0.59
	Pregnant	248	69.2	71.1	1.05
Humid forest	Mother	1693	105.6	106.7	0.56
	Pregnant	338	96.2	97.9	1.23

The prevalence of zinc deficiency in mothers is illustrated in **Figure 74.** The percentage prevalence is 48.3% in the moist savanna, 35.3% in the dry savanna and 10.5% in the humid forest.

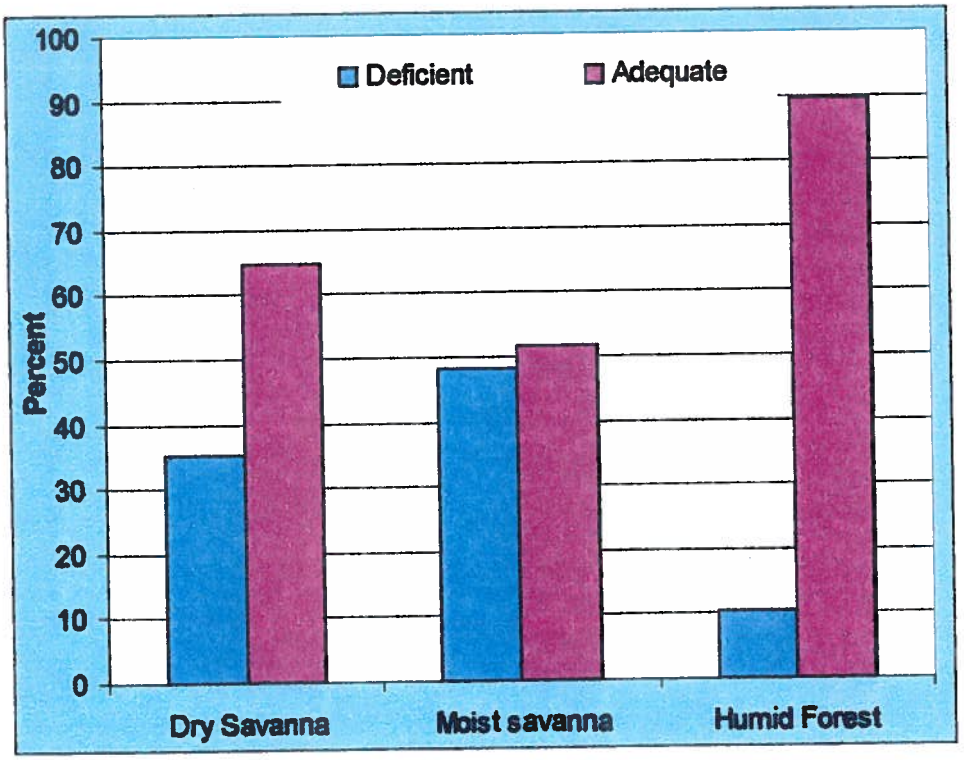


Figure 74. Zinc status of mothers by agroecological zones

The prevalence of zinc deficiency in pregnant women was higher (73.4%) in the moist savanna, and lowest (23%) in the humid forest. The dry savanna zone has a prevalence of 42.6% as shown in **Figure 75.**

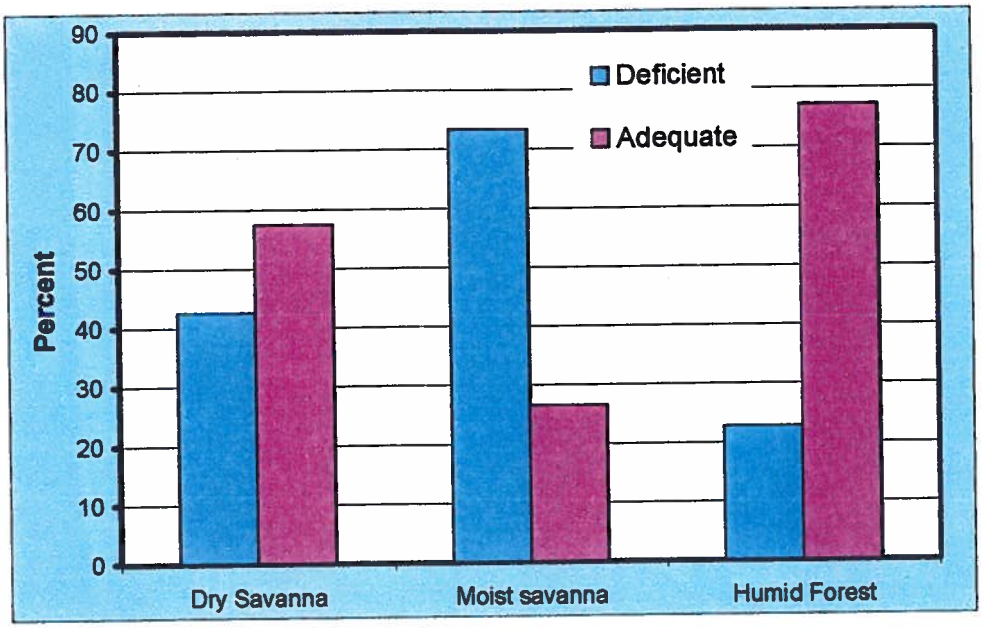


Figure 75. Zinc status of pregnant women by agroecological zones

The median serum zinc concentration of mothers and pregnant women by sector is presented in **Table 64.** In the rural areas, the median serum zinc concentration for mothers is 92.6 ng/ml and 83.7 ng/ml for pregnant women. In medium areas, the levels were 95.2 ng/ml for mothers and 82.2 ng/ml for pregnant women while in urban areas the zinc concentrations were 96.7 ng/ml for mothers and 85.8 ng/ml for pregnant women.

Table 64. Serum zinc concentration of mothers, and pregnant women by sector

Agro ecological zone	Group	Number of observations	Median ng/ml	Mean ng/ml	Std. Err.
Rural	Mother	1443	92.6	94.5	0.69
	Pregnant	314	83.7	86.1	1.37
Medium	Mother	1463	95.2	96.9	0.69
	Pregnant	295	82.2	86.3	1.53
Urban	Mother	873	96.7	96.7	0.77
	Pregnant	186	85.8	86.1	1.65

Prevalence of zinc deficiency in mothers by sector is illustrated in **Figure 76.** The percentage zinc deficiency prevalence is slightly higher (30%) in the rural than in medium (28%) and urban (25%) sectors.

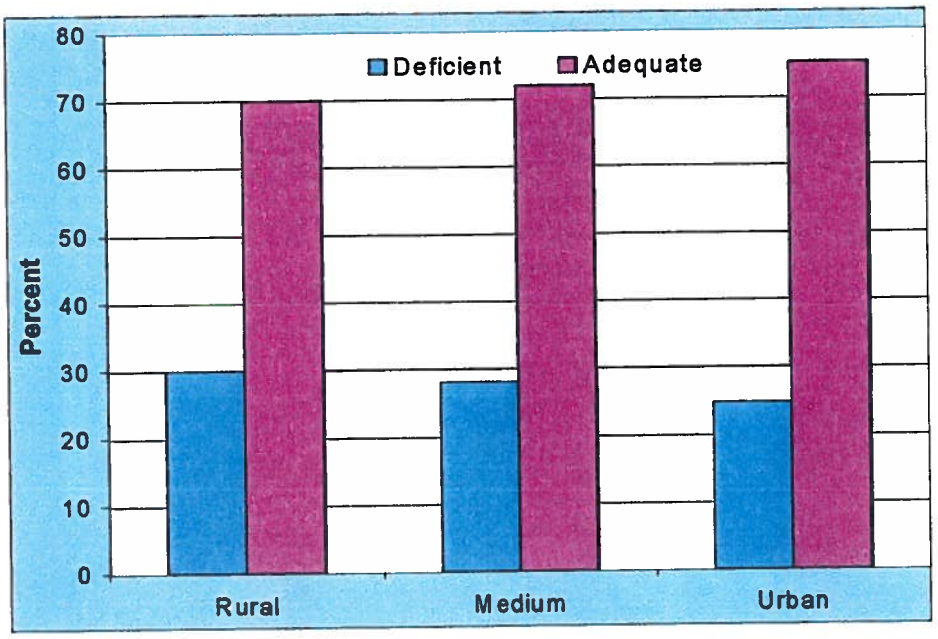


Figure 76. Zinc status of mothers by sector

Prevalence of zinc deficiency in pregnant women by sector is illustrated in **Figure 77.** The percentage prevalence is higher in the medium (46%) than in the rural (43%) and urban (41%) sectors.

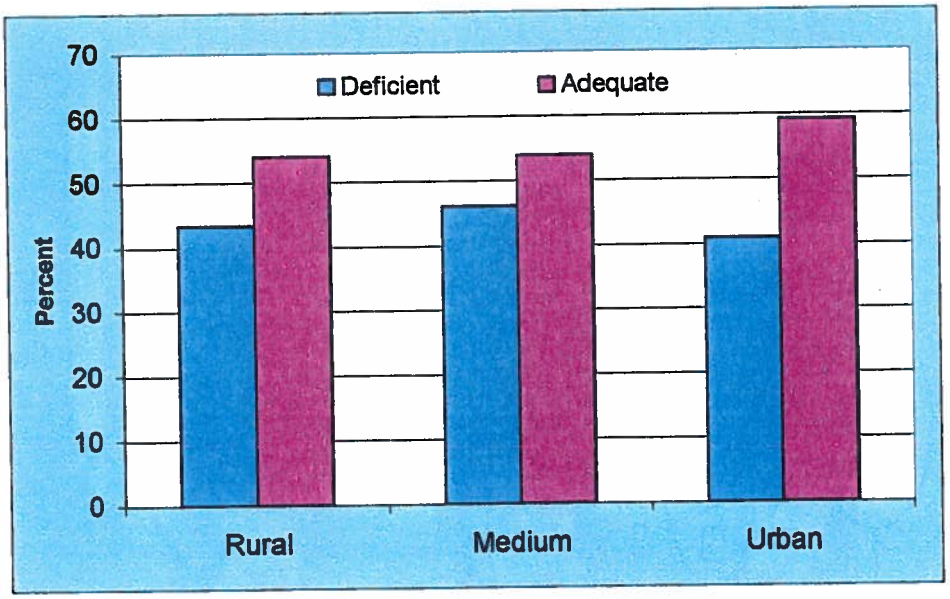


Figure 77. Zinc status of pregnant women by sector

Information on states for zinc status of children under-5, mothers, and pregnant women is presented in **Appendix 13.**

Summary on Zinc

Zinc Status of Children

- A national deficiency prevalence among children under-5 was 21%; one out of every five children.
- The deficiency in the dry savanna was about 74%; this is twice the level in the moist savanna and humid forest.
- The prevalence in the rural sector was about 26%, which is much higher than the 17% in the urban and medium sectors.
- Nationally, about 80% of the children surveyed had normal zinc status. When the data was disaggregated by agroecological zone, 64% of the children under-5 in the moist savanna and humid forest had normal zinc status and only 26% in the dry savanna zone.
- About 82% in the medium and urban sectors have adequate zinc level while about 75% are in the rural sector.

Zinc status in mothers

- Nationally, about 28% of the mothers surveyed were zinc deficient.
- The geographical distribution showed 48% are in the moist savanna, 35% in the dry savanna while a low (10.4%) prevalence was found in the humid forest.
- The percentage prevalence is higher in the medium (46%) than in the rural (43%) and urban (41%) sectors.

Zinc Status in pregnant women

- More than two-fifths (43.7%) of pregnant women throughout the country are zinc deficient.
- The prevalence of zinc deficiency in pregnant women was higher (73.39%) in the moist savanna, and lowest (23%) in the humid forest. The dry savanna zone has a prevalence of 42.6%.

- The prevalence across the three sectors was similar although the rural (43.3%) and medium (46.1%) seem to have slightly higher percentages than the urban (40.8%).

8.5 Iodine status

Iodine deficiency disorders (IDD) constitute the single greatest cause of preventable brain damage in the fetus and infant, and of retarded psychomotor development in young children. IDD remains a major threat to the health and development of populations worldwide, but particularly among preschool children and pregnant women in low-income countries (WHO, 2000). It results in goiter, stillbirth, and miscarriages, but most devastating toll involves mental retardation, deaf-mutism, and impaired educability. While cretinism is the most extreme manifestation, of considerably greater significance are the more subtle degrees of mental impairment that lead to poor school performance, reduced intellectual ability, and impaired work capacity.

The daily requirement of iodine range between 50μg and 150μg per day depending on age, sex and physiological status of the individual. The level of iodination of salt has to be sufficient to cover this requirement together with losses from the point of production to the point of consumption including the expected shelf life. It also has to take into account the per capita salt consumption in an area.

Urinary iodine excretion is a good marker of the very recent dietary intake of iodine and therefore, is the index of choice for evaluating the degree of iodine deficiency and of its correction. In this survey, urinary iodine has been adopted as the epidemiological criterion for assessing iodine nutrition of children under-5, mothers and pregnant women. Consequently, urinary iodine was analyzed from samples collected from children under–5, their mothers and pregnant women.

Classification of laboratory results of urinary analysis has employed the references and cut off points recommended by ICCIDD/WHO/UNICEF 1996. The cut off points are as follows:

Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentrations	
Mean urinary iodine (μg/L)	Iodine nutritional status
< 20	Severe iodine deficiency
20 - 49	Moderate iodine deficiency
50 - 99	Mild iodine deficiency
100 - 199	Optimal
200 - 299	More than adequate
> 300	Possible excess

Source: ICCIDD/WHO/UNICEF, 1996

The overall values for children under-5, mothers and pregnant women at the national level are presented in **Tables 65.** The median for the children is 183.7ug/L, while that of their mothers and pregnant women are 151.9ug/L and 167.1 ug/L respectively. According to current recommendations produced by WHO, UNICEF, and ICCIDD, median urinary iodine concentrations of 100-200ug/L in samples from school children and adults indicate adequate iodine intake and optimal iodine nutrition. This recommendation was made on the basis of the assumption that the threshold of 100ug/L would allow values <50ug/L (concentrations that indicates persistent, at least moderate iodine deficiency in the population) in no more than 20% of the population (Delange et al., 2002)

Table 65. Urinary iodine concentration in children under-5, mothers, and pregnant women at the national level

Group	Number of observations	Median µg/L	Mean µg/L	Std. Err.
Child under 5	2428	183.7	249.5	4.8
Mother	3104	151.9	197.4	3.2
Pregnant women	660	167.1	210.0	6.5

Based on these ICCIDD/WHO/UNICEF criteria for classification, 29.2% of the children suffer various degree of iodine deficiency while 46.5% have more than adequate levels. Approximately 4% suffer from severe deficiency, 8.4% from moderate, and 17.2% from mild deficiency. Only 30% of the children had optimal level of iodine. However, it is noteworthy that 18.9% of the children had more than adequate while 21.9% had possible excess intake of iodine and run the risk of adverse health consequences **(Figure 78).**

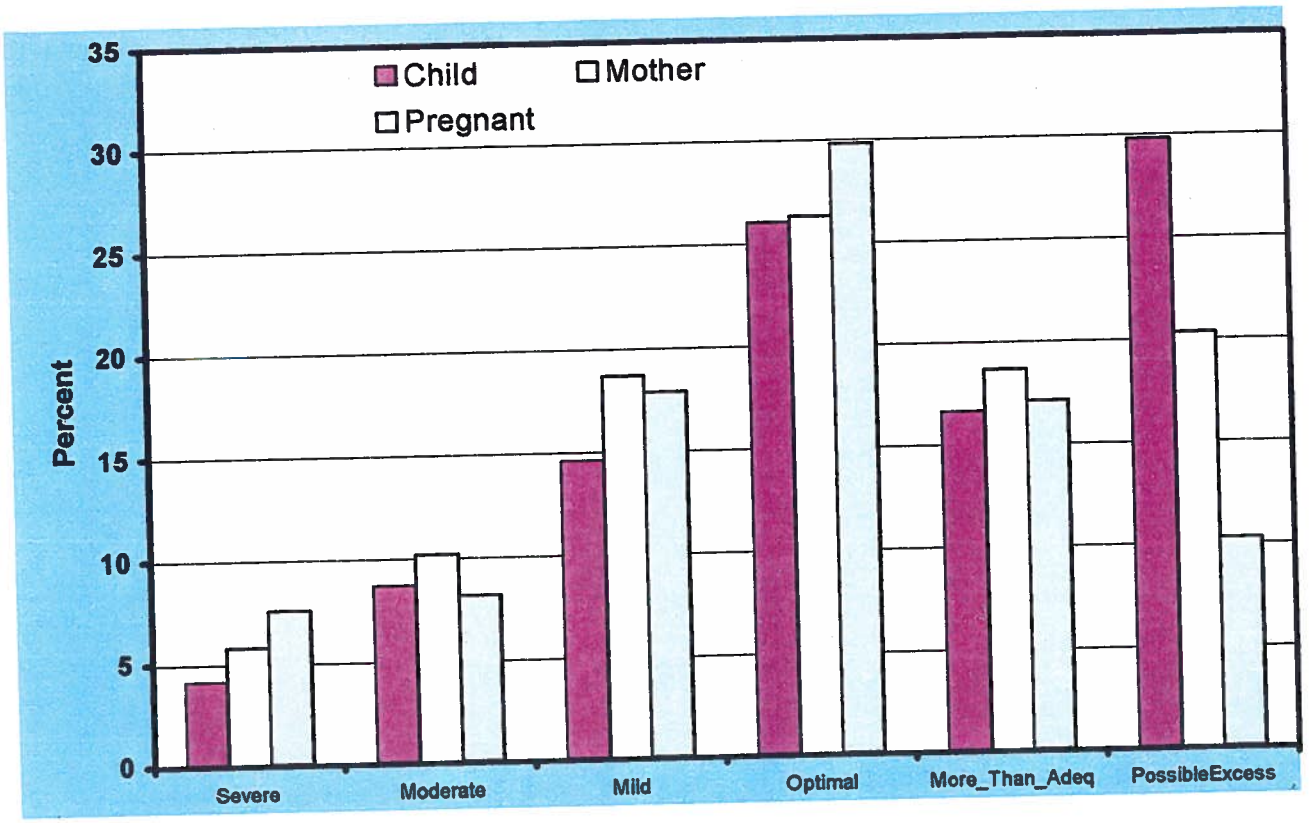


Figure 78. Profile of national iodine status of children, mothers and pregnant women

Furthermore in mothers 34.7% had varying degrees of iodine deficiency, 26% had optimal level while 38.9% had more than adequate intake. Approximately 4.2% suffer from severe deficiency, 8.8% from moderate, and 17.8% from mild deficiency. Among the mothers, 18.3 had more than adequate iodine intake and 22.2% with possible excess and run the risk of adverse health consequences.

Among the sub sample of pregnant women, 29.5% had iodine deficiency, 29.8% had normal or optimal range of iodine intake. 23.4% had possible excess.

The mean and median values for urinary iodine concentration across the agroecological zones are presented in **Table 66.** Children under-5 in the dry savanna had the highest urinary iodine concentration (245.5 µg/L) followed by the humid forest (184.2 µg/L). Children in the moist savanna had the least (163.9 µg/L) median urinary iodine concentration. Mothers and pregnant women in the moist savanna had urinary iodine concentration lower (132.8 and 152.1 µg/L, respectively) than those in the dry savanna (175.4 and 177.8 µg/L, respectively) and humid forest (161.1 and 178.1 µg/L, respectively).

Table 66. Urinary iodine concentration in children under-5, mothers, and pregnant women disaggregated by agroecological zones

Agroecological zone	Group	Number of observations	Median µg/L	Mean µg/L	Std. Err.
Dry savanna	Child	521	245.5	343.2	14.1
	Mother	799	175.4	232.4	7. 7
	Pregnant	175	177.8	217.7	12.7
Moist savanna	Child	1191	163.9	214.9	5.6
	Mother	1421	132.8	170.3	3.8
	Pregnant	299	152.1	193.6	8.8
Humid forest	Child	716	184.2	238.8	7.9
	Mother	884	161.1	209.3	6.2
	Pregnant	186	178.1	229.2	13.6

In the review of iodine nutrition across the agroecological zones **(Figure 79),** the proportion of those with possible excess intake, which may constitute a danger on health hazard, are 44.9%, 35% and 41.3% in the dry savanna, moist savanna and humid forest zones respectively in children under-5. Iodine deficiency among children in the three-agroecological zones is 8.2%, 18.6% and 9.2% in the dry savanna, moist savanna, and humid forest respectively.

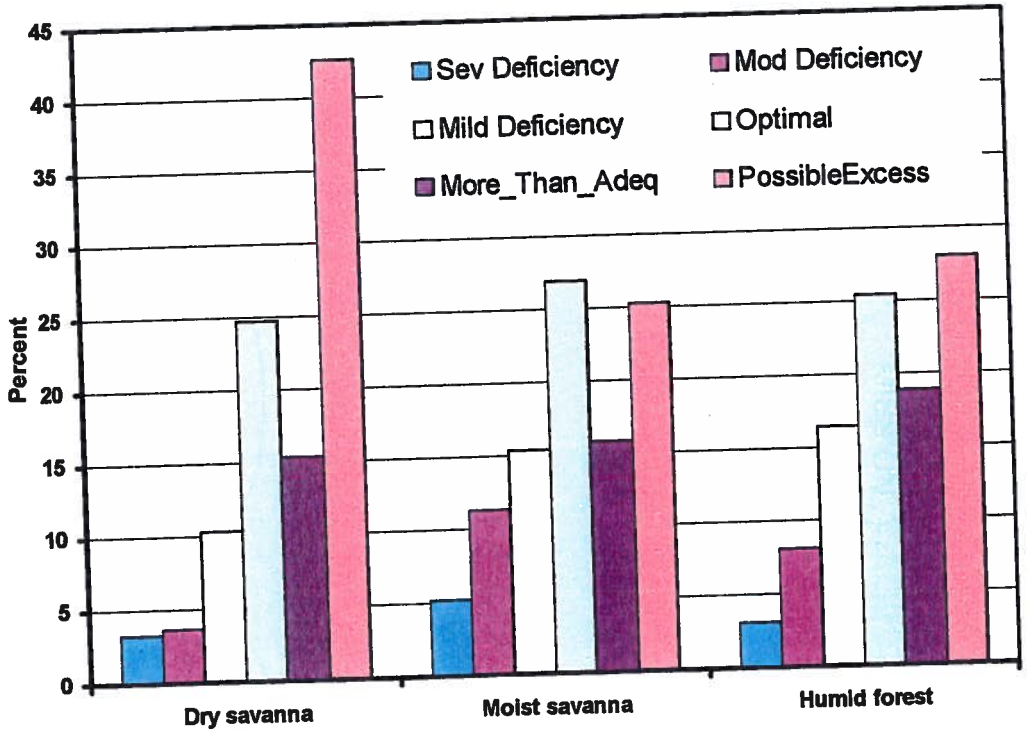


Figure 79. Profile of iodine status of children under-5 by agroecological zone

Iodine deficiency in mothers by agroecological zones is 12.1%, 18.1% and 10.3% in the dry savanna, moist savanna, and humid forest respectively **(Figure 80).** The percentage of those with mild deficiency ranged from 16.2-20.4% across agroecological zones.

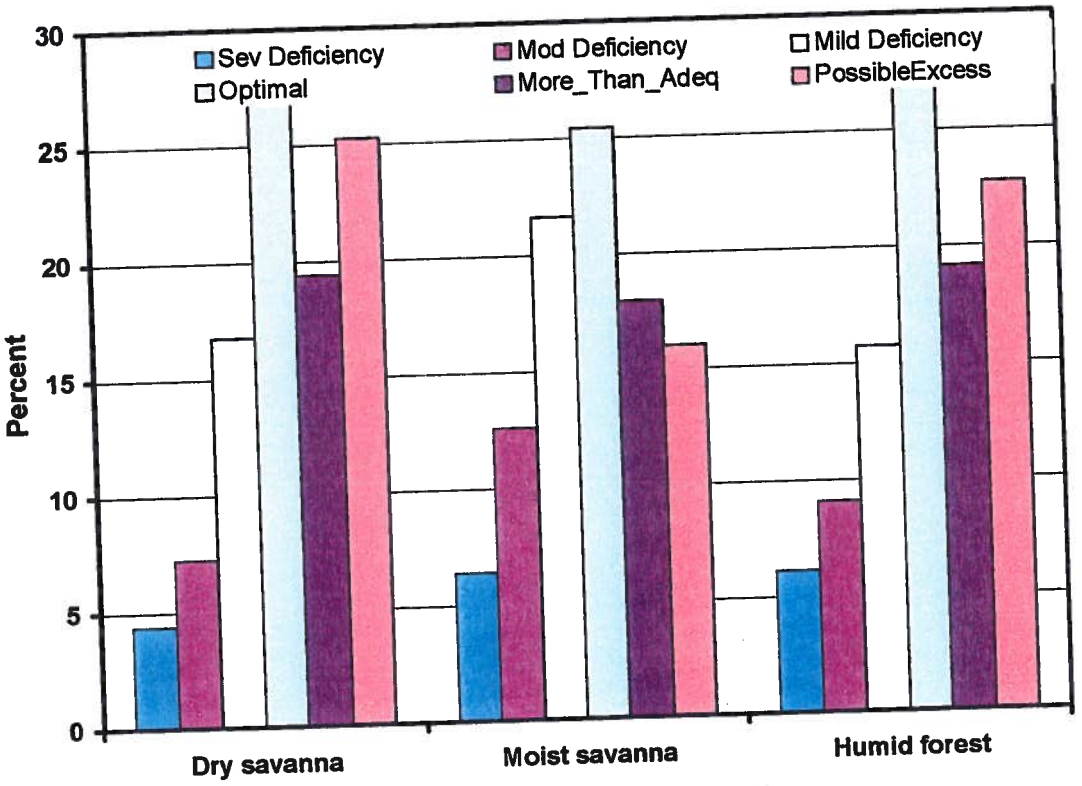


Figure 80. Profile of iodine status of mothers by agroecological zone

In pregnant women deficiency rate are 8.5%, 14.7% and 12.3% for the dry savanna, moist savanna and humid forest respectively **(Figure 81).** Although the deficiency level is low, over a third of pregnant women in all agroecological zones had possible excess iodine intake being 38.2%, 34.7%, and 39.2% in dry savanna, moist savanna and humid forest, respectively. Pregnant women with adequate iodine status were more in the dry savanna (37%) followed by those in the moist savanna and humid forest at 29.8%. Across the sectors, the percentage of pregnant women with adequate iodine nutrition was similar (31-33%).

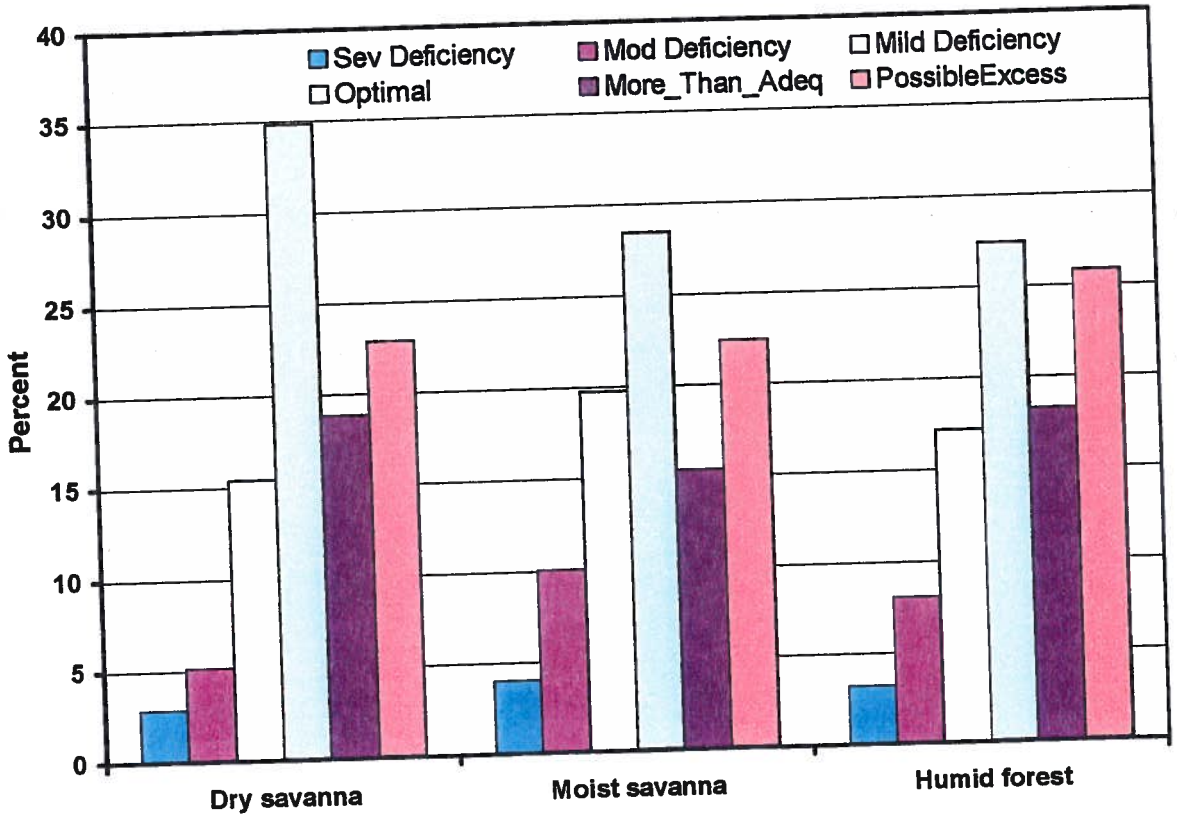


Figure 81. Profile of national iodine status of pregnant women by agroecological zone

The mean and median values for urinary iodine concentration across the sectors are presented in **Table 67.** Children under-5 in the medium sector had the highest urinary iodine concentration (207.5 µg/L) followed by urban (195.5 µg/L) and those in the rural sector had the least (166.9 µg/L) median urinary iodine concentration. Mothers and pregnant women in rural areas had urinary iodine concentration lower than those in urban and medium areas.

Table 67. Urinary iodine concentration in children under-5, mothers, and pregnant women disaggregated by sector

Sector	Group	Number of observations	Median	Mean	Std. Err.
Rural	Child	1126	166.9	229.2	6.9
	Mother	1457	127.4	172.7	4.5
	Pregnant	312	150.2	198.7	9.6
Medium	Child	669	207.5	278.8	10.2
	Mother	839	180.3	219.1	6.2
	Pregnant	171	186.9	221.9	12.3
Urban	Child	633	195.5	254.7	8.4
	Mother	808	178.6	219.4	6.4
	Pregnant	177	170.3	218.3	12.6

The iodine nutrition profile amongst the children, mothers and pregnant women are similar across the three sectors. Deficiency of iodine is reported in 12.7%, 13.2%, and 9.7% of children under-5 in the medium, rural and urban sectors respectively **(Figure 82).** More than adequate and possible excessive intakes of iodine are seen in 51%, 42% and 32.8% of children in the rural, medium and urban sectors respectively.

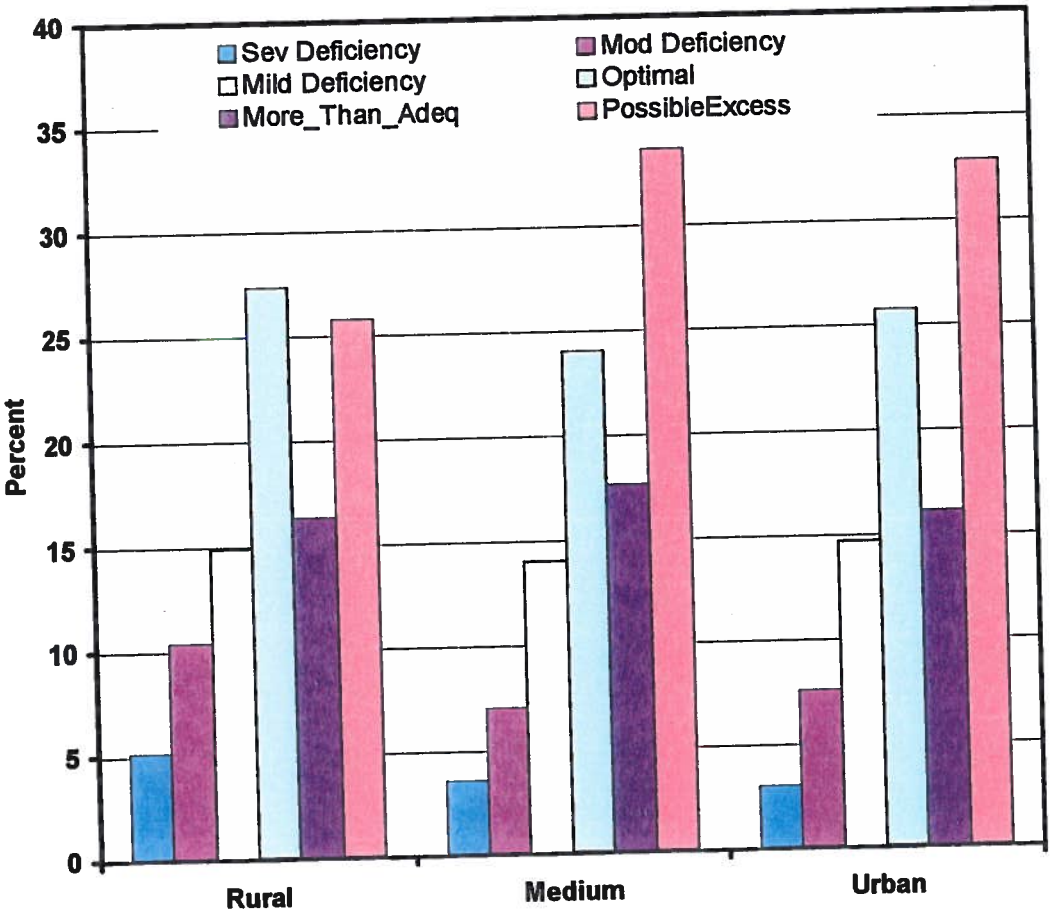


Figure 82. Profile of national iodine status of children under-5 by sector

Iodine deficiencies among mothers are 10.4% in the urban, 12.7% in the medium and 15% in the rural sectors **(Figure 83).** More than adequate intake is seen 19.1% of the mothers in the rural sector, 18.7% of those in the medium sector, and 16.9 in the urban sector. Those with possible excess iodine intake were observed in the rural (18.4%), medium (25.5%) and urban (26.4%) sector.

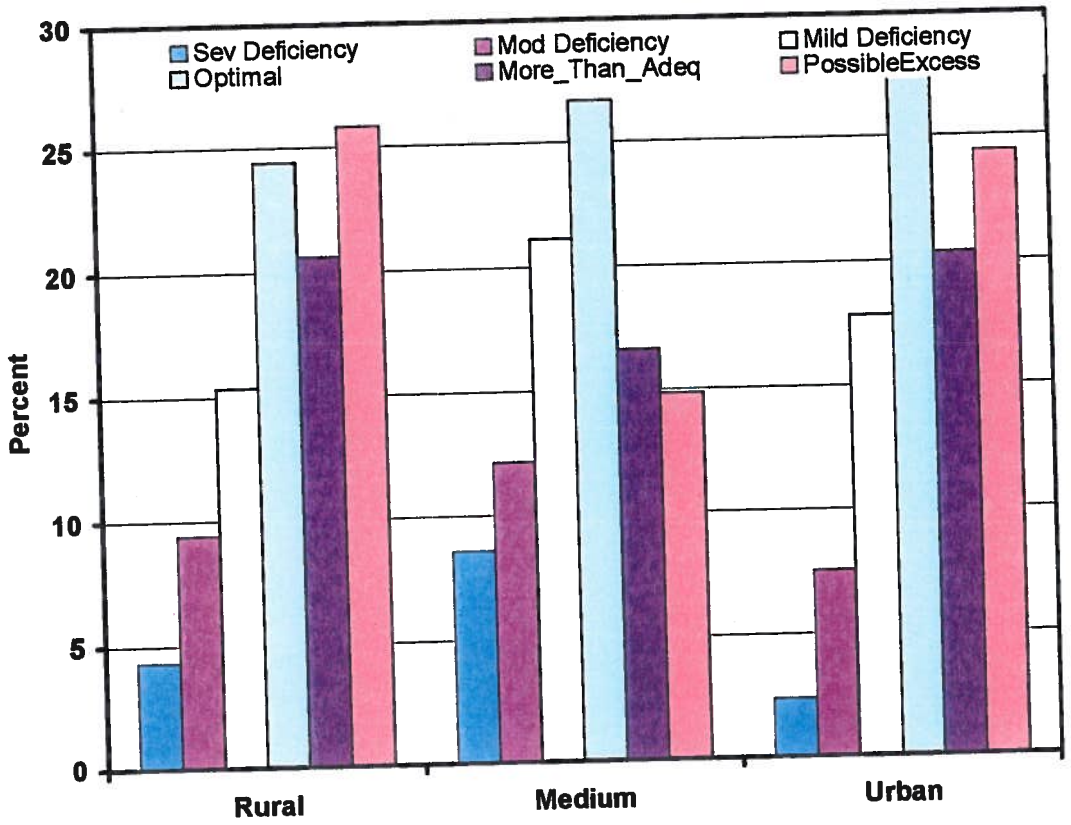


Figure 83. Profile of iodine status of mothers by sector

Among pregnant women, iodine deficiency is reported as 10.7% in the medium, 9.7% in the urban and 14.8% in the rural sectors. Excess intake is equally reported in 37% in the rural, 41% in the urban and 45% in the medium sectors **(Figure 84).**

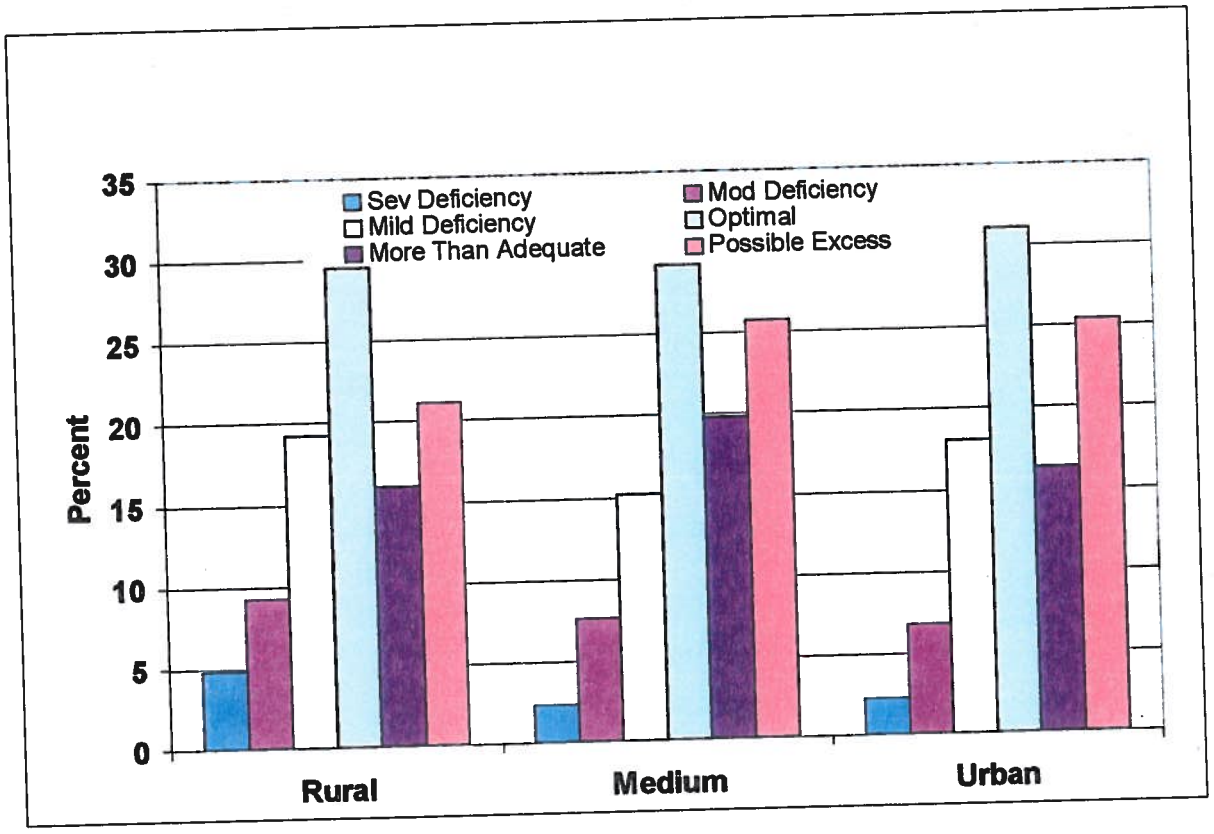


Figure 84. Profile of national iodine status of pregnant women by sector

Information on states for iodine status of children under-5, mothers, and pregnant women is presented in **Appendix 14.**

Summary on iodine status of children under-5, mothers, and pregnant women.

Iodine status of children under-5

- At the national level, 3.7% of children under-5 suffers from severe iodine deficiency and 8.4% are suffering from moderate iodine deficiency. If those who are severely deficient and those who are moderately deficient are merged, 12.1% of children-under 5 is iodine deficient.

- The level of iodine deficiency is high in the moist savanna at 18.6%, followed by the humid forest at 9.2%, and 8.2% in the dry savanna zone. In addition, more children with mild deficiency reside moist savanna (19.3%) than in the humid forest (17.8%) and dry savanna (10.6%).

- The distribution of iodine deficient children under-5 is 13.2% in rural, 12.7% in medium and 9.7% in the urban sector.

- At the national level, 18.9% of children under-5 had more than adequate intake of iodine and 21.9% had possible excess. Those with more than adequate intake ranged from 18 to 19% and those with possible excess intake ranged from 17 to 28% across the agroecological zones.

- At the sector level, the percentage of children under-5 with more than adequate intake ranged from 16 to 20% and those with possible excess intake ranged from 20 to 26% across the sectors.

Iodine status of mothers

- Thirteen percent of mothers are suffering from iodine deficiency nationally.

- At the agroecological zone level, more mothers residing in the moist savanna (18.1%) were iodine deficient followed by those in the dry savanna (12.1%) and humid forest (10.3%).

- Mothers suffering from iodine deficiency were more in the rural (15%) than in the medium (12.7%) and urban (10.4%) sector.

- At the national level, 18.3% of mothers had more than adequate intake of iodine and 22.1% had possible excess. Those with more than adequate intake ranged from 17 to 19% and those with possible excess intake ranged from 16 to 27% across the agroecological zones.

- At the sector level, the percentage of mothers with more than adequate intake ranged from 16 to 19% and those with possible excess intake ranged from 18 to 26% across the sectors.

- Mothers with adequate iodine status were 28.8% at the national level, ranged from 26 to 30% across the sectors.

Iodine status of pregnant women

- At the national level, 12.4% of pregnant women are iodine deficient.

- In disaggregating by agroecological zones, pregnant women in the moist savanna were more iodine deficient (14.7%) followed by those in the humid forest (12.3%) and dry savanna (8.5%).

- Pregnant women suffering from iodine deficiency were more in the rural (14.8%) than in the medium (10.7%) and urban (9.7%) sector.

- At the national level, 18.2% of pregnant women had more than adequate intake of iodine and an equal percentage (18.7%) had possible excess. Those with

more than adequate intake ranged from 16 to 20% and those with possible excess intake ranged from 18 to 19% across the agroecological zones.

- At the sector level, the percentage of pregnant women with more than adequate intake ranged from 16 to 21% and those with possible excess intake ranged from 17 to 20% across the sectors.

- Pregnant women with adequate iodine status were 19% at the national level, ranged from 29 to 37% across agroecological zones and 31-33% across sectors.

CHAPTER 9
HEALTH AND CARE

9.1 Child health

One of the key objectives of the survey was to collect information on the health of mother and her child who is under-5 years old. The health of the child and data on mortality and morbidity constitute an important part of such information. Consequently, mothers of children under-5 were requested to provide information on the illness profile, methods of prevention (including vaccination) and treatment of common diseases of these children.

The health of children was first assessed on whether the child was ill during the last two weeks, preceding the survey day. The observed results show that 57% of all respondent's children were ill during that period. Information on how often the child was sick with different sicknesses during the year was solicited. Results are presented in **Table 68.** Malaria was the most prevalent as it affected 71.3% of the children and a large majority (32.4%) between two to four times in the year. Prevalence of malaria was highest in the humid forest (75.7%) and lowest in the moist savanna (71.7%) and dry savanna (71.2%). Those who suffered malaria 2-4 times within the year were more in the dry savanna (36.3%) followed by those in the humid forest (35.2%) and moist savanna (31.1%). More children in the rural areas (73.9%) were affected by malaria than in the medium (70.6%) and urban (67.5%) sector.

Diarrhea was the second most prevalent (48.7%) among children under-5. Prevalence of diarrhea is much more in the rural (52.5%) than either the medium (49.6%) or urban (42.7%) sectors. It was also higher in the dry savanna than the humid forest and least in the moist savanna (12.7%).

Cough without fever: This question was aimed at soliciting information on upper respiratory tracts infections. This was the third most frequent ailment among the children surveyed (47.5%). This is highest in the rural sector (51.1%), and lower in the medium (44.4%) and urban (45.4%) sectors **(Table 68).**. This condition was higher in the humid forest (51.1%) than in the dry savanna (35.8%) and moist savanna (47.2%).

Measles is easily recognized by mothers but could be confused with other rash-associated febrile illnesses. However, it is a once-a-lifetime infection. This affected about 21.9% of the children; the highest prevalence was among children from the rural (22.7%), and least from the urban (21.5%) and medium (21.3%) areas **(Table 68).** The nutrient-depleting nature of measles predisposes children to severe/clinical malnutrition. The prevalence in the dry savanna (30.1%) is higher than in moist savanna (15.1%) and humid forest (20.2%).

Whooping Cough: The prevalence of whooping cough is understandably low (8.9%) nationally. It is higher in the rural (11.0%) than the urban (6.8%) sector. It is also higher in the dry savanna (11.4%) than in moist savanna (8.1%) and humid forest (7.6%) **(Table 68 and 69).**

Table 68. Malaria, measles, diarrhoea, cough and whooping cough frequencies in children under-5 by national and agroecological zone.

			Agroecological zone		
Disease	**Frequency**	**National**	**Dry savanna**	**Moist savanna**	**Humid forest**
Malaria	0	28.7	28.8	28.4	28.8
	1	24.3	26.7	21.8	24.2
	2-4	32.4	36.3	31.1	35.2
	>4	14.6	8.2	18.8	16.3
Measles	0	78.1	69.9	84.8	79.8
	1	16.4	26.6	10.0	12.9
	2-4	5.3	3.5	5.0	6.9
	>4	0.2	0.0	0.1	0.4
Diarrhea	0	51.2	33.3	52.6	61.5
	1	19.9	25.7	17.1	18.2
	2-4	21.6	31.9	20.3	16.1
	>4	7.2	9.2	10.1	4.3
Cough	0	52.5	64.1	52.9	49.0
	1	23.4	17.1	18.8	24.5
	2-4	19.8	16.8	22.7	22.0
	>4	4.3	1.9	5.7	4.6
Whooping	0	91.1	88.6	91.9	92.4
	1	3.7	7.4	2.7	1.6
	2-4	4.9	3.9	5.4	5.4
	>4	0.3	0.1	0.0	0.6

Table 69. Malaria, measles, diarrhoea, cough and whooping cough frequencies in children under-5 by national and sector.

			Sector		
Disease	**Frequency**	**National**	**Rural**	**Medium**	**Urban**
Malaria	0	28.7	26.1	29.4	32.5
	1	24.3	22.4	25.5	26.0
	2-4	32.4	35.2	30.5	30.3
	>4	14.6	16.3	14.6	11.2
Measles	0	78.1	77.3	78.7	78.5
	1	16.4	15.6	17.3	16.6
	2-4	5.3	6.6	4.0	4.9
	>4	0.2	0.5	0.0	0.0
Diarrhea	0	51.2	61.5	48.6	50.5
	1	19.9	18.2	19.0	21.0
	2-4	21.6	16.1	25.5	20.3
	>4	7.2	4.3	8.0	8.3
Cough	0	52.5	49.0	49.0	55.6
	1	23.4	24.5	24.5	22.0
	2-4	19.8	22.0	22.0	17.7
	>4	4.3	4.6	4.6	4.7
Whooping	0	91.1	92.4	89.0	92.4
	1	3.7	1.6	4.0	3.7
	2-4	4.9	5.4	6.6	3.6
	>4	0.3	0.6	0.4	0.2

Location of treatment

In evaluating childcare practices, the place of treatment of a sick child, which is part of home health practices, is indicative of the quality of care given to the child. A wide range of social, cultural and economic factors influence what choices households make in treating their sick children. Household choices on location of treatment, which may also be indicative of the quality of treatment, may be crucial for the child under five.

The results indicate a high level of active health seeking behaviors by caregivers. The four popular options household caregivers usual adopt include the following in their order of importance: use of Primary Health Care (PHC) facilities (29%), going to chemist shops (21%), traditional healing homes (17.6%), and the use of hospitals (13.5%) **(Table 70).** The PHC facilities and hospitals (mostly) represent the public health service that the government provides.

Table 70. Location of treatment centers by agroecological zone and sector

		Agro ecological zones			Sector		
	National	Dry Savanna	Moist Savanna	Humid Forest	Rural	Medium	Urban
Nowhere	5.9	6.5	5.0	6.2	5.6	6.3	5.9
Chemist Shop	20.7	17.9	13.7	27.2	19.6	20.7	22.9
Primary Health Care	28.6	21.9	38.9	26.9	30.3	31.3	20.7
Traditional Healing Home	17.6	38.9	14.3	3.9	20.9	17.6	11.2
Private Clinic	5.6	0.4	5.9	9.1	4.8	5.7	6.7
Hospital	13.5	9.2	13.4	16.7	9.3	11.8	24.2
Others	0.8	0.2	0.8	1.4	1.1	0.4	1.0
Not Applicable	7.3	4.9	8.0	8.7	8.4	6.2	7.2

While cultural beliefs and practices may explain the use of traditional healing homes (17.6%), the cost considerations among other factors may explain the relatively low use (5.5%) of private clinics.

Across the zones, the most common option in the dry savanna is the traditional healing home (39%), PHC in the moist savanna (39%), the use of Chemist Shop (27.2%) and PHC (27%) in the humid forest. The use of PHC facilities is equally appreciably low in the dry savanna (22%), followed by the use of Chemist shop (18%), and a substantially lower use of hospitals (9.2%) compared to the other zones. About 17% of households in the humid forest zone use hospitals. It is interesting to note that use of traditional healing homes, which was observed to be the most common option in the dry savanna, and appreciably used in the moist savanna was least used in the humid forest zone (4%).

The use of private clinics was as low as 0.4% in the dry savanna, and as high as 9% in the humid forest zone. While the use of Primary Health Care was the most common option in the rural and medium areas, 30.3% and 31.3% respectively, hospitals (24.2%) and PHC facilities were the most common options in the urban areas. The use of chemist shops though consistently high across the sectors was

used most by households in the urban areas (22.9%). Households utilizing private clinics were fairly distributed across the zones.

Malaria prevention methods

The most popular method used in the prevention of malaria is insecticide spray (52%). Across the agroecological zones their use were 44.8%, 67.3%, and 49.9% in the dry savanna, moist savanna, and humid forest respecvtively. Window netting use is few (4%) **(Table 71).** The second most used method are other methods (29%), in which the mosquito coil was more frequently used (66.0%) followed by leaf and Ota Pia-Pia (11.3%). The use of insecticides in the prevention of malaria was 48.3%, 51.8%, and 60.4% in rural, medium, and urban sectors respectively.

Table 71. Malaria prevention methods

Type of prevention method	National	Agro ecological zones			Sector		
		Dry Savanna	Moist Savanna	Humid Forest	Rural	Medium	Urban
Insecticides	52.5	44.8	67.3	49.9	48.3	51.8	60.4
Bed Nets	14.2	18.0	7.4	15.0	14.7	14.8	10.7
Windows/Door Netting	4.1	0.5	3.6	8.1	3.5	3.7	5.7
Others	29.2	36.7	21.6	27.1	32.5	29.7	23.3

Nationally, 14.2% of the respondents use bed nets. In the dry savanna, only 18.0% use bed nets followed by those in the humid forest (15.0%) and moist savanna (7.4%). In the rural sector, 14.7% of the respondents, 14.8% in the medium sector, and 10.7% in the urban sector use bed nets in the prevention of malaria.

Treatment of diarrhea

Oral rehydration solution (ORS) was the most popular (55%) method of treating diarrhea, while homemade salt sugar solution comes a far second (26.8%). The use of ORS is by 64.8% of respondents in the dry savanna, 58.1% in the moist savanna and about 43% in the humid forest. The use of homemade salt solution 17.9%, 22.2%, and 39.0% in the dry savanna, moist savanna, and humid forest respectively. The use of ORS in the sectors was similar, with the highest being 56.7% in urban, 55.9% in medium, and 53.8% in rural areas **(Table 72)**.

Table 72. Treatment of diarrhea

Type of treatment	National	Agroecological zones			Sector		
		Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
ORS	55.2	64.8	58.1	43.0	53.8	55.9	56.7
Home Made Salt Solution	26.8	17.9	22.2	39.0	24.4	29.5	26.8
Others	18.0	17.3	19.7	17.4	21.8	14.6	16.5

It would appear that access (physical and economic) are determinant of the choice of treatment given by mothers to their children to treat/or manage diarrhea. About one fifth of the mothers used other methods notable significant of them being herbs and use of dispensary.

Does the child have a health card?

Nationally, 52.7% of the children had an immunization card while 47.2% did not have a card. Although the possession of a health card was not necessary for participation in the national immunization days (NID's), however, those who do not have health cards were not participating in growth monitoring and promotion programs.

Immunization profile

Nationally only 21% of the children surveyed had all or 'complete' immunization prescribed against vaccine-preventable childhood illnesses (BCG, DPT and Oral Polio, Measles). Thirty-six percent (36%) had 'no immunization' at all, while 43% had 'some' **(Table 73a).**

Among the children who had all the immunization, the highest proportion (32.8%) was in the humid forest, and the lowest (9.6%) in the dry savanna and intermediate (20%) in the moist savanna.

Among those who had no immunization, the higher proportion (64%) was from the dry savanna and lowest (10.7%) from the humid forest. The full benefits of childhood immunization is best achieved when all prescribed immunization are given to the child.

The percentage of children who had all immunizations was lowest (18%) in the rural and highest (28%) in the urban sector. Conversely 'no immunization' was highest

(38%) in the rural and lowest (24%) in the urban sectors. Does educational level of mother affect the immunization status of the child? The answer is not clear-cut.

Table 73a. Profile of immunization of children under-5 by national, agroecological zone, and sector.

Category	All immunizations	No immunization	Some immunizations
National	21.07	35.97	42.97
Agroecological zones			
Dry savanna	9.6	64.0	26.0
Moist savanna	20.0	35.0	44.6
Humid forest	32.8	10.7	56.0
Sector			
Rural	18.0	38.0	43.0
Medium	23.0	34.0	42.0
Urban	28.0	24.0	46.0

The proportion of those who had all immunization increased with mother's education, 11.7% in mothers with no formal education, and 24% in mothers with primary school (not completed), 32.6% in primary completed, 40% in secondary school completed and 45% in children of mothers with post secondary education (**Table 73b**). There is a gradual increase in the percentage of children under-5 with all immunizations as the age of the mother increases.

Table 73b. Profile of immunization of children under-5 by education and age

Category	All immunizations	No immunization	Some immunizations
Education of mother			
No education	11.7	51.9	36.5
Primary (not completed	24.2	25.5	50.2
Primary (completed)	32.6	17.2	50.2
Secondary school (not completed)	30.4	14.4	55.2
Secondary school	40.4	10.5	49.1
Post secondary	45.0	2.7	52.3
Informal	6.0	81.3	12.7
Age of mother			
15-19	6.8	53.6	39.6
20-24	17.3	42.6	40.1
25-29	22.2	36.2	41.6
30-34	24.8	35.4	39.8
35-39	25.4	33.2	41.4
40-44	29.1	31.8	39.1
44-49	29.7	25.3	45.1

9.2 Infant feeding practices

As an important part of infant feeding, breastfeeding has always been promoted because of its demonstrated advantages for practically all infants. Apart from its nutritional value, it possesses anti-infectious properties, psychological and emotional advantages as well as economic advantages especially for under-privileged families.

Consequently, mother's decision to breastfeed, its time of initiation, duration and intensity has been shown to affect the overall health and indeed survival of the infant. In Nigeria, the desire to breastfeed has never been a problem, the problem has always been the duration and whether it was exclusive or not.

Awareness of exclusive breastfeeding in nursing mothers

Most nursing mothers (55%) are not aware of exclusive breastfeeding (EBF) and only 45% are aware **(Table 74).** This pattern is upheld in the dry savanna zone. There are more who are aware in the humid forest (62%) and moist savanna (58%).

There seem to be about equal awareness and no awareness in the rural sector, but more awareness in the medium and urban sectors.

Table 74. Awareness of exclusive breastfeeding in nursing mothers

		Agroecological zone			Sector		
	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
Yes	55.0	42.6	58.4	62.2	48.1	57.5	64.0
No	45.0	57.4	41.6	37.8	51.9	42.5	36.0

Introduction of food or water

Other foods/water were introduced in the first month in 73.2% of subjects. The practice of exclusive breastfeeding is low in parallel with the high non-awareness **(Table 75).** About 15% can be considered to have practiced EBF nationally for 6 months. Majority in all the agroecological zones introduced other foods in the first month, and about 20% waited until 3-6 months to introduce other food or water with breastfeeding in the moist savanna and humid forest.

Table 75. Introduction of Foods/Water

Period	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
0 Month	73.2	92.8	67.3	62.1	73.8	73.7	71.3
Less than 3 months	11.9	4.3	12.7	17.3	12.2	12.4	10.8
3-6 Months	14.8	2.9	20.0	20.5	13.9	13.9	19.9

For how long was the last child exclusively breastfeed?

The prevalence of those who did not exclusively breastfeed is similar with previous record. The percentage range for those who did not exclusively breastfeed is 58-90 in the agroecological zones and nationally it is 69.6%. Those who exclusively breastfed for 4-6 months were 7.9-24.7% in the different agroecological zones and 19.4% nationally **(Table 76).** There were higher in the rural (70.8%) and medium sectors (69.4%) and lower (67.9%) in the urban sector.

Table 76. For how long was last child exclusively breastfed

		Agroecological zone			Sector		
Period	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
Not exclusively breastfed	69.6	89.9	63.5	58.2	70.8	69.4	67.9
1-3 Months	11.0	2.2	11.7	17.2	12.3	10.3	20.4
4-6 Months	19.4	7.9	24.8	24.7	16.9	9.5	22.6

Knowledge/Awareness of Growth monitoring

On a national basis, more mothers (58.6%) are not aware of growth monitoring while (41.3%) are the reverse in the case of moist savanna and humid forest. From those who are aware only 20.4% practiced it. More mothers were not aware of growth monitoring in the dry savanna (68.9%) followed by the humid forest (55.9%) and moist savanna (50.8%). The percentage of those who practiced growth monitoring ranged from 6.8% in the dry savanna to 27.3% in the humid forest **(Table 77)**.

Table 77. Awareness and practice of growth monitoring

		Agroecological zone			Sector		
	National	Dry savanna	Moist savanna	Humid forest	Rural	Medium	Urban
Aware							
Yes	41.4	31.1	49.2	44.1	32.8	45.0	51.8
No	58.6	68.9	50.8	55.9	67.2	55.0	48.2
Practiced							
Yes	20.4	6.8	25.5	27.3	16.6	20.4	27.5
No	79.6	93.2	74.5	72.7	83.4	79.6	72.5

Mothers in the urban sector were more aware of growth monitoring (51.8%) and also practiced it (27.5%). Those in rural areas were the least aware (32.8%) and also practiced it the least (16.6%).

Summary of child health

- Malaria was the most prevalent as it affected 71.3% of the children and a large majority (32.4%) between two to four times in the year. Prevalence of malaria was highest in the humid forest (75.7%) and lowest in the moist savanna (71.7%) and dry savanna (71.2%).

- Those who suffered malaria 2-4 times within the year were more in the dry savanna (36.3%) followed by those in the humid forest (35.2%) and moist savanna (31.1%). More children in the rural areas (73.9%) were affected by malaria than in the medium (70.6%) and urban (67.5%) sector.

- Prevalence of diarrhea is much more in the rural (52.5%) than either the medium (49.6%) or urban (42.7%) sectors. It was also higher in the dry savanna than the humid forest and least in the moist savanna (12.7%).

- The four popular options household caregivers usual adopt include the following in their order of importance: use of Primary Health Care (PHC) facilities (29%), going to chemist shops (21%), traditional healing homes (17.6%), and the use of hospitals (13.5%).

- Across the zones, the most common option in the dry savanna is the traditional healing home (39%), PHC in the moist savanna (39%), the use of Chemist Shop (27.2%) and PHC (27%) in the humid forest. The use of PHC facilities is equally appreciably low in the dry savanna (22%), followed by the use of Chemist shop (18%), and a substantially lower use of hospitals (9.2%) compared to the other zones.

- The most popular method used in the prevention of malaria is insecticide spray (52%). Across the agroecological zones their use were 44.8%, 67.3%, and 49.9% in the dry savanna, moist savanna, and humid forest respecvtively. Only 4% use window netting. The use of insecticides in the prevention of malaria was 48.3%, 51.8%, and 60.4% in rural, medium, and urban sectors respectively.

- Nationally, 14.2% of the respondents use bed nets. In the dry savanna, only 18.0% use bed nets followed by those in the humid forest (15.0%) and moist savanna (7.4%). In the rural sector, 14.7% of the respondents, 14.8% in the medium sector, and 10.7% in the urban sector use bed nets in the prevention of malaria.

- Oral rehydration solution (ORS) was the most popular (55%) method of treating diarrhea, while homemade salt sugar solution comes a far second (26.8%). The use of ORS is by 64.8% of respondents in the dry savanna, 58.1% in the moist savanna and about 43% in the humid forest.

- Nationally only 21% of the children surveyed had all or 'complete' immunization prescribed against vaccine-preventable childhood illnesses (BCG, DPT and Oral Polio, Measles). Thirty-six percent (36%) had 'no immunization' at all, while 43% had 'some'.

- The proportion of those who had all immunization increased with mother's education, 11.7% in mothers with no formal education, and 24% in mothers with primary school (not completed), 32.6% in primary completed, 40% in secondary school completed and 45% in children of mothers with post secondary education.

- About 15% can be considered to have practiced EBF nationally for 6 months. Majority in all the agroecological zones introduced other foods in the first month, and about 20% waited until 3-6 months to introduce other food or water with breastfeeding in the moist savanna and humid forest.

9.3 Care for women

9.3.1 Empowerment

The issue of women empowerment is recognized as an important one, and indeed as a key factor in care for women. Analysis of responses to key issues on women empowerment is presented in **Table 78.** In majority (70–80%) of cases, women will always discuss issues with their husbands especially when it relates to their own (71%) or their children (83%) health. Between 3.3– 4.4% of the respondents indicated that they would never discuss such issues with their husbands.

Table 78. Status of women empowerment

Level	Discuss with their husband when sick			Discuss with their husband when children are sick		
	Never	Sometime	Always	Never	Sometime	Always
National	4.4	23.9	71.2	3.3	13.0	83.3
Agroecological zone						
Dry savanna	6.8	26.9	72.1	1.0	11.5	87.8
Moist savanna	2.7	17.6	79.8	6.9	9.7	89.4
Humid forest	8.4	25.6	64.9	6.8	16.3	75.8
Sector						
Rural	4.9	24.5	70.1	3.6	13.7	82.2
Medium	4.5	21.9	73.0	3.3	11.9	84.2
Urban	3.4	25.8	70.5	2.5	13.5	83.8

More women in the moist savanna (79.8%) discuss with their husbands when they or their children (89.4%) are sick when compared to those in the humid forest (64.9% and 75.8% respectively). The percentage was similar at the sector level ranging from 70.1 to 84.2%.

When it comes to decision making however, just over half (50.4%) of respondents at the national level indicated that their husbands may reconsider his position or accepts hers in the event of a disagreement, for example, override her opinion. The percentage of those who indicated that their husband would reconsider his position or accepts her opinion was high in the dry savanna (61.2%) followed by moist savanna (48.9%) and humid forest (38.5%). For the sector, the percentage was not very different at 49.4%, 50.8%, and 52.0% in the rural, medium, and urban respectively.

In the humid forest, almost half (49.5%) of respondents say their husbands will override their views in the event of disagreement. The corresponding figures for dry and moist savannas are 33.9% and 41.3% respectively **(Table 78).**

Table 78. Women empowerment (continued)

Level	Husband's decision when there is a disagreement				Number of rest per week (%)			
	N/A	Reconsider his position	Takes my opinion	Overrides	Never	Once a week	Twice a week	More than twice a week
National	6.8	29.3	21.1	42.3	16.3	26.8	24.7	31.9
Agroecological zone								
Dry savanna	4.8	38.4	22.8	33.9	19.9	26.7	23.2	30.2
Moist savanna	2.8	21.1	27.8	41.3	10.0	28.1	27.3	34.5
Humid forest	10.9	23.1	15.4	49.5	17.6	26.1	24.3	31.5
Sector								
Rural	7.3	31.3	18.1	42.9	18.9	27.9	25.5	27.8
Medium	6.7	26.2	24.6	42.0	15.8	26.4	24.3	33.3
Urban	6.2	30.7	21.3	41.6	13.3	25.4	23.9	37.4

In providing care for women through empowerment, it is vital that women's overall workload allows enough time for rest. While 16.3% of respondent nationwide say their workload allows no time whatsoever for rest, twice as many (31.9%) say they have time more than twice in a week to rest **(Table 78).** Overall more than half (51.5%) has time to rest once or twice per week. However there were interesting zonal variations in these variables.

The workload for women seems to be heavier in dry savanna and humid forest compared to moist savanna. About 20% of women respondents in the dry savanna (19.9%) and humid forest (17.5%) indicated that their workloads never allow any time to rest. The corresponding figure in the moist savanna was 10%. Women in the moist savanna rest more than twice a week (34.5) when compared to those in the dry savanna (30.2%).

9.3.2 Reproductive rights

This section on reproductive rights was designed to explore the contributions women have on their own reproduction. This was explored in the awareness of child spacing, discussing with husband about issues of planned parenthood and the type of support they enjoyed during pregnancy. Awareness of child spacing is higher in the humid forest (76%) than in the moist savanna (63%) or the dry savanna (48%) **(Table 79)**. Discussing child spacing with spouses suggest a right to determine when to and when not to employ child spacing techniques. Discussing with spouses was highest in the humid forest (50%) than the moist savanna (33%) and least in the dry savanna (7%). There is a parallel between awareness and discussing the issue.

In the sectors, awareness of child spacing was higher in the urban (73%) than the medium (64%) and the rural (59%) sectors. Discussing child spacing was higher in the urban (38%) than rural (30.5%) and (29%) in the medium sectors.

Access to antenatal care and its utilization was higher in the humid forest (76%) and urban (75%), than in the moist savanna (69%) and medium (64%), dry savanna (39%) and rural (55%). This is a measure of safe motherhood initiatives being encouraged in the country.

The measure of support for women while pregnant was explored not only by the degree of antenatal care but also through increased financial support. Those who indicated increased financial support were 53% in the moist savanna and 34% in the humid forest. The proportion of women without financial support was similar in the three sectors.

Responses as to whether or not household chores were reduced during pregnancy were almost 50% in all the agro-ecological zones and the sectors. This is consistent with the notion that physical labour continues even in pregnancy in African women.

More than half of the women confirmed increased food share during pregnancy: 53% in the dry savanna, 52% in the moist savanna and 62% in the humid forest. Similar pattern is found in the three sectors.

Table 79. Women's reproductive rights

	Percentage Distribution															
	Awareness child Spacing		Discussing child spacing with husband.		Type of support enjoyed during pregnancy											
					Antenatal care		Increased financial Support		Reduced HH chores		Improved food share		Others		None	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
National	64.3	35.7	31.8	68.2	62.8	37.2	48.9	51.1	49.5	50.5	56.5	43.6	4.1	95.9	10.8	89.2
Agro ecological zones																
Dry Savanna	48.3	51.7	7.2	92.8	39.3	60.7	28.7	71.3	41.1	58.9	52.9	47.1	3.7	96.3	18.8	81.2
Moist Savanna	62.9	37.0	32.7	67.3	69.3	30.7	46.6	53.4	47.6	52.4	51.5	48.5	4.4	95.6	9.8	90.2
Humid Forest	76.1	22.4	50.2	49.8	76.3	23.7	65.6	34.4	57.1	42.9	62.3	37.7	4.2	95.8	5.6	94.4
Sector																
Rural	59.2	40.0	30.5	69.5	55.4	44.6	44.1	55.9	47.8	52.2	53.3	46.8	3.4	96.6	12.3	87.7
Medium	63.8	35.6	29.5	70.5	64.3	35.7	48.1	51.9	47.2	52.7	55.4	44.6	4.1	95.9	11.5	88.5
Urban	72.9	26.5	38.2	61.8	74.6	25.4	59.5	40.5	56.6	43.4	64.3	35.7	5.5	94.5	6.7	93.3

9.3.3 Economic Rights

The economic rights of the mother are recognized as one of the most important in the overall empowerment of women. Taken together with food share within the household, these should provide an eloquent indication of the level of care received by the women.

When asked if women were allowed to participate in income generating activities, almost 90% in the humid forest were allowed by their husbands to participate in income generating activities. On the contrary, **(Table 80)** almost 40% of respondents in the dry savanna said they were not allowed. Differences in response to this question were not so different across rural (78.6%), medium (74%) and urban (75.7%) sectors.

Most mothers 69% in humid forest recognized the existence of a family tradition on food sharing. Forty nine percent of mothers in the dry savanna acknowledged such tradition in the family, while less than one third (26.8%) in moist savanna said they have no such tradition. Absolutely all (100%) of women that said they have such a tradition responded that the tradition restricts their food choice **(Table 80).**

These responses are related to the responses on who takes the least share when food is not enough. Between 70% (in humid forest) and 80% (in dry savanna) of women said they take the least share. In all the zones and sectors, husbands are the next members of the family to take the least share. The proportion of husband **(Table 80)** that will take the least share is higher in the urban areas (19%) than in medium (16.1% and rural (14%) areas.

Nationally, 51% of women indicated that their food share improved during pregnancy. During pregnancy **(Table 80)** however approximately 50% of respondents in dry savanna (45.5%), moist savanna (52.3%) and humid forest (53.4%) said their food share within the family is increased.

The most common occupation among those that engage in income generating activities is trading 26.9% followed by housewife at 16.1% and farmer at 12.8%. The percentages for food vendor, tailor and civil servants are 3.95%, 3.77% and 1.95% respectively **(Table 81).**

Table 80. Women's economic rights/food sharing

	Percentage Distribution											
	Income generating activity (1)		Food sharing activity (3)		Tradition restrict choice (4)		Least share of food (5)				Share improved during pregnancy (6)	
	Yes	No	Yes	No	Yes	No	Wife	Girl	Boy	Hus.	Yes	No
National	76.3	23.7	35.4	64. 6	100	0	74.9	1.8	1.8	15.8	50.7	49.3
Agroecological zone												
Dry Savanna	61.1	38.9	48.7	51.3	100	0	79.1	0.7	0.6	17.2	45.5	54.5
Moist Savanna	77.2	22.8	26.9	73.1	100	0	77.9	1.3	2.7	15.4	52.2	47.8
Humid Forest	87.4	12.6	69.1	30.9	100	0	69.9	2.9	2.1	15.2	53.5	46.6
Sector												
Rural	78.6	21.3	38.6	61.4	100	0	75.6	2.1	2.3	14.1	50.3	49.7
Medium	74.0	26.0	30.9	69.2	100	0	75.9	1.5	1.3	16.1	49. 9	50.1
Urban	75.7	24.3	36.8	63.9	100	0	72.2	1.8	1.6	19.0	52.6	47.4

Table 81. Women's economic rights/food sharing (occupation).

Occupation	Percentage	Occupation	Percentage
Akara seller	0.8	Hairdresser	1.4
Business	1.7	House wife	16.1
Civil servant	1.9	Trader	35.8
Farmer	12.8	Tailor	3.8
Fashion designer	0.7	Teacher	1.0
Food vendor	3.9		
Gari making	0.3		

Perception on education

Community perception of women education is presented in **Table 82.** Seventy-three percent of the respondents said that women education is encouraged while only 26% said it is discouraged with less than 1% (0.65%) saying it was tabooed. Disaggregating by agroecological zone revealed that encouragement of women education is greater in the humid forest (94.6%), than in the moist savanna (68.3%) and dry savanna (49.3%). In the dry savanna, 49.7% discourage women education followed by the moist savanna 29.9% and humid forest 5.1%. Those who encouraged women education were 81.7% in urban, 74.7% in medium, and 67.6% in rural sector. More women discouraged women education in the rural sector followed by those in the medium and urban sector **(Table 82).**

Responses collected on most preferred person to go to school when resources are scarce are also presented in **Table 82.** Forty percent preferred the boy/girl jointly while 12.2% will send the most intelligent person to school irrespective of whether they are boys or girls. Preference for both boys and girls was highest in the humid forest zone (48.7%) than the moist savanna (46.5%) and the dry savanna (22.9%) and the same pattern was re-enacted across the agro ecological zone for those that will send the most intelligent person to school with the humid forest having the highest of 21.1%. More people in the humid forest (45.1%) preferred the boy/girl option, whereas the intelligent person option was lowest in the medium sector (9.2%)

Table 82. Perception on women education

Education	Percentage Distribution										
	Community view on women education					Most preferred person for education when sources are limited					
	Encou -raged	Discour-aged	Tabooed	Others	Girls	Boys	Mother	Father	Boy/Girl	Most Intelligent	Others
National	73.3	25.8	0.7	0.3	3.7	40.0	0.2	0.3	39.9	12.2	4.8
Agro ecological zones											
Dry Savanna	49.3	49.7	0.6	0.4	1.7	64.7	0.2	0.3	22.9	5.6	4.5
Moist Savanna	68.3	29.9	1.6	0.2	4.4	38.5	0.4	0.3	46.5	6.1	3.8
Humid Forest	94.6	5.1	0.1	0.3	4.8	19.5	0.1	0.3	48.7	21.1	5.5
Sector											
Rural	67.6	31.0	1.0	0.4	3.2	44.1	0.3	0.5	33.9	13.5	4.6
Medium	74.7	24.6	0.4	0.3	4.4	38.3	0.2	0.1	43.7	9.2	4.1
Urban	81.7	17.9	0.3	3.6	3.6	30.3	0.1	0.3	45.1	14.6	6.1

9.4 Food Preservation

As part of the assessment of hygiene practices in the households surveyed, mothers of children under-5 were asked how they preserved foods that are cooked or/and left over and not consumed. The vast majority (67%) of respondents **(Table 83)** nationwide cover the food but keep it in the open. About 13% keep the food in the cupboard. Approximately the same percentage of respondents (11.1%) keeps the left over food warm. Only 4% of respondents preserve the food in a refrigerator. Significantly however, over 3% of women keep their food uncovered in the open.

Eighty percent in the dry savanna, 74% in moist savanna, and 52.7% in the humid forest cover and leave their food in the open. Only 12.8% of women in the urban sector store their cooked or leftover food in the fridge **(Table 83).**

The educational level of mothers has been cross tabulated with the food preservation methods **(Table 83)** they employ. The data show that the proportion of women using the more primitive food preservation methods (e.g. in the open, covered or not) decreases with increasing educational level. The percentage of respondents with informal education who keep their food in the open (with no cover) was 12.3%. This percentage is only 1% in those that went to secondary school while no respondent with post secondary education uses this food preservation method.

Conversely while only 1% of respondents with informal or no education use refrigerator to keep food, over one-quarter (26.2%) of those with post secondary education use refrigerators

Table 83. Food preservation methods by national, agroecological zone, and sector

	Open	Open cover	Cupboard	Keep warm	Fridge	Others
National	3.0	67.0	12.8	11.1	4.3	1.9
Agroecological zone						
Dry savanna	6.7	80.0	1.6	7.2	2.1	2.4
Moist savanna	1.5	73.9	4.6	14.1	4.3	1.5
Humid forest	1.2	52.7	26.4	12.2	5.9	1.7
Sector						
Rural	3.8	70.6	13.2	9.7	1.5	1.1
Medium	2.9	68.3	10.6	12.8	2.3	3.1
Urban	1.6	57.7	15.5	11.1	12.8	1.3

Table 83. Food preservation methods (Continued)

Education level	Open	Open cover	Cupboard	Keep warm	Fridge	Others
No education	37.9	37.3	44.9	15.5	25.5	9.3
Primary (not completed	7.9	2.7	8.3	10.0	7.1	3.4
Primary (completed)	18.6	9.2	16.3	29.1	26.9	15.2
Secondary school (not completed)	9.5	2.2	7.2	19.5	13.9	15.2
Secondary school (completed)	11.8	3.8	8.0	21.6	18.5	37.9
Post secondary	2.6	0.0	1.5	3.1	5.1	16.5
Informal	11.6	44.9	13.9	1.2	2.9	2.5
Age group						
15-19	3.2	77.1	7.6	8.6	1.4	2.1
20-24	3.4	71.7	10.3	9.7	3.5	1.3
25-29	4.1	67.9	10.8	10.5	4.9	1.8
30-34	2.9	67.6	11.9	10.5	5.1	1.9
35-39	2.5	65.3	14.9	10.9	3.8	2.5
40-44	1.2	68.2	13.8	10.4	3.7	2.7
44-49	4.4	63.9	11.7	13.3	4.4	2.2
>49	1.6	63.4	20.2	9.8	3.8	1.1

Hygiene spot checks (Discreet observations by interviewers)

practice of hygiene is an important index of maternal and child health and care. The tice of hygiene in the households studied was evaluated by the discreet observation of the ondent's environment by the interviewers. Indices considered include whether or not open age was found in the house, the presence of unwashed cooking or eating utensils in the se, if the container for drinking water was covered or not, and if the child or its caregiver untidy or not. Others include whether or not the inside of the house was swept, presence nimal droppings and stagnant water around the house.

r 40% of all the households surveyed did not sweep their houses during the period of the view. Animal droppings were found in 35% of households, with about one third of seholds having untidy children and caregivers. Over 26% of the households used open age, had unwashed utensils, and stagnant water around their houses. In the ecological zones, the dry savanna consistently had the highest proportions of households the observed unhygienic behaviors and practices **(Table 84)**

same pattern was observed across the sectors with the rural sector consistently having highest proportions of households with the observed unhygienic behaviors and practices. pattern of the unhygienic practices and behaviors observed as influenced by education is h that households whose household head had no education had a disproportionately high centage compared with other household heads in the literate categories that practiced poor sehold and environmental hygiene.

mary of care for women

A majority (70–80%) of cases, women will always discuss issues with their husbands especially when it relates to their own (71%) or their children (83%) health. Between 3.3– 4.4% of the respondents indicated that they would never discuss such issues with their husbands.

When it comes to decision making however, just over half (50.4%) of respondents at the national level indicated that their husbands may reconsider his position or accepts hers in the event of a disagreement, for example, override her opinion.

The percentage of those who indicated that their husband would reconsider his position or accepts her opinion was high in the dry savanna (61.2%) followed by moist savanna (48.9%) and humid forest (38.5%). For the sector, the percentage was not very different at 49.4%, 50.8%, and 52.0% in the rural, medium, and urban respectively.

The workload for women seems to be heavier in dry savanna and humid forest compared to moist savanna. About 20% of women respondents in the dry savanna (19.9%) and humid forest (17.5%) indicated that their workloads never allow any time to rest. The corresponding figure in the moist savanna was 10%.

Awareness of child spacing is higher in the humid forest (76%) than in the moist savanna (63%) or the dry savanna (48%). Discussing with spouses was highest in the humid forest (50%) than the moist savanna (33%) and least in the dry savanna (7%). There is a parallel between awareness and discussing the issue.

Access to antenatal care and its utilization was higher in the humid forest (76%) and urban (75%), than in the moist savanna (69%) and medium (64%), dry savanna (39%) and rural (55%).

When asked if women were allowed to participate in income generating activities, almost 90% in the humid forest were allowed by their husbands to participate in income generating activities. On the contrary, almost 40% of respondents in the dry savanna said they were not allowed. Differences in response to this question were not so different across rural (78.6%), medium (74%) and urban (75.7%) sectors.

Nationally, 51% of women indicated that their food share improved during pregnancy. In the agroecological zones, approximately 50% of respondents in dry savanna (45.5%), moist savanna (52.3%) and humid forest (53.4%) said their food share within the family is increased during pregnancy.

Seventy-three percent of the respondents said that women education is encouraged while only 26% said it is discouraged with less than 1% saying it was tabooed.

Disaggregating by agroecological zone revealed that encouragement of women education is greater in the humid forest (94.6%), than in the moist savanna (68.3%) and dry savanna (49.3%).

Responses collected on the most preferred person to go to school when resources are scarce indicates that 40% preferred the boy/girl jointly while 12.2% will send the most intelligent person to school irrespective of whether they are boys or girls.

A majority (67%) of the respondents nationwide cover the food but keep it in the open. About 13% keep the food in the cupboard. Approximately the same percentage of respondents (11.1%) keeps the left over food warm. Only 4% of respondents preserve the food in a refrigerator. Significantly however, over 3% of women keep their food uncovered in the open.

CHAPTER 10:
ASSOCIATIONS AND DISCUSSION

10.1 Nutritional status of children under-5

Results from the present survey show high prevalence of malnutrition among under-five children. The data show that 42% are stunted, 9% wasted and 25% underweight. The latest National Demographic and Health Survey (NDHS, 1999) for under-three recorded 45% for stunting, 12.5% for wasting and 27.3% for underweight.

Another survey (MICS, 1999) of under-three children in Nigeria also recorded very high prevalence of malnutrition among this age group. Prevalence figures were 34% stunted, 16% wasted and 31% underweight. W hile t he d ata f rom t he t hree s urveys show fairly similar pattern, MICS (1999) and NDHS (1999) surveys are not truly comparable with the present Survey.

Firstly, assessment of nutritional status of children was peripheral to these two earlier Surveys, which had strictly health and demographic foci. Secondly, these other surveys addressed only under-three children. The sample size in the present survey was also superior to those in t he o ther s urveys. I ndeed, t he M IC s urvey w as c onducted i n a section (focus of states) of the country.

The earlier NDHS (1990) report though somewhat old provide a possible source of data that could be compared with the present survey. In that survey, the prevalence of stunting was 31 %, wasting 11 % and underweight 35%. If this 1990 data were considered as baseline data, it may then be possible to pronounce on the true trend in the prevalence of these degrees of malnutrition among this age group. However, subject to the limitations of the NDHS data (1990) a trend in the nutritional status of under-five children could be perceived. Namely, that there is an increase in stunting from 31% in 1990 to 42% in 2001 while the prevalence of the other two have decreased; wasting from 11% to 9% and underweight from 35 to 25% over the same period. These figures indicate that over the decade 1990 – 2000 there has been a 39% increase in stunting, 18% reduction in wasting and 29% reduction in underweight. These figures are far from World Summit on Children (WSC) goals of reducing underweight by 50% of the 1990 levels by the year 2000.

In all these surveys, including the present (FCNS, 2001) the factors responsible for this high level of malnutrition include poor feeding (including breastfeeding) practices, food insecurity, poor socio-economic and environmental conditions and micronutrient deficiency.

Causes of malnutrition in under-five child

Several factors, basic and underlying have long been identified as causes of malnutrition in children (UNICEF, 1990). In the present study, an attempt has been made to explore association between all the variables encountered. Firstly, using variable clustering procedure as in factor or oblique principal analysis, groups of seemingly linked variables from the data set were identified. The outcome was a substantially reduced number of variables for modeling the malnutrition levels. These variables fall under 5 main categories:

Immunization
Family or Household size
Health seeking attitude
Hygiene practices
Socio-economic variables

Immunization variables include BCG, DPT1-3, and measles while the second category is influenced mainly by household size. Category 3 identified was made up of preferred medical treatment centres, while category 4 comprised observed hygienic practices. The income levels, occupation of household head, source of water and energy were among key determinants of the fifth cluster. Examination of **Table 85** shows that immunization (cluster 1) is associated with clusters 4 and 5, namely hygienic practices and social-economic status respectively. This is consistent with the association as elaborated by the conceptual framework.

Table 85. Cluster summary and inter cluster correlation matrix

Cluster	Members	Cluster Variation	Variation explained	Proportion explained	Second eigen value
1	17	1.5965	4.5966	0.2704	1.8977
2	8	2.8806	2.8806	0.3601	1.1827
3	7	2.6884	2.6884	0.3841	1.0533
4	18	3.7566	3.7556	0.2087	1.9111
5	16	2.5099	2.560	0.1569	1.3031
Inter cluster correlation					
Cluster	**1**	**2**	**3**	**4**	**5**
1	1.0000	0.0599	-0.1143	-0.4183	0.3793
2	0.0598	1.0000	-0.0101	-0.0101	0.0721
3	-0.1142	-0.0106	1.0000	0.0415	-0.0709
4	-0.4183	-0.01013	0.0415	1.0000	-0.2842
5	0.3793	0.0721	-0.0709	-0.2842	1.000

Secondly canonical correlation analysis was employed to identify associations among groups of variables; largely the biochemical variables versus the others. From these associations, it was possible to identify key variables in each group contributing to whatever measures of association. The first canonical correlation measuring the association between the biochemical variables and non-specific ecological and demographic variables was highly significant (r=033, p<0.0001), and was largely influenced by the biochemical variables zinc, vitamin A and E and hygiene practices. From the second canonical correlation, it was deduced that the association between the two groups of variables was by and large a measure of association between iodine levels and traditional methods of treatment (r=0.16, p<0.0001). Vitamin A and iron correlated significantly with environmental hygiene and use of insecticides).

The association between biochemical variables and those of access to water and sanitation suggested strong links between vitamin A and zinc with method of food preservation and primary energy source (r=0.22,p<0.0001). Other deductions included zinc and vitamin A with primary occupation and primary energy source (r=0.09, p<0.0001), vitamin E with hygiene practice (r=0.06, p<0.0001) and Iodine with socio-economic status.

While correlation does not denote causation, it however shows there is a potential relationship, either directly or indirectly.

Finally, the relationships between key categorical dependent variables and the explanatory variables were studied using the logistic regression model. The dependent variables were binary (e.g. stunting vs. not stunting), ordinal (e.g. Malnourished, normal obese and so on) or counts (frequency). The suitability or appropriateness of such models may be judged or measured by the percentage concordance which must be over 50%, the non-significance of the test of goodness of fit ("Somer's D" statistic) The model fit was measured by the test statistic of – 2 times the log likelihood, which is approximately chi-square distributed. Maximum likelihood estimates of the parameters of the logistic model and the odds ratios (relative strengths of associated probabilities) formed the basis of most of the inferences in fitting these models to various measures of malnutrition.

Stunting

A statistical significant logistic model (-2LogL= 5617, p < 0.0001; Percent Concordant=71.8, Somers' D = 0.439) was obtained when the probability of stunting was fit to several demographic, immunization, environmental and disease variables among others. The final model from a stepwise procedure is given in **Table 86**. Key explanatory variables included the level of education of the head of household, frequency of malaria and diarrhea recorded, vaccination against BCG, general level of

untidiness and food preservation methods (**Appendix 8-1**). Examination of the maximum likelihood estimates suggests that the level of (or probability of) stunting is very high in Nasarawa, Kebbi, and Kano (with high positive and significant estimates), and in households with uneducated heads (HH_Hd_educ = 1, that is, No Education). However, the probability is very low in Imo and Bayelsa (high significant negative estimates). The model identified further that those without BCG vaccination, for instance, had 50 percent higher chance of being stunted than vaccinated ones, and that the probability of stunting will increase by approximately 4% for every additional incidence of malaria and diarrhea (Odds ratios, **Table 86**). Other comparisons may be deduced from **Table 87 and Appendix 8-1.** For example, the odds of a child being stunted in Kebbi are 3.5 (point estimate) times than that of Akwa Ibom.

Table 86. Analysis of Effects of Logistic Model for Stunting

Effect	DF	Wald Chi-Square	Pr > ChiSq
STATE	11	175.8419	<.0001
HHead_Sex	1	4.8513	0.0276
HH_hd_educ	6	17.1817	0.0086
ANNUALINCOME	5	9.8592	0.0793
TRADITIONAL	1	2.4327	0.1188
INSECTICIDES	1	14.7629	0.0001
BEDNETS	1	1.6274	0.2021
BCG	1	15.5853	<.0001
DPT1	1	1.5966	0.2064
IMMUMEASLES	1	2.8466	0.0916
MALARIA	1	5.9103	0.0151
DIARRHEA	1	4.9834	0.0256
coughwithoutfever	1	3.8417	0.05
whoopingcough	1	1.8509	0.1737
UNTIDY	2	15.4892	0.0004
PRESERVEFOOD	5	16.3287	0.006
HH_head_Age	1	7.0691	0.0078

Table 87: Estimates of selected Odds Ratios for Stunting

Effect	Comparison	Point Estimate	95% Wald Confidence Limits	
STATE	01 vs 12	3.718	2.589	5.341
STATE	02 vs 12	1.031	0.752	1.413
STATE	03 vs 12	1.436	1.081	1.907
STATE	04 vs 12	1.539	1.143	2.071
STATE	05 vs 12	3.451	2.375	5.014
STATE	06 vs 12	1.892	1.406	2.545
STATE	07 vs 12	0.771	0.527	1.128
STATE	08 vs 12	1.171	0.795	1.725
STATE	09 vs 12	1.069	0.764	1.494
STATE	10 vs 12	0.466	0.334	0.649
STATE	11 vs 12	0.52	0.347	0.781
HHead_Sex	1 vs 2	1.386	1.037	1.852
HH_hd_educ	1 vs 7	1.042	0.821	1.323
HH_hd_educ	2 vs 7	0.914	0.66	1.267
HH_hd_educ	3 vs 7	0.789	0.606	1.026
HH_hd_educ	4 vs 7	0.908	0.652	1.265
HH_hd_educ	5 vs 7	0.745	0.569	0.976
HH_hd_educ	6 vs 7	0.669	0.493	0.908
INSECTICIDES	0 vs 1	1.306	1.14	1.497
BEDNETS	0 vs 1	1.129	0.937	1.362
BCG	0 vs 1	1.558	1.25	1.941
DPT1	0 vs 1	0.867	0.694	1.082
MALARIA		1.039	1.007	1.071
DIARRHEA		1.042	1.005	1.079
HH_head_Age		0.991	0.985	0.998

Wasting

The data set used for this analysis had 461 out of the total 4354 (10.6%) falling within the category of wasting. The logistic model fitted to the probability of wasting (=Yes) was highly significant, and met all the necessary criteria of appropriateness and goodness of fit. Principal explanatory variables included immunization against DPT and measles, frequency of measles and diarrhea, type of refuse disposal system and general care of the mother during pregnancy **(Table 88).**

Examination of the odds ratio **(Table 89)** indicates that only state 12 can be said to be highly associated with wasting (as the odds of other states being wasted relative to

state is less than 0.6 (between 0.248 and 0.562). Unlike stunting, the sex and educational level of household were not found to be directly associated with wasting of the child. Children without DPT1 have twice the likelihood of being wasted compared with those that are vaccinated, while those not immunized against measles are 47% more likely of being wasted. Finally a unit increase in the size of the household could increase the odds of being wasted by 3.4%.

Table 88: Analysis of Effects of Logistic Model for Wasting

Effect	DF	Wald Chi-Square	Pr > ChiSq
STATE	11	42.8444	<.0001
HHead_Sex	1	2.0509	0.1521
HH_hd_educ	6	9.7233	0.1368
PRIMREFDISP	2	6.726	0.0346
INSECTICIDES	1	9.7222	0.0018
DPT1	1	11.4302	0.0007
DPT2	1	5.5812	0.0182
IMMUMEASLES	1	6.3862	0.0115
workloadrest	3	7.6859	0.053
DIARRHEA	1	3.4602	0.0629
MEASLES	1	6.6251	0.0101
Cost_of_own_purchase	1	6.9709	0.0083
antenatalcare	1	8.2662	0.004
REDUCEDHH	1	2.8752	0.09
STAGNANTWATER	2	3.3369	0.1885
PRESERVEFOOD	5	7.9117	0.1612
hhsize	1	3.1547	0.0757

Table 89. Selected estimates of Odds Ratio for Wasting

Effect	Comparison	Point Estimate	95% Wald Confidence Limits	
STATE	01 vs 12	0.562	0.319	0.991
STATE	02 vs 12	0.324	0.195	0.536
STATE	03 vs 12	0.469	0.305	0.719
STATE	04 vs 12	0.456	0.285	0.732
STATE	05 vs 12	0.303	0.172	0.534
STATE	06 vs 12	0.522	0.337	0.809
STATE	07 vs 12	0.459	0.276	0.762
STATE	08 vs 12	0.463	0.275	0.779
STATE	09 vs 12	0.248	0.123	0.503
STATE	10 vs 12	0.558	0.349	0.893
STATE	11 vs 12	0.251	0.129	0.485
PRIMREFDISP	1 vs 3	1.32	0.514	3.39
PRIMREFDISP	2 vs 3	1.821	0.704	4.713
INSECTICIDES	0 vs 1	0.714	0.578	0.883
DPT1	0 vs 1	2.093	1.364	3.211
DPT2	0 vs 1	0.594	0.385	0.915
IMMUMEASLES	0 vs 1	1.472	1.091	1.986
workloadrest	0 vs 3	0.884	0.652	1.199
workloadrest	1 vs 3	0.679	0.515	0.895
workloadrest	2 vs 3	0.888	0.684	1.152
DIARRHEA		1.044	0.998	1.093
MEASLES		1.23	1.051	1.44
antenatalcare	0 vs 1	1.397	1.112	1.755
REDUCEDHH	0 vs 1	0.833	0.674	1.029
hhsize		1.034	0.997	1.074

Underweight

Over 30% of the observations of the data for the logistic analysis of underweight fall in the category of underweight (=Yes). The model for the probability of underweight (=Yes) had the following key explanatory variables (with levels of significance in parenthesis): agroecological zone (0.0003), sex of household head (0.0235), household head education level (0.0609), primary occupation (0.0489), the duration of breastfeeding of the last child (0.0116), insecticides (0.0156), DPT1 (0.0552), frequency of resting periods in a week (workloadrest; 0.0059), diarrhoea (0.0003), measles (0.0686), cost of own production and purchase (0.0193), child growth monitoring (0.0328), increased financial support during pregnancy (0.0524), untidy (0.0347) and age of household head

(0.0233). These variables were the most significant from a large number of explanatory variables covering various aspects of the study, including breastfeeding practices, frequency of diarrhea and malaria prevention practice through the use of insecticides.

Compared with other nutrition variables, underweight appear to be affected by a wide range and types of variables. This is perhaps not unexpected as underweight is after all the outcome of several basic underlying and intermediate variables.

Table 90. Selected Odds Ratio Estimates for Underweight

Effect	Comparison	Point Estimate	95% Wa Confidence	Id Limits
AEZ	1 vs 3	1.558	1.223	1.984
AEZ	2 vs 3	1.113	0.879	1.409
HHead_Sex	1 vs 2	1.481	1.054	2.08
HH_hd_educ	1 vs 7	0.921	0.729	1.164
HH_hd_educ	2 vs 7	0.793	0.563	1.115
HH_hd_educ	3 vs 7	0.742	0.567	0.972
HH_hd_educ	4 vs 7	0.738	0.519	1.051
HH_hd_educ	5 vs 7	0.639	0.479	0.852
HH_hd_educ	6 vs 7	0.733	0.512	1.049
PRIMOCCUP	0 vs 5	0.582	0.32	1.057
PRIMOCCUP	1 vs 5	0.68	0.385	1.201
PRIMOCCUP	2 vs 5	0.562	0.312	1.013
PRIMOCCUP	3 vs 5	0.533	0.289	0.981
PRIMOCCUP	4 vs 5	0.5	0.276	0.908
LASTCHILDBREAST	0 vs 6	1.609	1.018	2.543
LASTCHILDBREAST	1 vs 6	1.138	0.564	2.296
LASTCHILDBREAST	2 vs 6	1.797	1.004	3.215
LASTCHILDBREAST	3 vs 6	1.03	0.62	1.713
LASTCHILDBREAST	4 vs 6	0.993	0.554	1.78
LASTCHILDBREAST	5 vs 6	0.288	0.11	0.757
INSECTICIDES	0 vs 1	1.202	1.035	1.396
BCG	0 vs 1	1.202	0.946	1.527
DPT1	0 vs 1	1.377	0.993	1.911
DPT2	0 vs 1	0.758	0.537	1.07
DPT3	0 vs 1	0.832	0.64	1.08
DIARRHEA		1.071	1.032	1.111
MEASLES		1.112	0.992	1.246
UNTIDY	0 vs -1	1.002	0.752	1.335
UNTIDY	1 vs -1	1.23	0.913	1.657
HH_head_Age		0.992	0.985	0.999

Further assessment of the results from the regression model and odds ratios (**Table 90**) was undertaken to identify key determinants of children with high probabilities of incidence of underweight to include informal and no education, household head with fishing as primary occupation, breastfeeding duration of less than 3 months, and agroecological zone. Also a unit increase in frequency of diarrhea and measles would increase the odds by 7% and 11% respectively.

10.2 Micronutrient status of under-5 children

Micronutrient deficiency plays an important role in under-five malnutrition. Indeed, the nutrition goals of the 1990 World Summit on Children (WSC) included virtual elimination of iodine disorders as well as Vitamin A deficiency and its consequences, including blindness by the year 2000. The primary function of Vitamin A is to guarantee the integrity of epithelial cells, ensure proper vision, immune functions as well as reproduction. Vitamin A deficiency (VAD) results when the depletion of body stores occurs to the extent that physiological functions are impaired. VAD is also known to be a major contributing factor to the high infant and child mortality in Nigeria (UNICEF/FGN, 2001).

According to WHO, Nigeria is among the 34 countries in the world with serious problems of VAD related nutritional blindness and xerophthalmia (UNICEF/FGN 2001). Data from the PIC survey showed a projected national prevalence rate of 9.2% in children and xerophthalmia rate of 1.0% among children below 6 years of age. An earlier study in 1979 claimed that 61% of all blind children had corneal ulceration (WHO/ICCIDD, 1998). In addition, biochemical data from one of the southeastern states (Cross River) gave a serum level of 1.1µmol/l among children 0-1 year in 1980.

The government of Nigeria had declared in line with the World Summit on Children (WSC) goals (1990) a target of virtual elimination of VAD and its consequences by 2000. In achieving these, three strategies have been adopted namely; Supplementation, Food fortification and dietary diversification. Large scale vitamin A supplementation has been promoted for a long time in the country through the primary health care and especially the National Immunization Days (NID). In this regard many international non-governmental development agencies including Micronutrients Initiative (MI), UNICEF, Helen Keller International (HKI), BASICS II and World Vision are providing considerable assistance. Since 2000, supplementation has been linked directly with the national campaign against polio. The objective is to reach 39 million children 6. -60 months with high potency doses of vitamin A along with polio vaccination. It was hoped that by the end of year 2000, coverage of Vitamin A would be close to 90% (UNICEF/FGN 2001).

Acute invasive infections like malaria, bacterial infections, even intestinal parasites affect micronutrients status. It is known that levels of serum retinol decreases during infections and fevers while the level of serum ferritin increases . All the children sampled were free of physical signs and symptoms of infection at the time of the survey; i.e. they were apparently healthy. However, the use of C-reactive protein (CRP) was employed to identify those children with subclinical infections. The results therefore are presented in two ways: the results of all children irrespective of evidence of subclinical infections and the result when those with infections were excluded. In essence this study has, for the first time, attempted to establish the real level of serum ferritin and serum retinol with and without sub-clinical infections.

In the present Survey, the prevalence of vitamin A deficiency (VAD) nationally was 23.2% (marginal) and 3.6% (clinical). These figures are much higher than the 9.2% VAD prevalence indicated by the Participatory Information Collection Study (PICS, 1993), for this age group. Again, the data from the PIC survey are not strictly comparable. That survey was conducted only in some focal local Government Areas that were purposively sampled i.e. the data were not based on a nationally representative sample. The analytical method (Colorimetric) for the PIC survey is not as sensitive as HPLC that was used in the present study.

Even though the VAD prevalence (29.5%) observed in Nigerian children 0 – 59 months old in the present survey constitutes a deterioration from 9% previously observed, it is still significantly lower than that observed in many sub-Saharan countries. When compared with recent (1997 – 2002) figures from some other sub-Saharan African countries with similar under-5 mortality rates **(Table 91)**, the Nigerian prevalence rate is similar only to Uganda (27.9) and higher than that of Tanzania (24.0). It is perhaps significant to note that in this study, VAD survey samples were collected about three months after one of the two national mass Vitamin A supplement distribution campaign in 2001, precisely January – April 2001. It is therefore possible that a higher prevalence rate would have been observed had there not been such a campaign at the time.

Table 91. Percentage Prevalence of Vitamin A Deficiency in some sub-Saharan countries (1997 – 2002)

Country	Vitamin A Survey year	Observed Vitamin A prevalence
Benin	1999	70.2
Cameroon	2000	40.0
Central A. Rep.	1999	68.2
Gambia	1999	64.0
DR-Congo	1998	61.1
Kenya	1999	60.2
Liberia	1999	52.9
Madagascar	2000	41.8
Malawi	2001	59.2
Mozambique	2002	71.2
Nigeria	2001	29.5
Tanzania	1997	24.0
Uganda	2001	27.9
Zambia	1997	65.7
Average		**52.6**

The present study has provided for the first time, data on vitamin E status of under-five Nigerians. About 80% of under-five children, nationally had adequate serum vitamin E level, while 20% were considered to be vitamin E deficient. The median value of 6.3mg/dl obtained for this age group however is only about one half (50%) of the maximum value (13.8mg/dl) used as cut off point of adequate vitamin E status for children 12 month old. Presently, there appears to be no other published data on the vitamin E status of this age group of Nigerians.

The situation is different for iron deficiency. Iron deficiency anemia is recognized as the most common micronutrient malnutrition problem in the world and has thus received considerable scientific attention worldwide. In Nigeria most of the studies have however, been on age group other than under-five, especially neonates and mothers (Oguntona, 1989). Results from the present study suggest that 34% of under-five children are at different stages of iron deficiency. This puts iron deficiency in this age group as being of medium public health significance. The PIC (1993) Survey obtained a prevalence rate of 29.4% in some purposively selected areas of the country.

However, as with the other values, differences also exist in the methodologies employed in the different surveys. While the PIC survey determined hemoglobin (Hb)

levels to classify children, the present study determined serum ferritin as a basis for classification. Any interpretation of trends in the IDA prevalence among this age group therefore, will be on the assumptions that the sample was representative of all children under-five in the country, and that the classification methods are approximate. In that case it would appear that the prevalence of iron deficiency among Under-five has not improved in Nigeria since the PIC survey of 1993.

Iodine deficiency has long been known to be a serious problem in Nigeria especially where the soil is deficient in the mineral. It is known that certain specific cognitive and intellectual functions are vulnerable to iodine deficiencies. Severely iodine deficient children, for example, are slower learners even than mildly iodine deficient children. These have serious implications for education, health and productivity.

Between 1960 and 1988, regional surveys in ten states of the country reported a Total Goiter Rate (TGR) of between 7.7% and 24.2%. In the middle belt state of Plateau, a 1988 survey of school children reported a mean urinary iodine excretion of 3.5 – 15.3µg/24hr. The PIC (1993) survey indicated a prevalence rate of 20% for IDD (as grade 1 and 2 goiter) with an estimated 25 to 35 million Nigerians at risk. This rates Nigeria as one of the highest goiter rates in Africa.

In response to this high prevalence rate, the government in 1992 adopted a national plan of action for the elimination of IDD for the 1993-95-plan period. To give effect to this plan, legislation on salt iodisation was enacted in 1993 mandating a concentration of 50ppm iodine in salt produced in or entering the country. Also, a national IDD committee was constituted in 1994 to co-ordinate the programme. The USI program in Nigeria required 50ppm of iodine in salt at the factory or point of entry in Nigeria and 30ppm at the retail or market level.

There are several indications that the IDD situation in Nigeria has improved significantly since the introduction of USI. A report in 1996 (Egbuta and Hettiaratchy, 1996) reported that 97% of all food grade, salt manufactured in Nigeria was iodized. The MICS report (MICS, 1999) also found that 98% of Nigerian households were using iodized salt. In 1998, an impact evaluation of USI was conducted by UNICEF in eleven LGA's in ten historically IDD endemic states. Compared to the 1993 data in the same LGAs, the data showed a significant reduction in the TGR among the subjects (6-11 yrs old) from 20% (national average) to 11%. The survey indicated that the rate of palpable goiter (i.e. types 1a & b) was still 10.6% while permanent goiter (type 2) was 1.2% in the eleven LGAs surveyed. A consultation report of the review of findings from 7-country study in Africa (WHO UNICEF/ICC IDD, 1996) cited a study at two locations in southern Nigeria. It was reported that the study found a prevalence rate ranging from 25.7% to 39.5%. The urinary iodine concentrations from the 293 subjects surveyed was reported to range from 260µg/l to 369µg/l.

Using the latest procedures (urinary iodine concentrations) and cut off points recommended by ICCIDD/WHO/UNICEF (1996), the present study obtained a substantially different prevalence rate for Under-five children. Results from this present study indicate that 27.5% of these children suffer various degree of iodine deficiency. The PIC (1993) survey gave an overall prevalence rate of iodine deficiency, assessed by low serum T4 concentration as 40.7%. If the methodologies used in the different surveys were comparable, it would have appeared that the prevalence rate of iodine deficiency had declined from 1993 to 2001.

IDD prevalence data for children reported by many countries (including the PIC 1993 study) usually refers to 6 – 10/11 years olds. The focus of the present study however was mothers of under-5 children, their under-5 children and pregnant women. The present prevalence data have therefore, provided information to fill some gap in our knowledge of iodine nutrition of children in this age group. That 27.5% of this age group suffers from various degree of iodine deficiency is rather worrying. This is because of the know consequences of IDD that includes hypothyroidism, impaired mental function, retarded physical development with implications for intellectual performance and productivity.

Of vital significance also, is the data from the present (FCNS 2001) survey which indicated that almost 30% of these children had excess iodine intake and thus run the risk of adverse health consequences. One consequence of an abnormally high intake of iodine is induced hyper thyroidism (IIH). This condition has been reported mostly in adults especially after widespread iodisation of salt or bread. A threefold increase in the number of new cases of IIH was reported over the period of salt iodisation in Zimbabwe (1992-95). It is not yet clear what the full implication of the large percentage (30%) of children found with excess iodine levels in this study would be.

It is noteworthy that information on salt intake by Nigerians is very scarce. A mean intake of 5.5g per day has recently been provided (UNICEF, 2003 personal communication) but a regional (Borno, NE Nigeria) study recorded daily salt intake ranging from 4.8g in children to 7.7g in adults (Oguntona et al, 1989)

Zinc is one of the so-called emerging micronutrients of importance. Although the importance of zinc in human nutrition has long been recognized (Prasad, 1963), none of the nutrition surveys earlier conducted has assessed zinc in the Subjects. It is even more important in children as it is well known that rapid growth (as in growing children) could result in low zinc status (Brown & Wuehler, 2000). Using the plasma zinc level of 50mg/dl as cut-off points, one out of every five children (21%) was found to be zinc deficient.

6.3 Modelling micronutrient status of children under-5

Vitamin A Deficiency

A highly significant model ($p < 0.0001$) was obtained when vitamin A deficiency was fitted as the response variable to several variables including the classification variable state. Key effects influencing vitamin A deficiency are indicated in **Table 92**. The other key factors influencing VAD as established by this model include education of household heads, primary source of water, antenatal care and key elements of household hygiene practices. These variables are consistent with what is generally known about the level of education (awareness) of caregiver and nutritional status of household members on the one hand and hygienic and care practices and VAD in particular. Also Nasarawa, Bayelsa, and Akwa Ibom States were less associated with VAD, while the worst states observed from the analysis (odds ratios) included Taraba, Borno, Kebbi, Osun and Edo States in that order.

Table 92. Analysis of Effects and Odds Ratios for vitamin A deficiency

Effect	DF	Wald Chi-Square	Pr > ChiSq
STATE	11	360.9228	<.0001
HH_hd_educ	6	10.3802	0.1095
PRIMOCCUP	5	8.6374	0.1244
PRIMSWATER	6	32.5448	<.0001
PRIMREFDISP	2	8.9796	0.0112
BCG	1	3.7188	0.0538
DPT2	1	1.7813	0.182
IMMUMEASLES	1	3.2313	0.0722
MALARIA	1	4.8354	0.0279
MEASLES	1	2.3399	0.1261
Cost_of_own_purchase	1	5.3624	0.0206
childgrowthmonitorin	1	1.9939	0.1579
antenatalcare	1	11.172	0.0008
UNWASHEDUTENSILS	2	11.852	0.0027
UNCOVERED	2	3.5147	0.1725
hhsize	1	3.7948	0.0514
HH_head_Age	1	3.2967	0.0694

Table 92 continued. Analysis of Effects and Odds Ratios for VAD

	Odds Ratio	Estimates	
	Point	95%	Wald
Effect	Estimate	Confidence Limits	
STATE 01 vs 12	1.079	0.531	2.193
STATE 02 vs 12	6.972	4.189	11.603
STATE 03 vs 12	8.184	5.04	13.29
STATE 04 vs 12	3.916	2.331	6.578
STATE 05 vs 12	9.166	5.284	15.9
STATE 06 vs 12	4.252	2.571	7.031
STATE 07 vs 12	13.508	8.33	21.906
STATE 08 vs 12	14.856	9.204	23.979
STATE 09 vs 12	1.707	0.925	3.149
STATE 10 vs 12	2.506	1.466	4.285
STATE 11 vs 12	0.812	0.384	1.717

Vitamin E deficiency

The high percentage of vitamin E deficient under-five children observed in the study could be explained by the magnitude and diversity of explanatory variables that included hygiene conditions, breastfeeding practices, immunization, frequency of fever, the size of the household and income status of household head. Kwara has the least problem, while most deficient vitamin-E states include (in increasing order of magnitude) Kano, Borno, Kebbi, Osun, Nasarawa and Taraba states **(Table 93).**

Table 93. Selected Odds Ratio Estimates for Vitamin E deficiency

	Selected Odds Ratio	Estimates	for Vitamin E	Deficiency
		Point	95% Wald	
Effect		Estimate	Confidence Limits	
STATE	01 vs 12	3.769	2.125	6.684
STATE	02 vs 12	1.331	0.834	2.124
STATE	03 vs 12	2.616	1.707	4.01
STATE	04 vs 12	0.958	0.633	1.45
STATE	05 vs 12	3.166	1.778	5.636
STATE	06 vs 12	2.012	1.291	3.135
STATE	07 vs 12	3.279	1.411	7.619
STATE	08 vs 12	4.843	2.236	10.491
STATE	09 vs 12	0.697	0.422	1.151
STATE	10 vs 12	1.071	0.691	1.661
STATE	11 vs 12	1.004	0.628	1.605
ANNUALINCOME	1 vs 6	1.709	1.198	2.438
ANNUALINCOME	2 vs 6	1.312	0.945	1.821
ANNUALINCOME	3 vs 6	1.248	0.908	1.715
ANNUALINCOME	4 vs 6	1.075	0.786	1.471
ANNUALINCOME	5 vs 6	1.118	0.809	1.543
CHILDUNTIDY	0 vs -1	1.232	0.603	2.516
CHILDUNTIDY	1 vs -1	2.87	1.418	5.808

Iron deficiency

Osun, Taraba, Kano, Edo, Borno and Kebbi had the highest probabilities associated with iron deficiency, while relatively those associated with least deficiency were Kwara, Nasarawa and Akwa Ibom **(Table 94).**

Table 94. Odds Ratio Estimates on iron deficiency for states

Effect	Selected Odds Ratio	Point Estimate	95% Wald Confidence Limits	
STATE	01 vs 12	0.527	0.323	0.862
STATE	02 vs 12	3.345	2.327	4.808
STATE	03 vs 12	4.047	2.885	5.677
STATE	04 vs 12	1.768	1.227	2.548
STATE	05 vs 12	4.807	3.168	7.293
STATE	06 vs 12	3.426	2.402	4.885
STATE	07 vs 12	2.823	2.009	3.965
STATE	08 vs 12	3.958	2.834	5.526
STATE	09 vs 12	0.421	0.264	0.673
STATE	10 vs 12	1.414	0.983	2.033
STATE	11 vs 12	1.747	1.145	2.667
Association of Predicted Probabilities andObserved Responses				
Percent Concordant	71.3	Somers' D	0.428	
Percent Discordant	28.4	Gamma	0.43	

Zinc deficiency

State, occupation of household head, malaria prevention methods, BCG vaccination and basic hygienic practices were among other explanatory variables that contributed significantly to the model describing zinc deficiency status. **Table 95** indicates that Imo and Akwa Ibom were the only states with better zinc levels, as the others show considerable relatively high zinc deficiency levels. For instance, the odds of Kwara state having more zinc-deficient under-five children is more than 11 times higher than Akwa Ibom. Kebbi follows Kwara with odds of more than 7 times higher than Akwa Ibom state. Imo state has the least probability of having under-5 zinc deficient children. Children from households headed by fishermen have higher odds of being zinc deficient. The odds of a non-BCG vaccinated child being zinc deficient are almost 40% (odds ratio=1.38) more than that of the vaccinated child.

Table 95. Odds Ratio Estimates from zinc deficiency model

Effect	Odds ratio	Point Estimate	95% Wald Confidence Limits	
STATE	01 vs 12	2.006	1.348	2.983
STATE	02 vs 12	2.653	1.858	3.788
STATE	03 vs 12	2.633	1.886	3.674
STATE	04 vs 12	6.627	4.627	9.49
STATE	05 vs 12	7.589	4.871	11.824
STATE	06 vs 12	4.524	3.153	6.491
STATE	07 vs 12	2.629	1.742	3.968
STATE	08 vs 12	4.145	2.731	6.293
STATE	09 vs 12	11.247	7.551	16.751
STATE	10 vs 12	0.836	0.572	1.22
STATE	11 vs 12	3.407	2.275	5.103
PRIMOCCUP	0 vs 5	0.348	0.186	0.651
PRIMOCCUP	1 vs 5	0.254	0.138	0.466
PRIMOCCUP	2 vs 5	0.374	0.201	0.694
PRIMOCCUP	3 vs 5	0.354	0.188	0.667
PRIMOCCUP	4 vs 5	0.327	0.175	0.61
BCG	0 vs 1	1.381	1.14	1.673
PRESERVEFOOD	0 vs 5	1.016	0.557	1.853
PRESERVEFOOD	1 vs 5	1.209	0.696	2.1
PRESERVEFOOD	2 vs 5	1.081	0.757	1.543
PRESERVEFOOD	3 vs 5	0.879	0.595	1.297
PRESERVEFOOD	4 vs 5	0.747	0.503	1.109
Association of Predicted Probabilities and Observed Responses				
Percent Concordant	73	.9 Somers' D	0.481	
Percent Discordant	25	.8 Gamma	0.482	

Iodine deficiency

Borno, Kano and Akwa Ibom are the worst iodine deficient states **(Table 96 a and b).** This is only of relative interest, as the problem appears to be of the same intensity in all the states.

Table 96a. Analysis of Maximun Likelihood estimates for Iodine

Type II Analysis of Effects						
		Effect	DF	Wald Chi-Square	Pr > ChiSq	
	STATE		11	73.9743	<.0001	
				Standard		
Parameter		DF	Estimate	Error	Chi-Square	Pr > ChiSq
Intercept		1	1.6109	0.0414	1512.6628	<.0001
STATE	1	1	-0.3961	0.1588	6.2242	0.0126
STATE	2	1	-0.0726	0.1297	0.3131	0.5758
STATE	3	1	0.3786	0.1313	8.31	0.0039
STATE	4	1	0.069	0.1319	0.2737	0.6009
STATE	5	1	-0.0205	0.1437	0.0203	0.8866
STATE	6	1	0.6701	0.1295	26.7758	<.0001
STATE	7	1	-0.1671	0.1236	1.8281	0.1764
STATE	8	1	0.1739	0.1483	1.3753	0.2409
STATE	9	1	0.0321	0.1612	0.0397	0.842
STATE	10	1	-0.1989	0.1232	2.6083	0.1063
STATE	11	1	-0.7305	0.138	28.0129	<.0001

Table 96b. Analysis of Maximun Likelihood estimates of Iodine: Odds Ratio Estimates

		Point	95% Wald	
Effect	Odds Ratio	Estimate	Confidence Limits	
STATE	01 vs 12	0.518	0.343	0.781
STATE	02 vs 12	0.716	0.499	1.027
STATE	03 vs 12	1.124	0.781	1.617
STATE	04 vs 12	0.825	0.573	1.187
STATE	05 vs 12	0.754	0.513	1.108
STATE	06 vs 12	1.504	1.049	2.157
STATE	07 vs 12	0.651	0.458	0.925
STATE	08 vs 12	0.916	0.618	1.356
STATE	09 vs 12	0.795	0.525	1.204
STATE	10 vs 12	0.631	0.444	0.895
STATE	11 vs 12	0.371	0.255	0.539

6.4 Linking biochemical and child malnutrition variables

Results on stunting, wasting and underweight when regressed on measured biochemical variables – zinc, iodine, vitamin-A, vitamin-E and iron, were not as strong as those obtained with other variables, as levels of concordance were low for all and goodness of fit violated in the case of wasting. Nevertheless, vitamin A and E were found to contribute significantly to all the three models **(Appendix 8-2).** In other words, the vitamin A and vitamin E status of the children contributed significantly to the prevalence of the three categories of protein-energy malnutrition (stunting, wasting, and underweight) observed in these children.

6.5 Association of biochemical variables and malnutrition deficiencies with states

Previous sections had considered and discussed results based on individual measures of malnutrition and micronutrient deficiencies. In this section, we summarize by looking at biplots of deficiencies associated with vitamin A, vitamin E, iodine, iron, and zinc, along with overall measures of Stunting, Wasting and Underweight on the same plots with states. **Figure 8 5** and **Appendix 8 -2** provide the outcome of the joint fit of all variables, while **Figure 86** and **Figure 87** fits the data using biochemical and malnutrition variables, separately for emphasis on interpretation.

In **Figure 85** we can generally infer that, relative to other deficiencies, wasting is largely a problem with Bayelsa, while Nasarawa, Taraba, Borno, Kaduna, Kebbi, Kano and Kwara are associated with deficiencies in iodine, iron, vitamin A, vitamin E and low birth weight. Underweight and stunting are jointly linked, while Nasarawa and Imo are similar but could not be linked to any particular deficiencies. From **Figure 86** the biochemical spread by state is further amplified. Vitamin A is seen as a problem in Akwa Ibom, iron in Borno state, zinc in Kaduna and Kebbi while iodine is identified as problem in Osun and Taraba, and possibly Edo, Bayelsa and Nasarawa. Finally, the association of wasting with Bayelsa is further confirmed in **Figure 87,** underweight and stunting are associated with Nasarawa and Imo. Low birth weight appears to be a problem in most states including Kano, Edo, Kebbi, Kaduna (and to some extent Taraba, Borno, Osun, Kwara, and Akwa Ibom).

Figure 85. Biplot of all biochemical and malnutrition variables in children by states

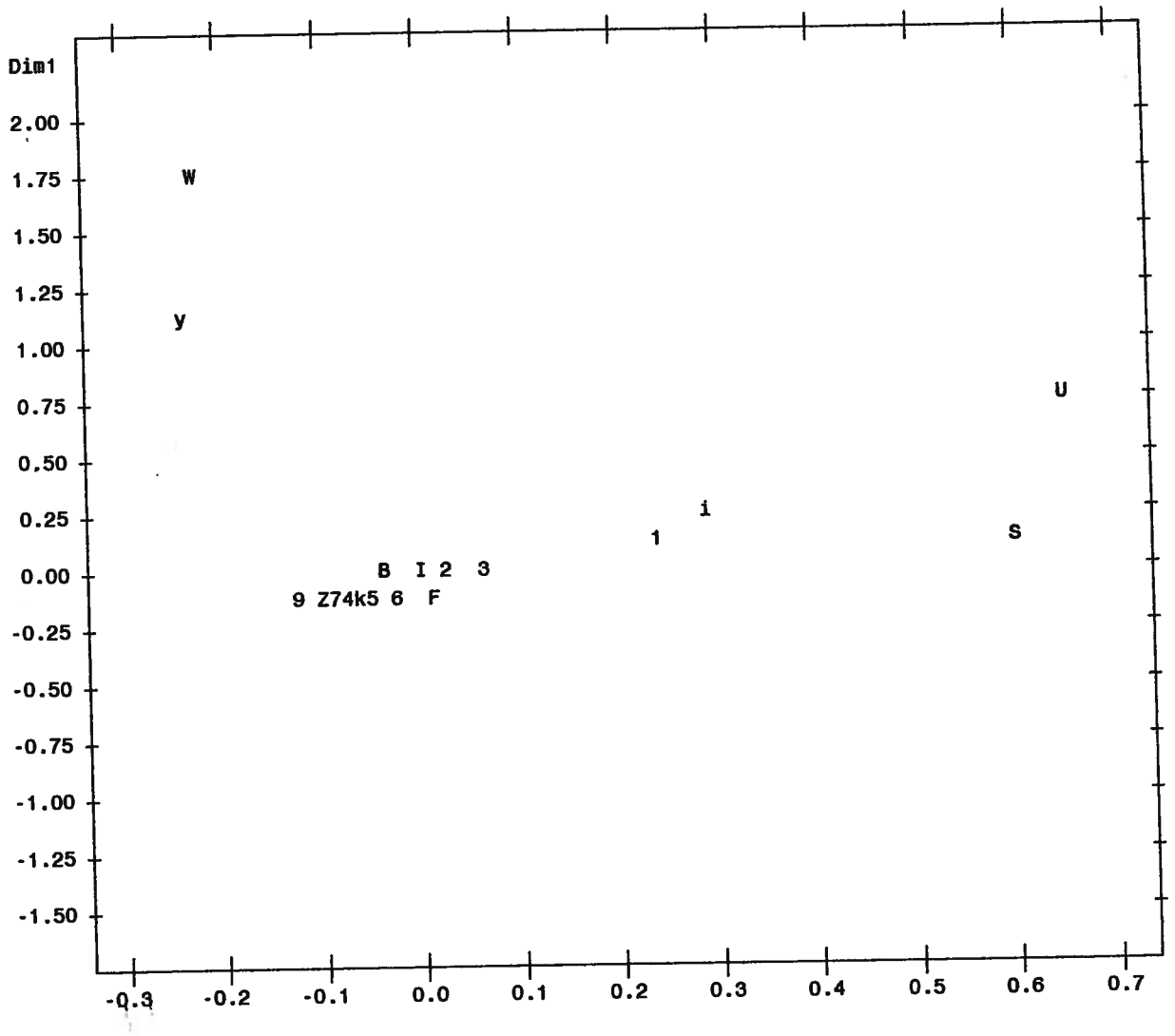


Figure 86. Biplot of all biochemical and malnutrition variables in child by states

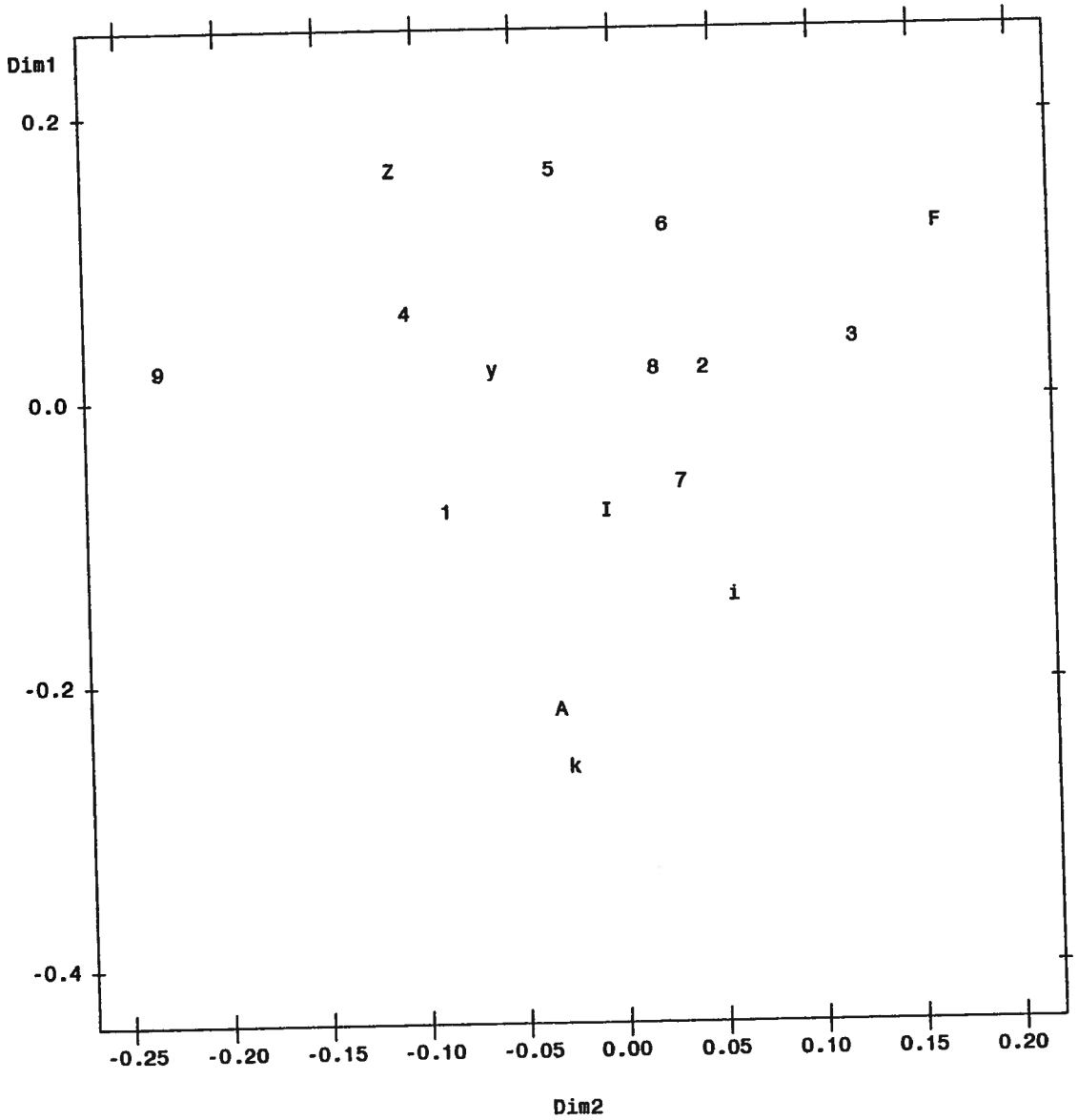
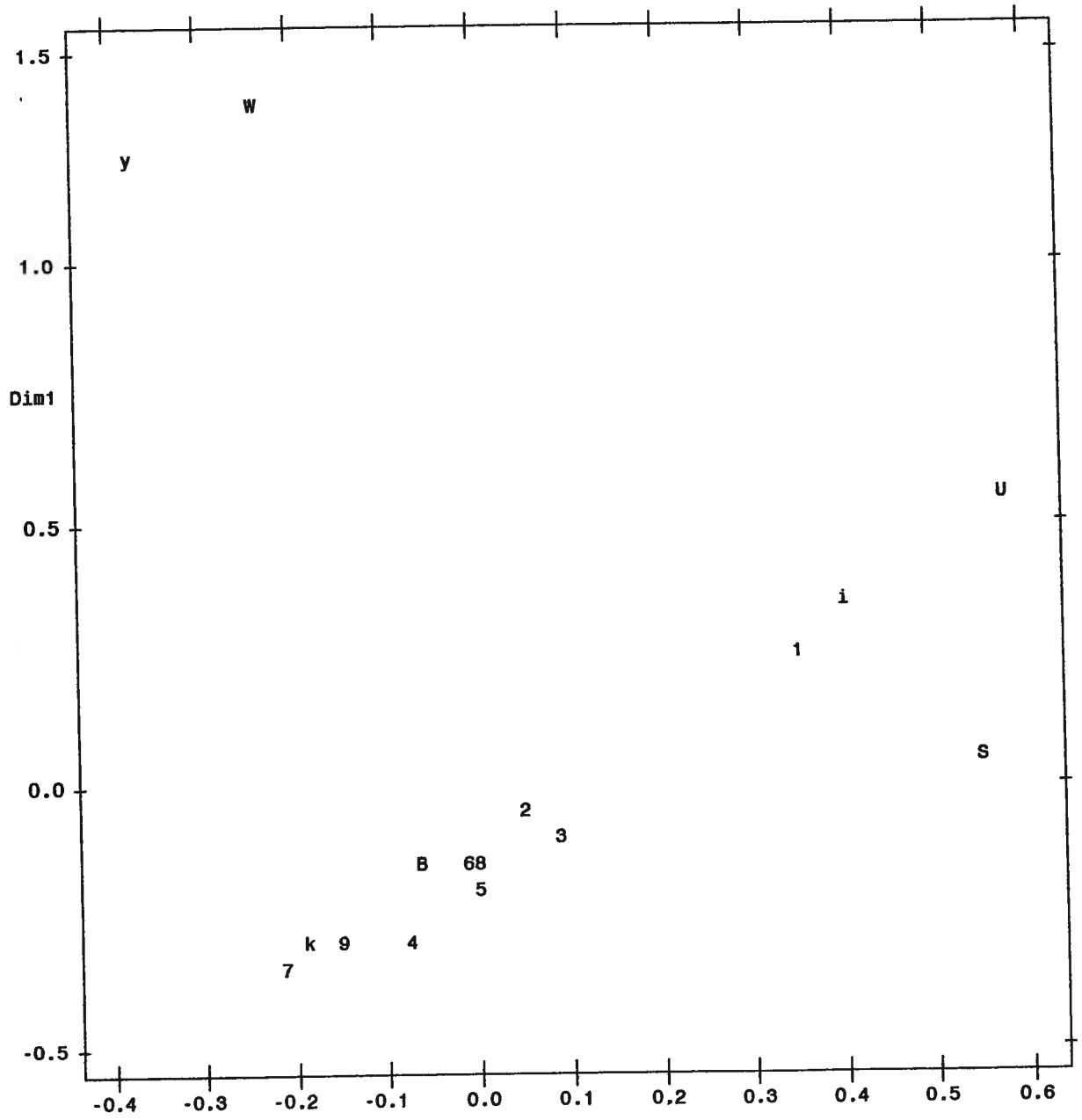


Figure 87. Biplot of all biochemical and malnutrition variables in children by states



>0.75 Very High

Unclassified households are those with at least one missing explanatory or response variables. From the data presented in the appendix, states, LGA, EA or households with high to very high-predicted probabilities associated with a particular or group of deficiencies may be further extracted for future intervention strategies.

6.7 Nutritional status of mothers

The survey employed Body Mass Index (BMI) as a simple and objective anthropometric indicator of the nutritional status of mothers. Nationally, 11.6% of mothers were found to be undernourished as they fell into the <18.5 category. Almost 70% of mothers fell within the normal range (18.5-24.99) of BMI. The normal range of over 60% is consistent with findings (FAO, 1994) in other African countries such as Tunisia (69%) and Togo (75.6%). Fourteen percent were considered overweight (25-29.99), while 5.7% were obese (30 and above).

The 11.6% prevalence of maternal under nutrition is lower than the prevalence of 16% reported for the country in 1999 (NDHS, 1999). It is not clear however, if this difference in prevalence is suggestive of improved adult nutrition between 1999 and 2001 or methodological differences in the design and sampling of the studies. An FAO analysis had indicated that the tendency toward emaciation (BMI < 18.5) is greater in Sahelian countries (e.g. Mali, 16%) than in tropical and subtropical areas wherein lies the greater part of Nigeria (FAO, 1994).

The women with BMI < 18.5 are considered to be chronically undernourished and have been classified into mild (BMI = 17.00-18.49), moderate (BMI = 16.00-16.99), and severe (BMI = < 16.00) categories of underweight. The survey showed a national prevalence of 9% mild underweight, 2% in the moderate category, and one percent prevalence of severe underweight. These results are comparable with some previous studies in Africa. A survey of six African countries (ACC/SCN 2000) showed that mild underweight affects more than 10% of women and in two countries (Chad and Madagascar) prevalence's are greater than 15%. While this survey indicates a national prevalence of moderate to severe underweight of about 3%, in five countries surveyed in Africa (ACC/SCN 2000), it was reported that moderate and severe underweight affects more than 3% of women.

The condition of Chronic Energy Deficiency (CED) is defined as a "steady state" where an individual is in energy balance i.e., the energy intake equals the energy expenditure, despite the low body weight and low body energy body stores There is evidence indicating that individuals with a BMI below 18.5 show a progressive increase in mortality rate, risk of illness and reduced work capacity. (FAO, 1997; ACC/SCN, 2000). A recent study among Nigerian women and men has shown that mortality rates among

CED individuals who are mildly, moderately and severely underweight are 40%, 140% and 150% greater respectively than rates among non CED individuals (Rotimi et. al., 1999).

Obesity is a disease of complex, multiple causes leading to an imbalance between energy intake and output to the accumulation of large amounts of body fat. Nationally, 14.2% and 5.7% of women of reproductive age in Nigeria were found to be overweight and obese respectively. There is, however, no existing national data on obesity among Nigerian women with which to compare this result. The NDHS 1999 only provided information on adult under nutrition and not on the prevalence of overweight and obesity. Existing data are drawn from several studies conducted in various parts of the country. Using the cut off of 20% above desirable weight for height, 58% of market women in Nigeria were considered obese (Okeke et al, 1983). A study in Benin City indicated a 58.3% prevalence of obesity among women in Benin City (Ogbeide, 1983) These studies are limited in scope and employed a different indicator (Weight for Height) for measuring obesity.

It has however been reported that obesity levels are usually low in sub-Saharan Africa (IFPRI, 2001). The same report however indicated less than 10% level of overweight for sub-Saharan Africa, and less than 5% for obesity. While an approximately 6% percent level of maternal obesity is essentially low compared to levels over 30% in some developed countries (FAO, 1994), it is noteworthy that the current levels in Nigeria exceed the reported regional levels. Obesity contributes to the development of many diseases, including diabetes, hypertension, stroke, cardiovascular disease, and some cancers. Due attention to the reportedly increasing rate of obesity even in developing countries becomes necessary for a country like Nigeria with a high level of under nutrition especially among children. A dual nutrition agenda of obesity and under nutrition could present difficult challenges in situation of scarce resources.

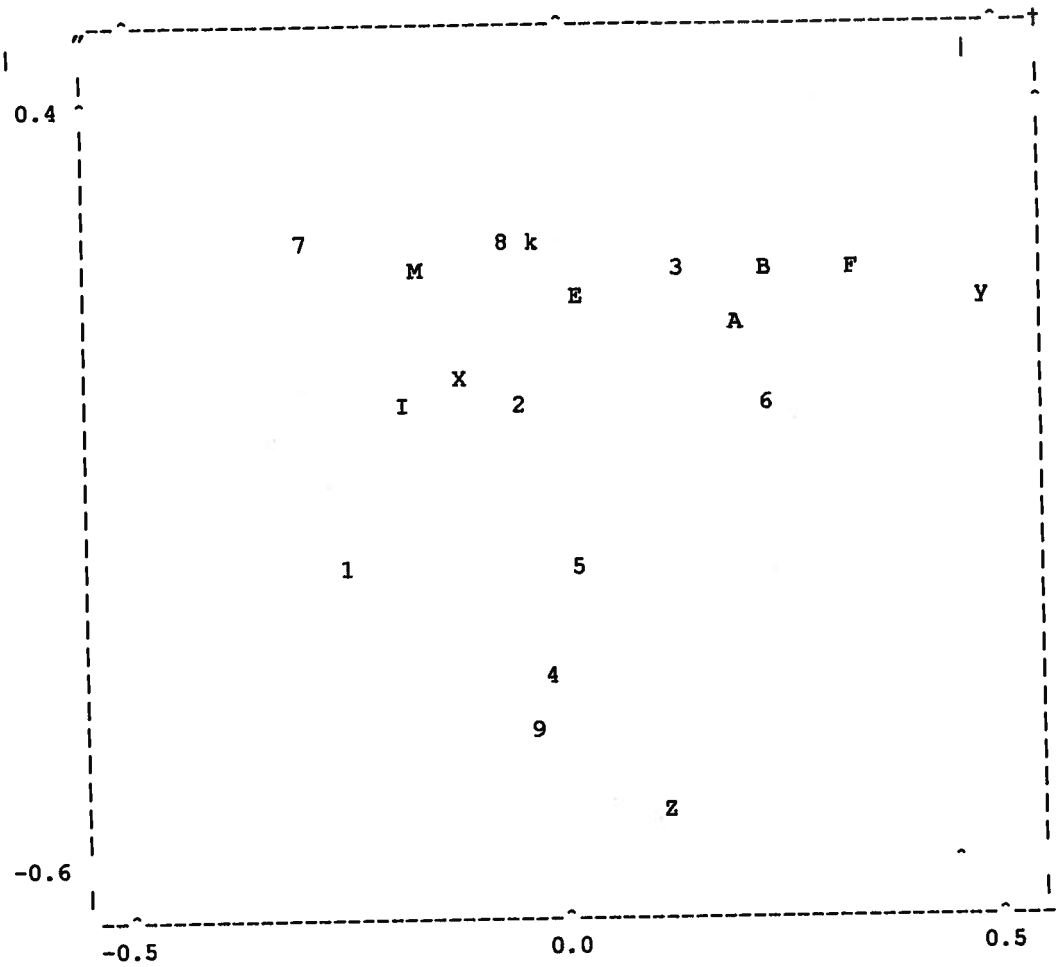
The concentration of obesity among urban women has been reported (Martorell, 2001). The findings of the survey revealed that the levels of overweight and obese mothers were more in the urban centres with 18.6% of mothers overweight and 9.0% obese compared to 12.6% and 13.4% of overweight mothers, and 4.6% and 4.8% of obese mothers in the rural and medium areas respectively. The rural, urban disparity is consistent with the findings of a study in Congo, which reported that the tendency to obesity was almost absent in rural Congo while 30% of urban women are obese (FAO, 1994). The Congo study linked higher socio-economic status with increased prevalence of obesity. While genetic factors could play a role, dietary and lifestyle factors are usually implicated.

In our study, several (observed and derived) response variables were studied using a variety of statistical and mathematical tools. With respect to BMI, initial examination of the association among variables suggested that BMI might be strongly linked with

certain micronutrients, notable vitamin A, vitamin E and iron (further details in next section and **Figure 88)**. This is further confirmed in the logistic modelling of obesity (binary responses) as presented in **Appendix 8-4 and 8-5** for the combined data set (all zones) as the multi-category BMI levels could not be pursued for the national data due to violation of some basic statistical assumptions (proportional odds assumption).

However, it was possible to fit the full multi-category model separately by zones. The body mass indexes of mothers had been categorized into Malnourished, Normal, Obese-Grade1, and Obese-Grade2. Considering a response (BMI code), which indicates one of the categories for a given woman, a multi-category logistic analysis was performed to identify factors that are associated with the body mass index of a woman. Since the response has categories that can be ordered, logistic models that can incorporate the ordering was employed. This results in models that have simpler interpretation and potentially greater power than ordinary category logit models. The effects of the explanatory variables from dry savanna **(Table 97)** are found to be different for all levels of the response; thus, proportional odds model is not appropriate (Score Test $p=0.0060$). A generalized logistic model was therefore fitted using the lowest level (malnourished) as a reference and the results are given in **(Table 97)**. The variables age of mother, age of household head, state, and sector were found to be significantly associated with the logits ($p<0.0046$).

Figure 88. Biplot of malnutrition of mothers by states



Legend: B- malnourish; X – low affordability; A – VAD; E – VED; F – Iron Deficiency; Z – Zinc Deficiency; I – Iodine Deficiency; State 1-9 correspond to State 01-09 respectively; y – Bayelsa; M is Imo; k – Akwa Ibom.

Table 97.The fitted Generalized logistic model for the Dry Savanna Zone

Pameter	BMI_code	DF	Estimate	Standard Error	Wald Par Chi-Square	Pr > ChiSq
Intercept	Obese Grade2	1	-5.6149	0.7357	58.2434	<.0001
Intercept	Obese Grade1	1	-2.895	0.4333	44.6365	<.0001
Intercept	Normal_Range	1	0.0552	0.3117	0.0314	0.8595
AGEOFMOTHER	Obese Grade2	1	0.0588	0.0259	5.1399	0.0234
AGEOFMOTHER	Obese Grade1	1	0.0603	0.0168	12.8266	0.0003
AGEOFMOTHER	Normal_Range	1	0.028	0.0125	5.0641	0.0244
HH_head_Age	Obese Grade2	1	0.0569	0.0177	10.2684	0.0014
HH_head_Age	Obese Grade1	1	0.0304	0.0119	6.4926	0.0108
HH_head_Age	Normal_Range	1	0.0197	0.00891	4.8639	0.0274
STATE 03	Obese Grade2	1	0.00993	0.2492	0.0016	0.9682
STATE 03	Obese Grade1	1	-0.3749	0.1397	7.2053	0.0073
STATE 03	Normal_Range	1	-0.3486	0.1021	11.666	0.0006
STATE 05	Obese Grade2	1	0.2232	0.348	0.4115	0.5212
STATE 05	Obese Grade1	1	0.8227	0.1705	23.278	<.0001
STATE 05	Normal_Range	1	0.709	0.1359	27.2259	<.0001
SECTOR 01	Obese Grade2	1	-0.3107	0.2266	1.8797	0.1704
SECTOR 01	Obese Grade1	1	-0.2526	0.1285	3.8657	0.0493
SECTOR 01	Normal_Range	1	-0.1066	0.0916	1.3535	0.2447
SECTOR 02	Obese Grade2	1	-0.1966	0.2372	0.6868	0.4073
SECTOR 02	Obese Grade1	1	-0.0975	0.1354	0.5179	0.4717
SECTOR 02	Normal_Range	1	0.1444	0.0955	2.2856	0.1306

The fitted model describes the logits of being in the three higher levels of the response variable using the first level as a base level. There are three different logistic equations in the fitted model which assumes that the effect of each predictor variable vary depending on the levels of the response variable. From the fitted model we observe that there is a significant effect of age of mothers and household head on the probability of being in the higher levels of BMI as compared to the lowest level. Mothers in Borno state have a significantly lower probability of having normal and obese-grade1 BMI while in Kebbi state there is a high likelihood of having normal and obese-grade1 BMI. There is no significant difference among the sectors except in rural areas where we observe a significantly lower probability of having obese-grade1 BMI. The interpretations of this model are clearer in terms of odds ratio. The odds ratios for the fitted model with 95% confidence intervals are given in **Table 98.**

Table 98. Odds Ratio Estimates for the Dry Savanna Zone

Effect		BMI_code	Point Estimate	95% Wald Confidence	Limits
AGEOFMOTHER		Obese Grade2	1.061	1.008	1.116
AGEOFMOTHER		Obese Grade1	1.062	1.028	1.098
AGEOFMOTHER		Normal_Range	1.028	1.004	1.054
HH_head_Age		Obese Grade2	1.059	1.022	1.096
HH_head_Age		Obese Grade1	1.031	1.007	1.055
HH_head_Age		Normal_Range	1.02	1.002	1.038
STATE	03 vs 06	Obese Grade2	1.275	0.643	2.527
STATE	03 vs 06	Obese Grade1	1.076	0.713	1.624
STATE	03 vs 06	Normal_Range	1.012	0.764	1.34
STATE	05 vs 06	Obese Grade2	1.578	0.541	4.608
STATE	05 vs 06	Obese Grade1	3.563	2.099	6.048
STATE	05 vs 06	Normal_Range	2.913	1.925	4.41
SECTOR	01 vs 03	Obese Grade2	0.441	0.202	0.963
SECTOR	01 vs 03	Obese Grade1	0.547	0.343	0.873
SECTOR	01 vs 03	Normal_Range	0.933	0.655	1.33
SECTOR	02 vs 03	Obese Grade2	0.495	0.219	1.118
SECTOR	02 vs 03	Obese Grade1	0.639	0.392	1.042
SECTOR	02 vs 03	Normal_Range	1.2	0.832	1.73

As can be seen from **Table 98**, for higher age of mothers and head of a household, the odds of having higher level of BMI increases. This is also observed in Borno state as compared to Kano state. The odds of having obse-grade1 and normal BMI in Kebbi state are 3.56 and 2.91 times the odds in Kano state respectively. Moreover, Mothers who are live in rural areas have lower odds of having obese-grade1 and normal BMI than those who are other areas.

Moist Savanna Zone: Fitting the Cumulative Logit Model for BMI

An association analysis of sector and BMI categories indicates that they are significantly associated (p-value=0.0052), while this is not the case for BMI and the States in the moist savanna zone (p-value=0.2994). In modeling BMI for moist savanna, univariate models were first fitted taking each predictor separately and those predictors, which were significant at 25% level, were included in the multiple logistic regression stage. Eleven were fitted (age of mother, primary source of water for drinking and other domestic uses, cost of own purchase, number of women, duration of breastfeeding of the last child, borrow money to buy food stuffs, annual income, index2, education of head of household, sector and iodine). Final model is given in **Table 97.** It was as usual

important to assess the model fit together with the possibility of the proportional odd assumption. The tests indicate that both proportional odds assumption (p-value=0.0819) and goodness-of-fit assumptions hold.

Type III analysis of effects in **Table 97** reveals that age of mother, education level of head of household and sector are significant. Age of mother was highly significant with an odds ratio of 0.95. This means that the odd of a mother falling in a given BMI level and below versus above reduces by a multiplicative power of 0.95 for each year increase in age. As a mother becomes old, the odds of falling below normal versus above reduce which may imply that there are high chances of becoming obese a mother grows old. Looking at sector, the likelihood of mother being malnourished in the rural sector is 60 percent higher than in the urban sector. From the maximum likelihohood estimate Household head's education level 1 is significant and associated with malnourished.

Fitting the Cumulative Logit Model for BMI in the Humid Forest Zone

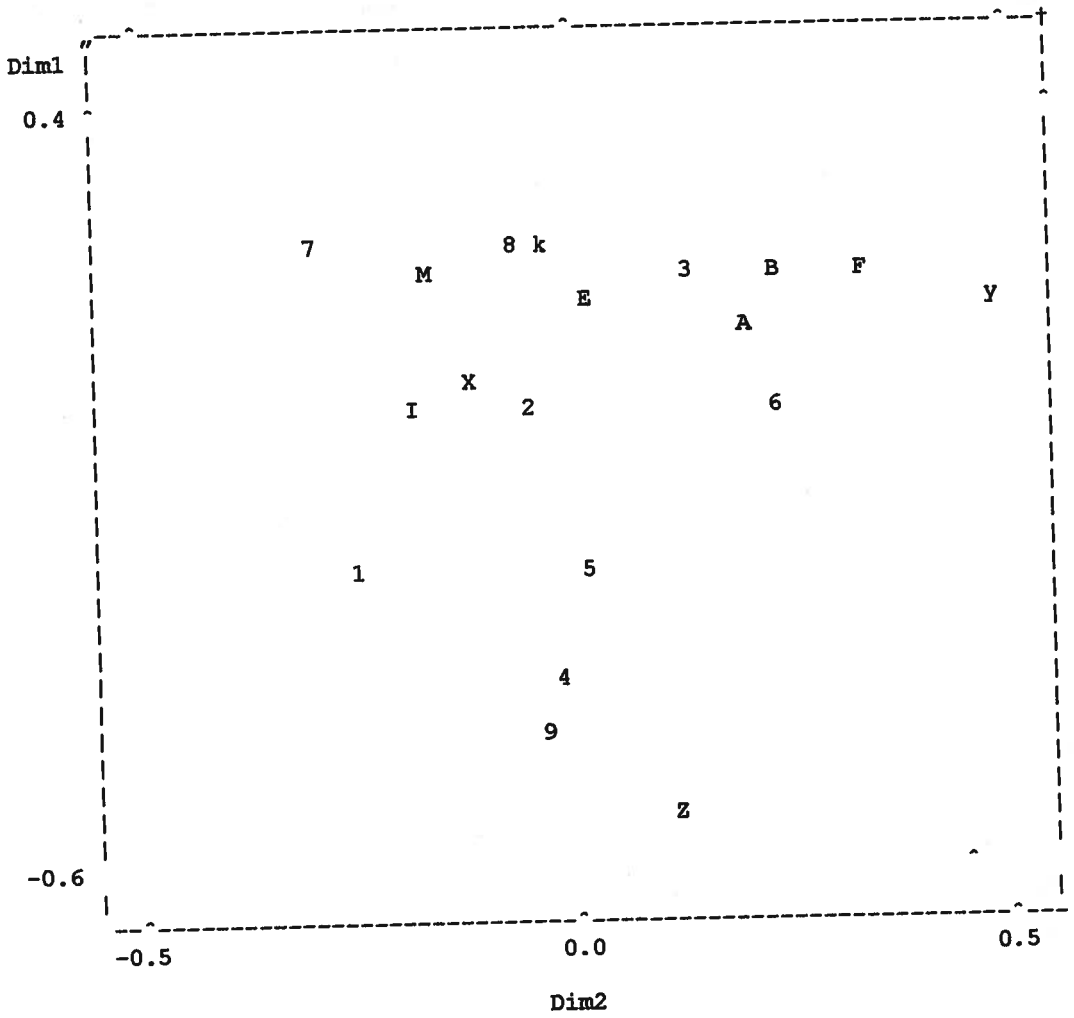
In the search for plausible models, the forward, stepwise and backward selection procedures were explored. Two separate models are presented. Key explanatory variables are indicated under the effect column in **Appenidx 8-6.** Before interpreting the parameter estimates, the model assumptions were checked. The score test for the proportional odds assumption had a chi-square value of 46.1526 with 34 degrees of freedom and a corresponding p-value of 0.0798. Thus assumption of proportional odds ratio was fulfilled. **Appenidx 8-6.** gives the type III analysis of effects. All the covariates apart from sector are significant with p-values less than 0.05. The parameter estimates of the model are given in **Appendix 8-7**.

We then modeled probabilities of levels of BMI code having Lower Ordered Values (towards malnourished). The levels of BMI vary statistically from state to state. From **Appendix 8-7** we observe that controlling for other factors in the model, women in Osun and Akwa-Ibom State are more likely to be malnourished than those in Edo, Imo and Bayelsa. Mothers from high-income groups move towards obesity, while low income ones move towards malnourishment. The relatively unlimited ability to purchase food by the high-income group could be a possible explanation for the tendency towards obesity, while poverty could be the reason for malnourishment. From the maximum likelihood estimates for Education, it can be inferred that mothers from non-educated headed household are more than 50% more likely to be malnourished in humid forest (based on odds ratios which are not shown).

6.8 Micronutrient status of mothers

In analysing the biochemical variables from our study on women, several procedures were evaluated. **Figure 89** provide results of analysis based on the contingency table of deficiency of micronutrients (and malnourishment) with the 12 states studied. Correspondence analysis provided a simple basic illustration of the extent of malnourishment (BMI < 18.5), vitamin A, vitamin E, iodine, zinc and iron deficiencies in women when viewed together, and their relative spread among the states. The first two dimensions used accounted for 74% of the total chi-square suggesting reliability of plots produced in **Figure 89.** From the plot, one can deduce association of vitamin A, vitamin E, iron deficiencies and malnourishment with Borno; vitamin E with Edo, Akwa-Ibom and possibly Imo; iodine deficiency among women in Taraba; while the closest state with possible association with zinc deficiency is Kwara.

Figure 89. Biplot of malnutrition of mothers by States



Legend: B- malnourish; X – low affordability; A – VAD; E – VED; F – Iron Deficiency; Z – Zinc Deficiency; I – Iodine Deficiency; State 1-9 correspond to State 01-09 respectively; y – Bayelsa; M is Imo; k – Akwa Ibom.

Detailed modelling of the relationships between the levels of deficiencies and other variables were further explored and are reported further. Examination of **Appendix 8-7** suggests that most of the variability in the observed micronutrient variables cannot be accounted for by the survey stratification variables – states, local government areas, enumeration areas, as over 80% of the variability is due to error. This suggests considerable emphasis needs to be placed on future intervention strategies at the household level. Further study of the analysis of fixed effects of the malnutrition variable, BMI, identifies vitamin E deficiency levels as the only observed micronutrient

variable where differences in BMI significantly differ **(Appendix 8-8).** Vitamin E deficient mothers have significantly lower BMI values than those who are not deficient, despite the small difference in BMI values indicated in **Table 99.**

Table 99. Least Squares Means of BMI by Vitamin E deficiency levels

Effect	VitED	Estimate	Standard Error	DF	t Value	Pr>|t|
VitED	E_Def	21.4778	0.5459	4362	39.34	<.0001
VitED	E_NotDef	21.8824	0.5245	4362	41.72	<.0001

Differences Of Least Squares Means

Effect	VitED	_VitED	Estimate	Standard Error	DF	t Value	Pr>|t|
VitED	E_Def	E_NotDef	-0.4046	0.1645	4362	-2.46	0.0139

Vitamin A Deficiency (VAD)

The national figure for those at risk of VAD was about 13% with dry savanna having the highest rate of 19.6%, moist savanna 14.5% and humid forest 8.8%. VAD may be an important factor contributing to maternal mortality and to poor pregnancy and location outcomes as well as night blindness in women. Available data from the 1993 PIC study showed that the prevalence of VAD was 7.3% in mother (FGN/UNICEF, 1994). The data also agreed that VAD is heavily concentrated in the north of the country with rate of 15% in north west, 9% in north east, 4% in south east and 2% in south west. We cannot accurately deduce from this study that the VAD is on the increase in Nigeria partly because of differences in methodology used in the two studies. The PIC study employed the old colorimetric method of Neeld and Pearson (1963) and concentrated only on the UNICEF focal LGA while the present study used the more sensitive reversed-phase HPLC method of Catignani and Bieri (1983) and all country inclusive multi-stage sampling procedure to select mothers.

Results from the study of possible determinants of VAD (VAD=A_Def) from biochemical and non-biochemical variables for the combined data set using stepwise logistic procedure identified the classification variables state and sector as contributing significantly in the model. However, further desegregation of analysis by agroecological zone provided a clearer picture as to variables likely to influence VAD. However, no appropriate model could be obtained for the humid forest from the variables available.

The results of the analysis of data in dry savanna are given in **Table 100.** The global test for the fitted model was found to be significant (p=0.0006) indicating that at least one of the predictor variables has a significant association with the response.

From the fitted model, we observe that the risk for vitamin A deficiency of a mother have a significant association with her age, age of household head and the state where she is leaving. In particular, the odds of having vitamin A deficiency in Borno state is 2.2611 times the odds in Kano state. Moreover, for a one-year increase on the age of household head, the odds of risk to vitamin A deficiency decreases by 4%. The model also suggests that a one-year increase in the age of a mother, the odds of having vitamin A deficiency increases by 5.8%.

The adequacy of the fitted model was examined through Hosmer and Lemeshow Goodness of fit Test statistic, which is appropriate for the case of continue predictors. Based on the predicted probabilities, the observations were grouped in to ten and then the expected and observed number of VAD was computed. The test revealed that the fitted model is good for the data with p-value of 0.1238. Moreover there is about 63% concordance of the predicted probabilities and observed responses this is also supported by Somers' D tests statistic (p= 0.287). No influential observation was found.

Table 100. Fitted logistic model (maximum likelihood and odds ratio estimates) for VAD in the dry savanna

		Standard			
	Estimate	Error	Chi-Square	Pr> Chisq	
Intercept	1	-3.3182	0.5995	30.6382	<.0001
STATE	1	0.4206	0.1859	5.1195	0.0237
STATE	1	-0.0253	0.2258	0.0126	0.9108
AGEOFMOTHER	1	0.0507	0.0261	3.767	0.0523
HH_head_Age	1	-0.0346	0.0203	2.9026	0.0884
Odd ratio estimate	0.95		**Point**	**95%**	**Wald**
Effect			**Estimate**	**Confidence**	**Limits**
STATE	3 vs 6		2.261	1.206	4.241
STATE	5 vs 6		1.448	0.674	3.111
AGEOFMOTHER			1.052	1	1.107
HH_head_Age			0.966	0.928	1.005

The Type III analysis of effects of the fitted model for the moist savanna imply that coping strategy 3, (borrow money to buy food stuffs) for example, has an association with vitamin A status; that, there is an association between sector and vitamin A status in mothers. The odds ratio of 2.070 associated with strategy3 level 2 means that the odds of a mother being vitamin A deficient versus not increases by a multiplicative factor of 2.07 when a mother opts to rely on less expensive foods other than purchase food on credit. Similarly, the odds of being vitamin A deficient in mothers located in medium sector is almost 8 times that of the urban woman. Mothers in Taraba State are 17 times more likely of being vitamin A deficient than those in Kwara State.

Vitamin E Deficiency (VED)

The median Vitamin E concentration for women nationally was 7.3µg/dl with about 87% of the women with normal serum Vitamin E level and 13% with VED. To date there has been no national nutrition survey that assesses the Vitamin E status of mothers and to the best of our knowledge this is the first time that VED is assessed in women in Nigeria.

Modelling VED (=Deficient) identifies state variable and source of main toilet as key explanatory variables from among a range of demographic, health and survey stratification variables. Further examination of the maximum likelihood estimates suggests STATE as only plausible variable.

From the odds ratios and maximum likelihood estimates of final model and with reference to the 13% at risk of vitamin A deficiency observed in the sample, it may be inferred that surveyed mothers in states Nasarawa, Imo and Bayelsa are more likely to be Vitamin E deficient relative to other states.

Iron Deficiency (IronD)

In the present survey, approximately 24% of mothers are of different stages of iron deficiency with about 13% of them already with iron stores (serum ferritin value of less than 12µg/dl) suggestive of Iron deficiency anemia. The most recent data reported 25% anemia in mother using hemoglobin concentration methods defining anemia as Hb≤12µg/dl. Despite limitations imposed by methodology and sampling procedure in the PIC study, we could carefully say that the WSE goal of reduction of IDA in women by one third of the 1990 level by year 2000 may have been achieved in Nigeria.

A key variable influencing the status of iron deficiency is the level of household income. Controlled for effect of states, analysis of the logistic model suggests that low-income homes have lower probabilities of iron deficiency relative to the highest income group .

Further partitioning of the analysis by agroecological zone gave useful results. The fitted model based on the selection procedure for the probability of having iron deficiency in the dry savanna is given in **Table 101**. The likelihood ratio for the global hypotheses was found to be significant (<. 0001). From the model, we observe that the probability of having iron deficiency is significantly associated with food related coping strategies and state. There are lower odds of having iron deficiency among mothers who have used the following strategies: rely on help from a relative or fiend outside the household, ration money to household members to buy street foods, and reduce number of meals eaten in a day. In particular, women who rely on help from a relative or friend outside the household had significantly lower odds (30% lower) of having iron deficiency than those with other strategies. The odds of observing iron deficiency in Borno were more than one and half times that of Kano.

Hosmer and Lemeshow Goodness of fit test was used to examine the appropriateness of the fitted model, and hence the validity of the conclusions. The results are given in table 9. The test supports the adequacy of the model with a p value of 0.7216. This indicates that the variables included are sufficient for predicting the response using the fitted model.

Table 101. Fitted logistic iron deficiency model for the dry savanna zone: Odds ratio estimate

Parameter	DF	Estimate	Standard Error	Wald Chi-Square		Pr > ChiSq	Estimate		95% Confidence
Intercept		1	-0.8753	0.0754	134.9	<.0001			
Strategy6		1	-0.3159	0.1334	5.606	0.0179	0.729	0.561	0.947
Strategy8		1	-0.3171	0.2116	2.247	0.1339	0.728	0.481	1.102
Strategy10		1	-0.2592	0.1736	2.229	0.1354	0.772	0.549	1.084
STATE	3	1	0.2335	0.0805	8.418	0.0037	1.618	1.26	2.078
STATE	5	1	0.0143	0.0974	0.022	0.8833	1.3	0.952	1.775

For the moist savanna agroecological zone, significant variables for fitting iron deficiency included age of mother, annual income, household head education, and state.

For the humid forest zone, Sector, State, BMI code, vitamin E deficiency and zinc deficiency were found to be significant **(p-values in Table 102).**

States: 1=Nasarawa; 2=Taraba; 3=Borno; 4=Kaduna; 5=Kebbi; 6=Kano; 7=Osun; 8=Edo; 9=Kwara; 10=Imo; 11=Bayelsa; and 12=Akwa Ibom.

Table 102. Type III Analysis of Effects for iron deficiency model for mothers in the humid forest zone

Effect	DF	Chi-Square	Pr> ChiSq
STATE	4	46.1566	<. 0001
SECTOR	2	10.2463	0.006
BMI code	3	7.2126	0.0654
Vitamin E deficiency	1	6.2769	0.0122
Zinc deficiency	1	2.5787	0.1083

The probability modelled is probability of having iron deficiency. Taking the urban sector as the base line, we observe that women in urban areas are less likely to be iron deficient. Women in the rural sector are also less likely (or as likely) to be iron deficient compared to the urban sector. On the other hand women in Osun state and Imo state are less likely to be iron deficient compared to women in Akwa Ibom state while the odds of iron deficiency of women in Edo state and Imo are not significant from the odds of iron deficiency in Akwa Ibom state. Women who are malnourished or are obese grade 1 are less likely to be iron deficient compared to obese grade 2 women while the odds of iron deficiency for obese grade 2 women are not significantly different from the odds of iron deficiency of women who are of normal range of BMI. In addition, we observe that women who are vitamin E deficient are less likely to be iron deficient while the zinc deficient are more likely to be iron deficient.

Zinc Deficiency

Zinc nutrition is important because of its influence on the development and integrity of immune system as zinc is directly related to protein synthesis and cell division. The prevalence of zinc deficiency in Nigeria mothers was about 28%. This present study is the first attempt to assess the zinc status of Nigerian women, to the best of knowledge, as vitamin A, Iron and Iodine are the only micronutrient deficiencies that are thought to be of any public health significance.

In fitting the model for zinc deficiency, several variables were examined with the stepwise logistic procedure. These variables included agroecological zone, state, sector, household head education, annual income, primary occupation, refuse disposal system, primary source of water, source of energy, main toilet facilities, practice of exclusive breastfeeding, and food coping strategies.

The final model involved the location of mothers (state), annual income and food coping strategies 1 (reliance on less preferred food) and 9 (Limit food intake in favor of children).

Iodine Deficiency

Iodine deficiency is another major threat to the health of Nigeria women with an estimated 25 to 35 million Nigerians at risk, principally in areas where the soil is deficient in iodine. The most direct evident manifestation of a relatively developed form of IDD is Goiter, the enlargement of the thyroid glands. Historically, Nigeria has had one of the highest Goiter rate in Africa (SAA, 2001). The only nationwide study on IDD carried out in 1993, estimated the sub-clinical IDD on the criterion of low serum thyroxin (T4) to be 44% for mothers and 12% when the criterion of elevated Serum Thyroid Stimulating Hormone (TSH) is used.

In the present study, 35% of the mothers had varying degrees of iodine deficiency and 39% had more than adequate intake of iodine using the urinary iodine excretion methodology. Among the mothers, 20% with possible excess and 35% with deficiency gives over half (55%) running the risk of adverse health consequences related to iodine nutrition. To the best of our knowledge, this is the first time where more than adequate and possible excess iodine intake is reported and its antecedent effect on the salt iodisation policy of the country. Iodine deficiency is being tackled through promotion of iodised salt consumption with over 98% of Nigeria household reported to be consuming iodised salt.

Two explanatory models for iodine deficiency were obtained form the study. The first model had state, annual income level of household and primary source of water as key variables while the second had only state as the explanatory variable.

6.9 Overview of models of predicted deficiency probabilities for mothers

For the mothers, the cut off limits used in constructing the tables useful for future intervention strategies were as follows:

Probability of deficiency	<0.1	Very Low
	0.1 to <0.3	Low
	0.3 to <0.5	Moderately High
	=>0.5	High

Predicted probabilities associated with various deficiencies were generally lower than those for the under-five child.

6.10 Micronutrients status of pregnant women

Statistical distributions of the measured biochemical variables for the pregnant women show uni-modal peaks for all, while vitamin A (not shown) and vitamin E are similar and normally distributed. Zinc is approximately normal with respect to skewness, but markedly peaked (leptokurtic). Iron and iodine are positively skewed. These distributions are shown in **Figures 90.**

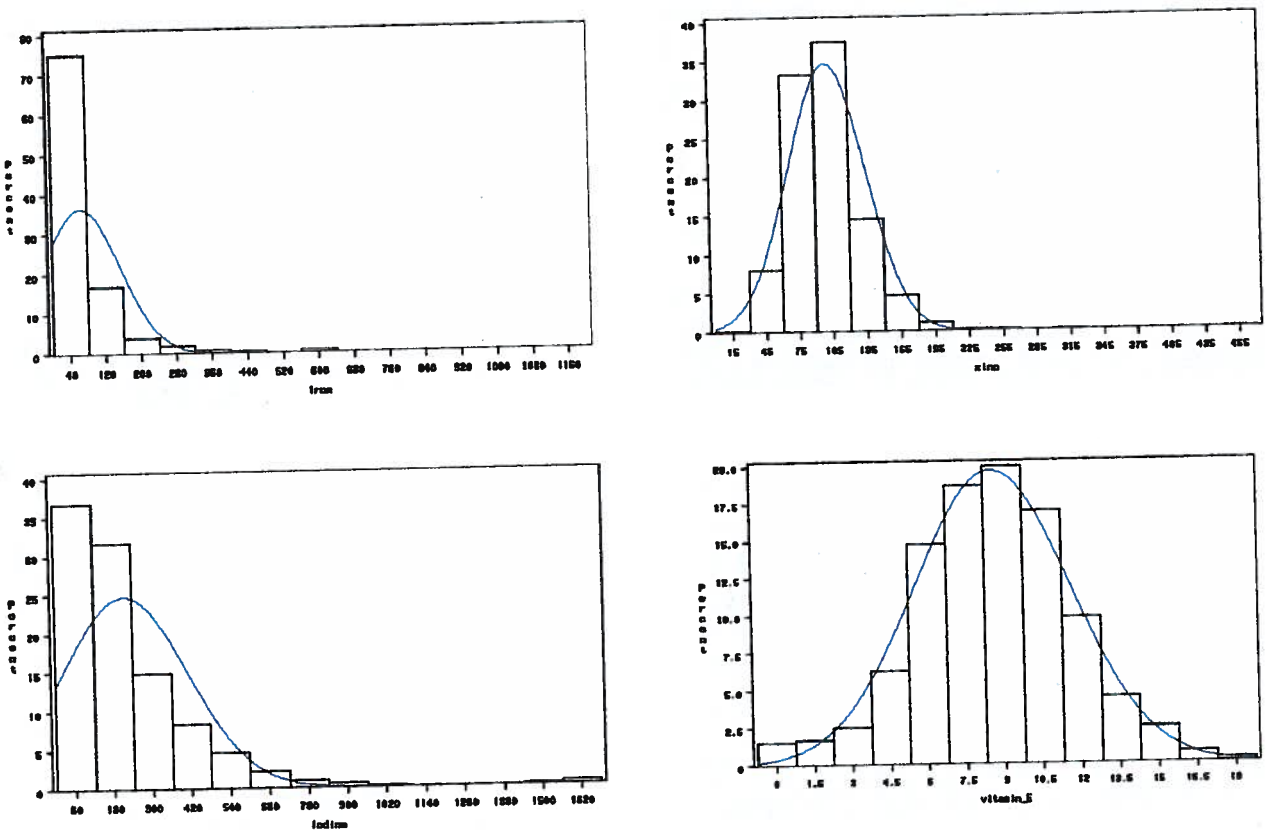


Figure 90. Statistical distributions of the measured biochemical variables for the pregnant women

Analyses of the distribution of total variance indicates that most of the variation in the observed biochemical variables is either at the household level or unaccounted for. The situation for zinc **(Table 103)** is slightly different with about 12% of the variation at the level of Enumeration Areas.

The study has revealed that the 5 biochemical variables observed in the study can be classified into 3 independent clusters: vitamin A and E in one cluster, iron and zinc in another, and iodine on its own **(Table 104)**. Biological and ecological basis of these relationships need to be examined.

Table 103. Variance Components Estimates for biochemical variables from pregnant women.

Variance Component	Vitamin_A	Vitamin_E	Zinc	Iodine	Iron
	Estimate	Estimate	Estimate	Estimate	Estimate
Var(STATE)	1.39	0.62	5.98	1141.5	0
Var(EA)	5.43	0.9	58.47	1730	12.01
Var(LGACODE)	2.54	0.43	129.13	3454.4	996.22
Var(Error)	174.04	7.65	840.96	32094.2	6581.2
Total Variance	183.4	9.6	1034.54	38420.1	7589.43

Table 104. Classification of biochemical variables from pregnant women using Oblique Principal Component Cluster Analysis

ObliquePrincipalComponentClusterAnalysis					
		R-squared With			
		Own	Next	1-R**2	Variable
Cluster	Variable	Cluster	Closest	Ratio	Label
1	vitamin_E	0.5935	0.0002	0.4066	Vitamin_E
	Vitamin_A	0.5935	0.0003	0.4066	Vitamin_A
2	Iron	0.5342	0.001	0.4662	Iron
	Zinc	0.5342	0.002	0.4667	Zinc
3	Iodine	1	0.0025	0	Iodine
		Inter cluster correlation			
Cluster	1	2	3		
1	1	-0.01948	-0.00732		
2	-0.01948	1	-0.05019		
3	-0.00732	-0.05019	1		

The statistical design used in the study had agroecological zone as fixed category, and State, LGA, EA and households as random effects. Consequently, mixed model analysis with the mentioned random terms was used to identify any differences in

biochemical variables among the fixed agroecological zone levels. The results are presented in **Tables 105 and 104**. It was observed that with respect to vitamin A, differences exist among agroecological zones. However, only the humid forest can be said to have significantly different (higher) vitamin A values. However, no differences in vitamin E and iodine levels **(Table 104)** of pregnant women could be established among pairs of agroecological zone levels. While all levels of agroecologies differ from each other with respect to iron only the moist savanna and humid forest can be considered different when zinc is the response variable **(Table 104).**

Table 105. Analysis of agroecological zone of vitaminA (Mixed model procedure and Variance in Table 104).

Type 3 Tests of Fixed Effects							
			Num	Den			
Effect			DF	DF	F Value	Pr > F	
AEZ			2	8.67	10.07	0.0055	
Least square means							
Effect		AEZ	Estimate	Std.Error	DF	t Value	Pr > |t|
AEZ		1	35.3539	1.2292	6.76	28.76	<.0001
AEZ		2	37.8033	1.195	11.2	31.64	<.0001
AEZ		3	42.3366	1.0375	9.12	40.81	<.0001
Differences of Least Squa res Means							
				Standard			
Effect	AEZ	AEZ	Estimate	Error	DF	t Value	Pr > |t|
AEZ	1	2	-2.4494	1.7105	8.43	-1.43	0.1882
AEZ	1	3	-6.9827	1.6085	7.62	-4.34	0.0028
AEZ	2	3	-4.5334	1.5798	10.2	-2.87	0.0164

Vitamin A

The prevalence of Vitamin A deficiency recorded in this study is 19.2% for pregnant women. The pattern of deficiency shows a decrease from the dry Savanna (30.8%) to moist savanna (20.4%). The humid forest zone recorded a high prevalence (26.3%) rate than moist savanna. The pattern of deficiency prevalence was a little different in mothers with a steady decrease from dry to moist savanna and humid forest having the lowest. This was the pattern also recorded by the earlier (PIC, 1993) report for women of childbearing age.

One survey of pregnant women (Adeyefa, 1991) in the humid forest zone, found a VAD prevalence of 13.6%. It appears therefore that about 80% f pregnant women can be considered to have good Vitamin A nutriture. It is sometimes argued that VAD prevalence could be significantly higher during the third trimester of pregnancy as well as in lactating women. The consequence of this (intra-uterine nutrient restriction, growth retardation, increased mortality and morbidity etc) for the 20% or more of these pregnant women demand continued targeted intervention.

Vitamin E

The prevalence of Vitamin E deficiency in the country is 12%. The pattern of deficiency shows a decrease from the humid forest (14.6%) through moist savanna to dry savanna (7.6%). There are no previous prevalence data with which to compare the present value.

Iron

This survey chose to assess Iron status (mainly Iron deficiency) using ferrum only. Serum ferritin has been demonstrated to be a reliable and sensitive parameter for assessing Iron stores in healthy subjects. Our results show a prevalence of Iron deficiency above 50 % nationally. This is despite the existence of several Iron supplementation programme in many parts of the country. There is no doubt that malaria and other sub-clinical infections contribute to this observed Iron status suggesting Iron deficiency prevalence of greater magnitude. It is noteworthy however that the PIC (1993) study using haemoglobin values, recorded anaemia prevalence of 24.9% in women aged 15-45 years.

Zinc

Nationally only 56% of pregnant women enjoy normal Zinc status, meaning that over two-fifths were zinc deficient. There are very few studies of pregnant Nigerian women with which to compare these values. This is despite the fact that zinc appears to be abundant in the Nigerian environment. Very many houses in both urban and even rural sectors have galvanized roofing sheets from which rainwater is collected for domestic use. Besides galvanized pots, buckets and eating bowls are very common household items throughout the country. The contribution, if any, of all of these factors to Zinc nutritional status needs to be investigated.

Iodine

The prevalence of iodine deficiency among pregnant Nigerian women is 33.6%. Subjects in the moist Savanna Zone and Rural sector seem to share the highest prevalence burden. Generally however, about a quarter of pregnant women in the other agro-ecological zones and sectors are also Iodine deficient. Given the well known maternal Iodine deficiency conditions on mother and fetus, the prevalence rates among pregnant women is a matter of concern. Iodine deficiency in pregnant women can lead to miscarriages and stillbirths. The consequence of Iodine deficiency during pregnancy is impaired synthesis of thyroid hormones by the mother and the fetus (Delange and Hetzel, 2003). Such inadequate supply of thyroid hormones to the developing brain can result in mental retardation, rate of cell differentiation and gene expression (Glinder and Delange, 2000). This can lead to poor early childhood development, school readiness and academic/intellectual achievement. If uncorrected, it ca lead to poor adult productivity.

A prevalence rate of over 30% among this category of Nigerian women is rather unexpected given the success of USI programme in the country. A 98% salt iodisation level has been achieved in the country since 1998 and a recent survey (IDD Task Force, 2003) confirmed that level. Analyses of salt samples collected during survey showed varied iodine levels and could not yet be related to individual intake. Also although accurate national data on salt intake are not available, an estimate of 5.5g per person per day (UNICEF, 2003 – personal communication) was recently provided.

However, a study in Borno (NE Nigeria) recorded a daily salt intake by women of 7.2g per person (Oguntona et. al. 1989). With these levels of possible intake, the recommended daily intake of Iodine (200µg) for pregnant women should readily be met from iodized slat. It would probably be necessary to examine the interplay of factors that could reduce intake of this mineral in the home environment. Across all zones and sectors, about a third (27-35%) of pregnant women are found to have optimal iodine status. No comparable data were provided by the PIC, (1993) survey.

Using the latest ICCIDD/WHO/UNICEF (1996) classification, a high percentage (27%) of pregnant subjects are classified as having excess iodine and run the 'risk of adverse health consequences (Iodine-Induced Hyperthyroidism (IIH)), autoimmune thyroid diseases'. It appears to be a pervasive problem and its prevalence is over 40% in all the zones as well as in Urban and medium sectors. Such a high prevalence of high urinary iodine level must be a matter for concern to all stakeholders. Increased incidences of IIH following iodine supplementation programs have been reported in many countries in the past (Todd, 1998) and remedial measures have always been taken to control the condition. The basis for concern with regards to pregnant women include:

- The consequences on the fetus of excessive intake of iodine by pregnant women are still unknown

- Risk of iodine-induced hyperthyroidism usually follows high levels (200-299µg/L) of urinary iodine with 5-10 years after introduction of iodized salt in susceptible subjects

- The consequences of excessive iodine intakes on under-5 children are still unknown.

CHAPTER 11
POLICY IMPLICATIONS AND RECOMMENDATIONS

In November 2002, Nigeria launched a National Policy on Food and Nutrition as a means of confirming government's commitment to matters related to food and nutrition. The policy provides guidelines on how government intends to address the multifaceted problems of food and nutrition in Nigeria.

The objective of this section is not to review that policy but to highlight key aspects of the findings in this survey that have significant bearing in overall development policy of the country. In this context, the discussion will be against the background of the new set of development goals set by the World's heads of state and governments at the Millenium summit in September 2000. The new goals to be achieved by the year 2015, seek to, among other things, "Havle the proportion of the World's population living in extreme poverty (defined as those living in less than US$1.0 per day) and those who suffer from hunger"

The broad picture provided by the results of this survey is one of widespread poor nutritional status of under-5 children, their mothers and pregnant women. It is a scenario of pervasive malnutrition at the macro and the micronutrient levels throughout the country. Such a scenario has serious consequences for all the sectors of national development especially the key sectors of Health, Education and Economy. Using PROFILES – a process for Nutrition policy analysis and advocacy, developed by Academy for Education Development (AED), the functional consequences of malnutrition in Nigeria were calculated in 2001. The results showed that if no actions were taken, between 2001-2010, the consequences for survival (Health), Intelligence (Education) and Productivity (economy will be monumental. Specifically for:

i. Health: It was calculated that human losses will include
   a. 2.5 million child deaths due to malnutrition
   b. 300,000 child deaths due to Vitamin A deficiency
   c. 64,000 lives of women of reproductive age lost due to anemia

ii. Education
   a. 9 million newborns with mental impairment due to non-consumption of iodized salt.
   b. Reduction in IQ due to Iodine deficiency

iii. Economy: Productivity losses of 9.7 billion US$ consisting of
   a. 3 Billion US$ due to iodine deficiency
   b. 4.4 billion US$ due to child stunting

c. 2.3 billion US$ due to Iron deficiency anemia

The prevalence rates on which some of these calculations were based in 2001 were in fact lower than the rates obtained in the present survey. The situation therefore begs for immediate action. Actions that will focus on investing in Nutrition because it is the best way for developing human resources for sustainable economic growth and development.

Poverty

Poverty is central to almost all the problems encountered with the subjects in this survey. Over 70% of the households, for example, earned less than ₦55,000 per annum. This amounts to approximately US$1.50 per day per household (consisting on average 6 people). Data apart, evidence of poverty is so pervasive among the population that it has impacted negatively on all facets of their lives. This has reduced their access to many facilities including quality health care.

Consequently because of this poor access, poverty indirectly promotes ignorance. Ignorance in return prevents adoption of new and better health and nutritional practices. The results of this survey showed, many other studies worldwide, that education (especially of mothers) impact positively on quality of care, health, income, and nutritional status among others. This must be one of the rationales behind another millennium goal of achieving Universal Primary Education for all boys and girls by 2015.

The connection between ignorance and poverty is well known and these would have to be considered together in any attempt at achieving the Millennium goals. In view of this, it is absolutely critical for government to more aggressively pursue the objectives of both the Universal Basic Education and Poverty Eradication Programs.

Urban-rural dichotomy

Significant sectoral differences were observed in almost all variables measured in this survey. The differences in most cases are such that the urban sector is always better. This has an important implication for national policy on rural development. The migration of people (especially young economically productive men and women) from rural to urban areas needs to be slowed and stopped if the rural areas are not to be emptied of potential farmers and food producers.

Some of the reasons for the migration to urban areas were obvious from the profile of available infrastructure facilities recorded in the sectors in this survey. Access to education was in favor of urban areas where 44% were not educated compared to 49% in rural areas. On access to electricity, almost five times as many urban dwellers (11%) had access than rural dwellers (51.1%).

There is in existence a government Rural Development Program that seeks to vitalize the rural areas with provision of jobs and more infrastructure facilities. It is therefore very important that this program be strengthened so as to rectify the disparities between the urban and rural sectors.

Food security

In considering the issue of food security in the context of policy implications, two main themes appear critical from the results of this survey: 1) the critical importance of agricultural production and food processing/preservation; and 2) the equally important need for diversification of the cropping systems which will contribute to dietary diversification as a strategy to combat both malnutrition and micronutrient deficiency control.

The three agro-ecological zones used as a sampling frame in this survey covered the principal food crops and all the main staples produced and consumed in Nigeria.[1] Ordinarily, the largest proportion of people in that zone would consume the principal food crops in that zone. For example, the principal food crops in the dry savanna zone consist mainly of legumes; maize, millet and sorghum, while the PFC in the moist savanna include the principal food crops in the dry savanna plus yam and cassava. The principal food crops in the humid forest zone on the other hand consist mainly of cassava, yams, maize, plantain as well as vegetable oils.

Analysis of data from this survey reveal a progressive decline in the availability of cereals especially maize and sorghum from dry savanna zone through moist savanna zone to the humid forest zone. The reverse was the case with yams, cassava and plantains: that is, a progressive increase in the availability of these food crops from dry savanna zone through moist savanna zone to humid forest zone. Some significant findings related include the following:

- The most available staple foods that are major sources of energy (calories) were rice, cassava, maize, and yam. Cowpea, groundnut, and soybean are major source of plant proteins. Cowpea was the most available, followed by groundnuts, and soybean.

- For affordability, the same trends were observed. Rice was the most affordable, followed by cassava, maize, and yam. For legumes, cowpea was the most affordable followed by groundnuts and soybean.

- In the dry savanna, people consume sorghum more than 4 times a week, followed by maize and rice. Yam and cassava are the least consumed. In the moist savanna, more households consumed maize followed by sorghum, rice, cassava, and yam. The least consumed staple is plantain. Among those who responded in the humid forest, consume cassava more than 4 times a week, followed by maize, rice, and yam.

Although food availability is a function of several factors, (prices, household demographic and socio-economic etc) it can be used as a proxy to indicate the level of food security in a particular community. It is obvious from this study therefore that with regards to the principal food crops, there is a wide gap in the supply of some staple food crops (maize and cassava). In fact this study also found that the highest expenditure on staples was in cereals (N644 per week).

The situation is not very different with non-staples. Their availability is highly seasonal. Combined with the high perishability of major non-staple crops like cowpeas, groundnut and soybean, fruits and vegetables and lack of availability for more than 8 months, especially of fruits and vegetables, the overall pattern of food security therefore shows a general decline from the humid forest zone in the south through the moist savanna to the dry savanna in the far north. Meat products, green leafy vegetables, and banana were the least consumed across the zones.

All these have great implications for food production policy in the country. Among these are:

- The need to revitalize the national food production program. Special emphasis needs to be given to cassava, maize, yam, rice, cowpea, and groundnut with the objectives of eliminating the supply and making them available across agroecological zones.

- Increased production of value added products to ensure increased availability of these products throughout the year, consequently programs on food processing/preservation at the farm gate in should be more vigorously promoted.

- A more consistent comprehensive and directional policy on how to provide a cheap easily produced source of animal protein for the largest proportion of the Nigerian population is urgently needed. In this regards, poultry and fish production recommends themselves because of the ease of production and efficiency of feed conversion as well as high production and efficiency of feed conversion as well as high reproductive rate.

- Increased government support for food processing sector involved in processing and preservation of local foods – especially fruits and vegetables.

Micronutrient deficiency

The micronutrients that have been of focus in Nigeria are vitamin A, iron and iodine. Compared to previously available data, the situation appears to have deteriorated with almost all these micronutrients. Iron nutritional status appears to have declined to a prevalence of between 20-35% among the different age groups over the last decade. The same is true for Vitamin A status. Previously the prevalence of Vitamin A was estimated to be 9% while the present survey prevalence was 29.5%. Also the prevalence of iodine deficiency in excess of 16% was recorded in this survey for pregnant women. In addition to these three micronutrients the present survey examined Vitamin E and zinc. For both prevalence rates of over 20% were recorded.

Although micronutrient deficiency control (MNDC) received disproportionate mention in the recently launched National Policy on Food and Nutrition, there are several control programs currently being implemented in the country. These include supplementation, fortification and dietary diversification. All these programs need to be strengthened, widened/expanded and sustained. The policy guiding the several/control programmes needs to be harmonized at the national level. Therefore, it is recommended that:

- A more determined coordinated effort by the government in its Micronutrients Deficiencies Control program is needed. Presently, the components of the program are not co-coordinated. Consequently this does not allow for effective programming, monitoring and evaluation.

- In line with and arising from the broad National Nutrition Policy, recently launched by Government, the National Committee on Food and Nutrition (NCFN) develop a national program on Micronutrient Deficiency Control. This should give directional and focal effect to the several activities designed to control micronutrient deficiencies in the country.

- The current vitamin A supplementation programs should be pursued vigorously especially in areas identified to have high prevalence rates. Service delivery systems that has been shown to be cost effective should be used post NIDs to deliver these supplements on a regular basis.

- An infrastructure framework within the National Committee on Food and Nutrition should be instituted for properly focused supplementation programs coordination (initiation, monitoring, and evaluation).

- However, in view of continued high prevalence of iron deficiency, especially in mothers and pregnant women, continued iron/folate supplementation recommends itself. The effectiveness and efficacy of multi-mineral (e.g. Fe and Zn) tablets/supplements should be further explored for possible promotion and use in the country.

- Furthermore, iron fortification of suitable food vehicles should be carefully promoted. The iron levels for such fortification should be based on adequate information on consumption levels so as to achieve stated objectives.

- In the control of both iron and zinc deficiencies and indeed of all micronutrients, public education and appropriate information is of vital importance. Such education and information will allow people to make informed decisions about their food and greatly assist in controlling micronutrients deficiencies in the country.

- A National Program to promote dietary diversification is also recommended. The frequency of food consumption has revealed the different consumption patterns in each agroecological zone. The program that is being recommended will seek to encourage people to diversify the crops they produce and their diet.

- There is need to formulate a policy on zinc supplementation and fortification of an appropriate food vehicle.

- Government and other stakeholders should continue to encourage, support, and strengthen public-private partnership initiatives as exemplified by the National Fortification Alliance

Programs to control iodine deficiency have been on going in Nigeria for sometime now. Salt iodization has been established and there are reports that over 98% of household consume iodized salt in the country. Data from the present survey shows that despite this improvement, there are still specific areas with high prevalence of poor iodine nutrition (12.4% children, 15% pregnant women and 13% for mothers). In addition, the data from this survey indicates a high percentage of respondents as having possible excess iodine intake (39% in mothers, 23% pregnant women and 46% of children). Such a profile requires that measures be taken immediately to address the issue of iodine nutrition of the population. Consequently, the following recommendations are indicated:

- A comprehensive in-depth study is urgently required to investigate the profile of salt consumption in Nigeria as a whole and the sources of dietary iodine in

areas identified with more than adequate iodine intake and possible excess iodine intake

- An urgent review of the Universal Salt Iodization program with special emphasis on the levels of fortification is imperative

- Adequate training in diagnosing Iodine Deficiency and Iodine Induced Hyperthyroidism (IIH) should be mandatory for all medical personnel from the PHC levels

- Health monitoring must now include data on IIH at all levels

- There is need for a more rigorous campaign to educate and inform people on the implications of excess salt consumption.

Protein energy malnutrition

Protein energy malnutrition in Under 5 children still constitutes a very serious problem in Nigeria. From all indications, the prevalence has not improved significantly during the 1990's. Indeed there are indications that incidence of stunting has increased during the last decade. The continued deterioration of these conditions suggests that the programs that have been pursued so far need to be revisited. This calls for a more concerted and determined effort to control under -5 malnutrition. It is therefore recommended that:

- There is urgent need to explore new and more radical approaches to promote good breastfeeding practices and complementary feeding practices for this age group, if further deterioration of the condition is to be halted and reversed.

- There is need to strengthen existing child survival programs. It is recommended therefore, that a National Programme specifically addressing the nutrition of under 5 children (and their mothers) be instituted. This should be established with the assistance and co-operation of donor and development agencies as well as other foreign governments that have experiences with such programs, such as the W.I.C. program of the United States of America.

- A nation-wide program of training community based health workers, nutritionist, and other development workers at the community level to recognize symptoms of malnutrition and micronutrient deficiencies should be instituted.

- Establishment of small-scale processing units for the production of complementary foods at the community level as a source of income

generating activity for women and making safe and nutritious complementary foods available and affordable.

- Strengthen existing nutrition education programs at the community level and institute a training of trainers programs on nutrition, health and care.

Protein energy malnutrition in mothers

Almost 12% of mothers in the survey were found to be chronically energy deficient. This has serious consequences for their productivity economically and biologically. The causes are multifaceted; the remedies must also of necessity be multifaceted. This will involve issues that range from enhanced Women's right policy, to appropriate information, education and communication (IEC). Since the nutrition and health of mothers are intrinsically tied with those of children especially the under 5, it is recommended that:

- The recommended national program on nutrition for children should incorporate that of women. Such a programme would thus address key nutritional and health issues of both women and children. The components would include not only provision of adequate and appropriate food but also education, information and counseling.

Significantly this survey recorded a National prevalence of 14.2% overweight among women. Zonal and sectoral variations ranged up to 18.6%. Such a high prevalence should ring alarm bells over possibilities of serious future health problems of a different nature – obesity. In order to halt this trend, it is recommended that:

- The Federal and State Governments should initiate a vigorous health campaign against overweight. The objective would be to sensitize vulnerable groups to the importance of maintaining appropriate body weight and the health risk of being overweight. Appropriate Professional Associations (Nutrition Society of Nigeria, Dietetic Association, IFST, Nigeria Medical Association etc) should be enlisted in such a campaign.

Health and care

This survey revealed that 51% of all respondent's children were ill during the fortnight preceding the survey. The results also indicate a high level of active health seeking behaviours by caregivers. Significantly, malaria was the most prevalent as it affected 72% of the children especially in the Humid Forest.

- It is recommended therefore that to make significant improvement in Child Health in the country, more vigorous effort should be put into the governments on-going malaria eradication project. More children in the rural areas (32%) were affected that in urban (15%) areas. There is need to focus more therefore, in the rural areas of the country.

- It is also recommended that the promotion of ORT to control diarrhea should also be enhanced, as diarrhea was the second most prevalent disease among the children surveyed.

- More vigorous campaign on diarrhea control, again especially in the rural area will considerably improve child health in the country.

- In addition, existing child survival programs, including immunization against preventable child sicknesses need to be strengthened.

Infant feeding

The fact that 55% of nursing mothers encountered in this survey were UNAWARE of exclusive breastfeeding (EBF) suggests that past and existing programs to promote EBF have not been too effective. Besides, only 15% of mothers can be considered to have practiced EBF and over 73% introduced foods or water in the first month of the baby's lives. These statistics call for a radical review of current approaches and strategies to promote and sustain EBF and adequate complementary feeding practices.

- There is need for a policy that takes due cognissance of existing cultural norms and beliefs and tailored to the economic realities of most mothers in the country. As the problem is behavioral, appropriate messages would have to be designed to effect positive behavioral change in the mothers.

- It is recommended that this aspect could be a component of the National Programme for women, infant and children recommended earlier.

Care for women

In assessing care for women it is reasonable to postulate that such care is best provided firstly through empowerment. This survey shows for example that only 51% of women respondents say they have time to rest from homework once or twice per week. This survey also indicates low awareness of child spacing techniques and their own reproductive rights.

- As a first step, it is recommended that Nigeria enact appropriate laws to incorporate the principles of the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW) into the constitution. Secondly, a more effective institutional framework within the new Ministry of Women Affairs to focally address the issue of care for women is recommended.

Environmental health

This survey has indicated the presence of several poor hygienic practices by respondents. For example, animal droppings were found in 35% of the households surveyed while 40% had not swept the house as at the time of the interview. This is another example of behavioral problem that needs behavioral change communications as part of the package of solution.

- It is recommended that the environmental hygiene components of health education be strengthened at all levels.

- Also state Ministries of Environment should be established throughout the country with a clear mandate not only to ensure clean environment but also to educate people on the importance of hygienic environment.

Information, education, and communication

There are several indications from the responses of subjects in this survey that there is need for improved information, education, and communication (IEC) in health and nutrition matters. Responses on matters related to child health, infant feeding (including breastfeeding) and hygiene practices in particular suggest that positive behavioral changes are required. Although government structures exist to provide IEC materials, it appears that these have been mostly fragmented and ineffective. Therefore it is recommended that:

- A more focused, extensive and nationally coordinated Behavioral Change Communication (BCC) strategy be formulated and implemented.

Recommendations on cross cutting issues

- Government should continue to pursue with more vigor the achievement of the Millennium Goals with the objective of attaining the targets by 2015. In this regard, there is need to establish a Food and Nutrition Commission to address the issues of hunger and malnutrition.

- Government at all levels, agencies, private sector, mass media, and food and nutrition professionals should form a partnership to effect a positive behavioral change among Nigerians in issues of food consumption and nutrition.

- Despite the establishment of the Ministry of Women Affairs, issues on women's rights, health and care still need redress. The present institutional structures addressing women's issues need to be strengthened to better improve the health and nutritional status of women.

- A major finding of the survey is that the greatest variations-especially for biochemical indices was at the household level. Consequently, the most effective intervention strategies should be directed at the household (micro) level.

- There is a need to establish an institutional framework to ensure regular food consumption and nutrition surveys. In this regard, there is need to build on the experiences and capacity developed during this survey. Government has a responsibility to show that these experiences and capacity are not wasted.

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APPENDIX 1-1.
NIGERIA FOOD CONSUMPTION AND NUTRITION SURVEY 2001

This section to be filled by the state supervisor daily before dividing the questionnaires between the field teams and before going to the field

Area Code (For Official Use Only)

Zone		

Time interview started	

Address.
.....
.....
State.....
LGA.....
EA.....
Questionnaire No.....

SECTION 1: QUESTIONNAIRE IDENTIFICATION

	Name/No.	Code			
State					
LGA					
Sector (rural/medium/urban)					
EA					
Housing Unit No. or FCNS No.					
Household head.					
Address					
No. of persons in HH					
HH No. within housing unit		HH ____ of FCNS ____			

State codes: Nasarawa (01), Taraba (02), Borno (03), Kaduna (04), Kebbi (05), Kano (06), Osun (07), Edo (08) Kwara (09), Imo (10), Bayelsa (11), Akwa-Ibom (12)

LGA codes: See end of questionnaire. Codes from 01-72

Sector codes: Rural (01), Medium (02), and Urban (03)

Response Status.		
1. Completed 2. Partly completed	3. Not at home 4. Refused 7. Other: specify	5. HH not located 6. Moved away
No. of visits Length of interview (in minutes)		_____ _____

	Data collection	Field editing	Office editing	Data entry
Name	_____	_____	_____	_____
Date	_____	_____	_____	_____

2.2: SOCIO-ECONOMIC CHARACTERISTICS OF HOUSEHOLD *(Respondent: Head of Household/Suitable Proxy)*

We would like to know more about your household, and would like to begin by talking about what you do for a living

No.	Characteristics	Options	Code
1	Primary occupation of head of household	Farming (1) Trading (2) Civil servant (3) Artisan (4) Fisherman (5) Other (specify) (0)	
2.	Primary energy source	- No electricity (1) - Personal generator (2) - Rural Electricity board (3) - National Electrical Power Authority (4) -Solar Energy.....(5)	
3.	Primary source of water for drinking and other domestic uses (If source of drinking water is different from the one used for domestic uses, write code for domestic use in bracket)	- Pond/lake (1) - Spring/river (2) - Well (3) - Bore hole (4) - Pipe-borne water (5) -Rain water harvest..(6) -Others (specify) (7)	
4.	Primary method of refuse disposal	- Bush and others (1) - Refuse dump (2) - City service (3)	
5.	Main type of toilet	- Bush (1) - Pit latrines (2) - VIP latrines (3) - Water system (4) -Rivers (5) -Others (specify) (6)	
6.	Estimated annual income of household	5-14.99 thousand Naira (1) 15-24.99 (2) 25-34.99 (3) 35-44.99 (4) 45-54.99 (5) 55 and above (6)	

SECTION 3: FOOD SECURITY ***(Respondent: Head of the Household or meal planner/preparer)***

Please indicate the types, quantities, and availability/affordability of food items cooked and eaten by people in this household in the last ONE week in the following table:

WITHIN LAST YEAR (PERIOD: 1 YEAR)					WITHIN LAST WEEK (PERIOD: 1 WEEK)					
FOODS (a)	**Food Availability / Affordability** Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) **(f)**		Proportion (out of 10) from own production **(g)**	Proportion (out of 10) from the market **(h)**	If own production , please estimate market value (₦) **(i)**	If purchased, please state cost of purchase(₦) **(j)**
	Available **(b)**	Affordable **(c)**	No. of days/week (0-7) **(d)**	More than once daily (Y/N) **(e)**	Qty	Unit				
Cereals										
Maize										
Maize: Grain										
Maize Green										
Maize Flour										
Flour (Polished)										
Sorghum										
Sorghum Grains										
Sorghum Flour										
Millet										
Millet: Grains										
Millet Flour										
Rice										
Rice: Domestic										
Rice: Imported										
Wheat										
Wheat Grain										
Wheat Flour										

Note: Interviewer should please fill data in unshaded spaces only

FOODS (a)	WITHIN LAST YEAR (PERIOD: 1 YEAR)				WITHIN LAST WEEK (PERIOD: 1 WEEK)					
	Food Availability / Affordability Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) (f)		Proportion (out of 10) from own production (g)	Proportion (out of 10) from the market (h)	If own production , please estimate market value (₦) (i)	If purchased, please state cost of purchase(₦) (j)
	Available (b)	Affordable (c)	No. of days/week (0-7) (d)	More than once daily (Y/N) (e)	Qty	Unit				
Roots & Tubers										
Cassava / Cassava products										
Cassava Tubers										
Gari (uncooked)										
Yam / Yam products										
Yam tubers										
Yam flour										
Potato										
Sweet potato										
Irish potato										
Cocoyam (Corms)										

Note: Interviewer should please fill data in unshaded spaces only

WITHIN LAST YEAR (PERIOD: 1 YEAR)					WITHIN LAST WEEK (PERIOD: 1 WEEK)					
FOODS (a)	**Food Availability / Affordability** Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) **(f)**		Proportion (out of 10) from own production **(g)**	Proportion (out of 10) from the market **(h)**	If own production , please estimate market value (₦) **(i)**	If purchased, please state cost of purchase(₦) **(j)**
	Available **(b)**	Affordable **(c)**	No. of days/week (0-7) **(d)**	More than once daily (Y/N) **(e)**	Qty	Unit				
Legumes										
Cowpea Grains										
Groundnut (Shelled)										
Soybean Grains										
Soybean Flour										
Egusi (Melon shelled)										
Bambaranut (shelled)										
Other food groups:										
Plantain										
Green										
Ripe										
Banana										
Green										
Ripe										

Note: Interviewer should please fill data in unshaded spaces only

WITHIN LAST YEAR (PERIOD: 1 YEAR)					WITHIN LAST WEEK (PERIOD: 1 WEEK)					
FOODS (a)	**Food Availability / Affordability** Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) **(f)**		Proportion (out of 10) from own production **(g)**	Proportion (out of 10) from the market **(h)**	If own production , please estimate market value (₦) **(i)**	If purchased, please state cost of purchase(₦) **(j)**
	Available **(b)**	Affordable **(c)**	No. of days/week (0-7) **(d)**	More than once daily (Y/N) **(e)**	Qty	Unit				
Green leafy vegetables										
Water leaf										
Bitter leaf										
Spinach										
Pumpkin										
Cochorus/Ayoyo										
Non-leafy Vegetables										
Okro										
Tomato										
Pepper										
Cucumber										
Cabbage										
Carrots										

Note: Interviewer should please fill data in unshaded spaces only

FOODS (a)	WITHIN LAST YEAR (PERIOD: 1 YEAR)				WITHIN LAST WEEK (PERIOD: 1 WEEK)					
	Food Availability / Affordability Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) **(f)**		Proportion (out of 10) from own production **(g)**	Proportion (out of 10) from the market **(h)**	If own production , please estimate market value (₦) **(i)**	If purchased, please state cost of purchase(₦) **(j)**
	Available **(b)**	Affordable **(c)**	No. of days/week (0-7) **(d)**	More than once daily (Y/N) **(e)**	Qty	Unit				
Non-leafy Vegetables										
Fruits and products:										
Orange										
Mango										
Papaw										
Guava										
Pineapple										

Note Interviewer should please fill data in unshaded spaces only

WITHIN LAST YEAR (PERIOD: 1 YEAR)					WITHIN LAST WEEK (PERIOD: 1 WEEK)					
FOODS (a)	**Food Availability / Affordability** Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) **(f)**		Proportion (out of 10) from own production **(g)**	Proportion (out of 10) from the market **(h)**	If own production , please estimate market value (₦) **(i)**	If purchased, please state cost of purchase(₦) **(j)**
	Available **(b)**	Affordable **(c)**	No. of days/week (0-7) **(d)**	More than once daily (Y/N) **(e)**	Qty	Unit				
Meat and products										
Beef										
Mutton / Goat										
Pork										
Bush meat										
Snails										
Poultry meat										
Fish										
Shrimps										
Crayfish										
Eggs										
Dairy products										
Fresh milk										
Tinned milk										
Cheese										
Yoghurt										
Nono										
Powdwered milk										

WITHIN LAST YEAR (PERIOD: 1 YEAR)					WITHIN LAST WEEK (PERIOD: 1 WEEK)					
FOODS (a)	**Food Availability / Affordability** Indicate no. of months in the year for which food is :		**Frequency of Consumption**		Quantity eaten in last ONE Week (specify unit) **(f)**		Proportion (out of 10) from own production **(g)**	Proportion (out of 10) from the market **(h)**	If own production , please estimate market value (₦) **(i)**	If purchased, please state cost of purchase(₦) **(j)**
	Available **(b)**	Affordable **(c)**	No. of days/week (0-7) **(d)**	More than once daily (Y/N) **(e)**	Qty	Unit				
Bakery products										
Bread										
Biscuits										
Fats and oils:										
Red palm oil										
Groundnut oil										
Vegetable oil										
Beverages										
Cocoa										
Tea										
Coffee										

Note Interviewer should please fill data in unshaded spaces only

3.2 FOOD CONSUMED AWAY FROM HOME WITHIN THE PAST ONE WEEK

Please indicate day of the week, name of food consumed, whether purchased or not and the actual cost for purchased food items or estimated cost for unpurchased food items.

	Day 1			Day 2			Day 3			Day 4		
Household member number and name from Section 2.1 **(a)**	Food Name **(b)**	Purchased? Y/N **(c)**	Cost (N) **(d)**	Food Name **(b)**	Purchased ? Y/N **(c)**	Cost (N) **(d)**	Food Name **(b)**	Purchased? Y/N **(c)**	Cost (N) **(d)**	Food Name **(b)**	Purchased? Y/N **(c)**	Cost (N) **(d)**

State household member that consumed foods away from home during the last **ONE** week

3.2 FOOD CONSUMED AWAY FROM HOME WITHIN THE PAST ONE WEEK (Continue as necessary)
Please indicate day of the week, name of food consumed, whether purchased or not and the actual cost for purchased food items or estimated cost for unpurchased food items.

	Day 5			Day 6			Day 7		
Household member number and name from Section 2.1 **(a)**	Food Name **(b)**	Purchased? Y/N **(c)**	Cost (N) **(d)**	Food Name **(b)**	Purchased ? Y/N **(c)**	Cost (N) **(d)**	Food Name **(b)**	Purchased? Y/N **(c)**	Cost (N) **(d)**

State household member that consumed foods away from home during the last **ONE** week

Section 3.3 Food Related Coping Strategies ***(Respondent: Head of the Household or meal planner/preparer)***

When there is limited food in the household, what do you do to solve the problem?

No. (a)	Strategies (b)	Tick (ŏ) and rank appropriate strategies (c)
1.	Rely on less preferred foods	
2.	Rely on less expensive foods	
3.	Borrow money to buy food stuffs	
4.	Borrow food stuffs	
5.	Purchase food on credit	
6.	Rely on help from relative or friend outside the household	
7.	Limit portions at meal times	
8.	Ration money to household members to buy street foods	
9.	Limit your own intake to ensure that children get enough	
10.	Reduce number of meals eaten in a day	
11.	Skip whole day(s) without eating	
12.	Others (specify)	

SECTION 4: ASSESSMENT OF NUTRITIONAL STATUS *(Mother with an under 5 child)*

Now I would like you to tell me everything you had to eat and drink after you w oke u p yesterday morning. Include everything you ate and drank at home and away, even snacks, tea, or coffee

4.1: TWENTY FOUR-HOUR DIETARY RECALL FOR THE MOTHER

Date: ..... Day of the week: .....

Questionnaire No[1]:..... Name of subject: .....

Item No. (a)	Food/Drink Addition (b)	Description of Food or Drink (use volume, size or price) (c)	Place Taken (d)	Time (e)	Amount (how much did you actually eat/drink?) (f)	Weight equiv.[2] (g)

1. Was food intake usual? (Y/N) If no, how was it unusual?	4. Probe for supplements (iron, antimalaria, vitamins, other supplements) (Y/N) If yes, specify
2. Was it a feast day? (Y/N)	
3. Probe for sickness (Y/N): If yes, did sickness affect appetite (Y/N) If yes, how? Increase or decrease	5. Probe for fermented beverages consumed

[1] Should come from page 1 of questionnaire (Questionnaire No.)

[2] Do not fill this column of the form

TWENTY FOUR-HOUR DIETARY RECALL FOR THE MOTHER (CONTINUED)

Date: ..... Day of the week: .....

Questionnaire No[1]:..... Name of subject: .....

Item No. (a)	Food/Drink Addition (b)	Description of Food or Drink (use volume, size or price) (c)	Place Taken (d)	Time (e)	Amount (how much did you actually eat/drink?) (f)	Weight equiv.[2] (g)

1. Was food intake usual? (Y/N) If no, how was it unusual?	4. Probe for supplements (iron, antimalaria, vitamins, other supplements) (Y/N) If yes, specify
2. Was it a feast day? (Y/N)	
3. Probe for sickness (Y/N): If yes, did sickness affect appetite (Y/N) If yes, how? Increase or decrease	5. Probe for fermented beverages consumed

[1] Should come from page 1 of questionnaire (Questionnaire No.)
[2] Do not fill this column of the form

4. 2.: TWENTY FOUR-HOUR DIETARY RECALL FOR THE UNDER-5 CHILD
(Respondent: Mother of the under 5 child or suitable proxy)

Now I would like you to tell me everything (Name of Baby/Child) had to eat and drink after he/she woke up yesterday. Include everything he/she ate and drank at home and away, including snacks and drinks (and bottles or breast milk).

Date: ..... Day of the week: .....

Questionnaire No[1]:..... Name of subject: .....

Item No. (a)	Food/Drink Addition (b)	Description of Food or Drink (use volume, size or price) (c)	Place Taken (d)	Time (e)	Amount (how much did you actually eat/drink?) (f)	Weight equiv.[2] (g)

1. Was food intake usual? (Y/N) If no, how was it unusual?	4. Probe if the child received vitamin A during the recent NID (Y/N) Probe for supplements (iron, antimalaria, vitamins, etc.) (Y/N)
2. Was it a feast day? (Y/N)	If yes, specify
3. Probe for sickness (Y/N): If yes, did sickness affect appetite (Y/N) If yes, how? Increase or decrease	5. Probe if child was exclusively breastfed for the first 6 months (Y/N) 6. Probe for fermented beverages consumed

[1] Should come from page 1 of questionnaire (Questionnaire No.)
[2] Do not fill this column of the form

SECTION 5: HEALTH AND CARE ***(Respondent: Mother of the under 5 child)***
Now I am going to ask you some questions about your child

5.1: CHILD HEALTH

				Code	
1.	Has the child been sick during the last two weeks?			Yes (1)	No (0)
2.	How often was the child down with each of the following sicknesses this year? (state number of times)		Frequency		
		Malaria			
		Diarrhea			
		Measles			
		Cough without fever			
		Whooping cough			
		Others (specify)			
3.	Where did the child receive treatment? (Multiple responses possible)	Nowhere (1)			
		Traditional healing home (2)			
		Primary Health Care (3)			
		Chemist shop (4)			
		Hospital (5)			
		Private Clinic (6)			
		Others (specify) (7)			
		Not applicable (0)			
4.	Do you use the following for a. Prevention of malaria?			Yes (1)	No (0)
		Insecticides			
		Bed nets			
		Windows/Door netting			
		Others (Specify)			
	b. Treatment of diarrhea?	ORS			
		Home made salt solution			
		Others (specify)			
5.	Does the child have a health card?				
6.	Which of the following immunizations has the child had?	BCG/Oral polio at birth			
		DPT/Oral polio -1			
		DPT/Oral polio -2			
		DPT/Oral polio –3			
		Measles			
		None			

5.2: CARE FOR WOMEN *(Respondent: Mother of the under 5 child)*

Now I am going to ask you some questions about yourself

Empowerment			**Code**	
1.	If you are sick, how often do you discuss it with your husband.	Always (2) Sometimes (1) Never (0)		
2.	If one of your children is sick, how often do you discuss it with your husband?	Always (2) Sometimes (1) Never (0)		
3.	If there is a disagreement in decision making, what does your husband do generally?	Overrides (3) Takes my opinion (2) Reconsiders his position (1) Not applicable (0)		
4.	How often does your workload allow you some time to rest?	More than twice per week (3) Twice a week (2) Once a week (1) Never (0)		
Reproductive rights			Yes (1)	No (0)
1.	Have you heard of child spacing?			
2.	Do you discuss child spacing with your husband?			
3.	What kind of support do you enjoy during pregnancy?	- Antenatal care		
		- Increased financial support		
		- Reduced HH chores		
		- Improved food		
		Others (Specify)		
		- None		
Economic rights/Food share			Yes (1)	No (0)
1.	Are you allowed to engage in income- generating activities?			
2.	What is your occupation?			
3.	Is there a tradition you respect in food sharing in the family?			
4.	If yes, does the tradition restrict your choice?			
5.	If sometimes, food is not enough who takes the least share?	Self (1) Girls (2) Boys (3) Husband (4) Others (specify) (0)		
6.	Is your food share increased during pregnancy?		Yes (1)	No (0)
Education			**Enter Code**	
1.	How does the community view women's education?	Encouraged (1) Discouraged (2) Tabooed (3) Others (specify) (4)		
2.	In this household, when resources are limited, who is given preference in education?	Girls (1) Boys (2) Mothers (3) Fathers (4) Boys/girls equally (5) The most intelligent (6) Others (specify) (7)		

5.3: INFANT FEEDING PRACTICES ***(Respondent: Mother of the under 5 child)***
Now I would like you to answer a few question about how you feed/fed your baby

1.	Are you aware of exclusive breastfeeding?	**Yes** (1) **No** (0)	
2.	When did you start giving your youngest child anything (even water) other than breast milk?	0 months (0) 3 months (1) 6 months (2)	
3.	Your last child was exclusively breast fed for[1]	0 months (0) 1 months (1) 2 months (2) 3 months (3) 4 months (4) 5 months (5) 6 months (6)	
4.	Are you aware of child growth monitoring?	Yes (1)	No (0)
5.	Did you monitor the growth of your child using a chart?	Yes (1)	No (0)

[1] The purpose of this question is to check the validity/accuracy of question 2 above.

5.4: HYGIENE PRACTICES ***(Respondent: Mother of the under 5 child)***
With regard to food, that is cooked/left over or not consumed

No.	Indicators	Options	Code
1.	How do you preserve (keep) food that is not to be consumed immediately?		
		In the open - open (1)	
		In the open - covered (2)	
		Cupboard (3)	
		Kept warm (4)	
		Fridge (5)	
		Others (specify) (0)	

HYGIENE SPOT CHECK (THIS SECTION IS TO BE FILLED AFTER DISCREET OBSERVATION:

		Code		
		Yes (1)	No (0)	Do not know
	• Are there **open garbage** containers in the house?			
	• Are there **unwashed cooking/eating utensils** in the house?			
	• Is the container for drinking water **uncovered?**			
	• Is the primary carer for the child **untidy** (hands, clothes and nails)			
	• Is the youngest **child untidy** (hands, clothes and nails)			
	• Does the inside of **the house need to be swept?**			
	• Were **animal droppings** observed in the house?			
	• Was **stagnant water** observed around the house?			

Comments, if any:_____

SECTION 6: ANTHROPOMETRIC AND BIOCHEMICAL MEASUREMENTS *(Respondent: Mother and child under 5 child)*

6.1: ANTHROPOMETRIC MEASUREMENTS

		CHILD
INDICES	**MOTHER**	***Tick*** : Male ( ) Female ( )
Age	**(years)**	**(months)**
Weight (kg)		
Height (cm)		
Birth weight (kg)		
Presence of oedema		Yes No

Time interview finished	

6.2: BIOCHEMICAL MEASUREMENTS *(Respondent: Mother and child under 5)*

Medical team to collect biological samples (blood and urine) from eligible mother and child (***AND LABEL APPROPRIATELY***). See Interviewers' Manual page **126-131**

SERUM RETINOL .....
URINARY IODINE .....
SERUM ZINC CONCENTRATION .....
SERUM FERRITIN .....

State	Selected LGA	Code	Status	State	Selected LGA	Code	Status
Nasarawa	Keana	01	rural	**Osun**	Oshogbo	37	urban
01	Nassarawa	02	urban	**07**	Ife South	38	medium
	Keffi	03	medium		Ifedayo	39	rural
	Wamba	04	rural		Ila	40	urban
					Ife East	41	medium
Taraba	Bali	05	medium		Irepodun	42	rural
02	Gassol	06	rural		Ola Oluwa	43	rural
	Ussa	07	rural				
	Jalingo	08	urban	**Edo**	Etsako West	44	medium
	Sardauna	09	medium	**08**	Egor	45	rural
	Ardo Kola	10	rural		Etsako East	46	rural
					Orhionmwon	47	urban
Borno	Maiduguri	11	urban		Esan West	48	medium
03	Monguno	12	medium		Ovia S.W.	49	rural
	Damboa	13	medium				
	Abadan	14	rural	**Kwara**	Oyun	50	medium
	Bayo	15	rural	**09**	Ekiti	51	rural
	Biu	16	urban		Offa	52	urban
	Gubio	17	medium		Ilorin West	53	medium
	Kwaya Kwar	18	rural		Irepodun	54	rural
Kaduna	Makarfi	19	medium	**Imo**	Owerri Municipal	55	urban
04	Kauru	20	rural	**10**	Oru East	56	medium
	Kaduna South	21	urban		Isu	57	rural
	Lere	22	medium		Ohaji/Egbema	58	rural
	Kajuru	23	rural		Aboh-Mbaise	59	urban
					Okigwe	60	medium
Kebbi	Dandi	24	rural		Orsu	61	rural
05	Birnin-Kebbi	25	urban		Njaba	62	rural
	Bagudo	26	medium				
	Gwandu	27	rural	**Bayelsa**	Yenagoa	63	urban
				11	Sagbama	64	medium
Kano	Kano Municipal	28	urban		Ekeremor	65	rural
06	Bichi	29	medium				
	Kura	30	medium	**Akwa-Ibom**	Etinan	66	medium
	Tofa	31	rural	**12**	Ikono	67	medium
	Tudun-Wada	32	urban		Ibesikpo Asutan	68	rural
	Rano	33	medium		Ikot-Ekpene	69	urban
	Gwarzo	34	rural		Itu	70	medium
	Bagwai	35	rural		Nsit-Ubium	71	rural
	Takai	36	rural		Okobo	72	rural

APPENDIX 1-2.
FOOD CONSUMPTION AND NUTRITION SURVEY INSTRUMENT
QUESTIONNAIRE FOR PREGNANT WOMEN

This section to be filled by the interviewer daily before going to the field

Area Code (For Official Use Only)

Zone		

Time interview started	

Address.
.....
.....
State.....
LGA.....
EA.....
Questionnaire No.....

SECTION 1: QUESTIONNAIRE IDENTIFICATION

	Name/No.	Code			
State					
LGA					
Sector (rural/medium/urban)					
EA					
Health Clinic/Facility					
Address					

State codes: Nasarawa (01), Taraba (02), Borno (03), Kaduna (04), Kebbi (05), Kano (06), Osun (07), Edo (08) Kwara (09), Imo (10), Bayelsa (11), Akwa-Ibom (12)

LGA codes: See end of questionnaire. Codes from 01-72

Sector codes: Rural (01), Medium (02), and Urban (03)

Response Status.		
1. Completed	3. Not at home	5. HH not located
2. Partly completed	4. Refused	6. Moved away
	7. Other: specify	
No. of visits		_____
Length of interview (in minutes)		_____

	Data collection	Field editing	Office editing	Data entry
Name	_____	_____	_____	_____
Date	_____	_____	_____	_____

24 Hour Dietary Recall Protocol for the pregnant woman

Date: ..... Day of the Week: .....Questionnaire No[1]:.....

Subject ID No:.....Age.....Gestation.....LMP*.....EDD**.....

Name of Subject: .....Parity.....Occupation.....

Item No. (a)	Food/Drink Addition (b)	Description of Food or Drink (use volume, size or price) (c)	Place Taken (d)	Time (e)	Amount (how much did you actually eat/drink?) (f)	Weight equiv.[2] (g)

1. Was food intake usual? (Y/N) If no, how was it unusual?	4. Probe for supplements (iron, antimalaria, vitamins, other supplements) (Y/N)
2. Was it a feast day? (Y/N)	If yes, specify
3. Probe for sickness (Y/N): If yes, did sickness affect appetite (Y/N) If yes, how? Increase or decrease	5. Probe for fermented beverages consumed

[1] Should come from page 1 of questionnaire (Questionnaire No.)
[2] Do not fill this column of the form
* L.M.P. – Last Menstrual Period
** E.D.D.- Expected Date of Delivery

24 Hour Dietary Recall Protocol for the pregnant woman

Date: ..... Day of the Week: .....Questionnaire No[1]:.....

Subject ID No:.....Age.....Gestation.....LMP*.....EDD**.....

Name of Subject: .....Parity.....Occupation.....

Item No. (a)	Food/Drink Addition (b)	Description of Food or Drink (use volume, size or price) (c)	Place Taken (d)	Time (e)	Amount (how much did you actually eat/drink?) (f)	Weight equiv.[2] (g)

1. Was food intake usual? (Y/N) If no, how was it unusual?	4. Probe for supplements (iron, antimalaria, vitamins, other supplements) (Y/N)
2. Was it a feast day? (Y/N)	If yes, specify
3. Probe for sickness (Y/N): If yes, did sickness affect appetite (Y/N) If yes, how? Increase or decrease	5. Probe for fermented beverages consumed

[1] Should come from page 1 of questionnaire (Questionnaire No.)
[2] Do not fill this column of the form
* L.M.P. – Last Menstrual Period
** E.D.D.- Expected Date of Delivery

Biochemical measurements

Medical personnel to collect biological sample (blood and urine) from eligible pregnant (***AND LABEL APPROPRIATELY***). See Manual page **126-131**

SERUM RETINOL .....
URINARY IODINE .....
SERUM ZINC .....
SERUM FERRITIN .....

State	Selected LGA	Code	Status	State	Selected LGA	Code	Status
Nasarawa	Keana	01	rural	**Osun**	Oshogbo	37	urban
01	Nassarawa	02	urban	**07**	Ife South	38	medium
	Keffi	03	medium		Ifedayo	39	rural
	Wamba	04	rural		Ila	40	urban
					Ife East	41	medium
Taraba	Bali	05	medium		Irepodun	42	rural
02	Gassol	06	rural		Ola Oluwa	43	rural
	Ussa	07	rural				
	Jalingo	08	urban	**Edo**	Etsako West	44	medium
	Sardauna	09	medium	**08**	Egor	45	rural
	Ardo Kola	10	rural		Etsako East	46	rural
					Orhionmwon	47	urban
Borno	Maiduguri	11	urban		Esan West	48	medium
03	Monguno	12	medium		Ovia S.W.	49	rural
	Damboa	13	medium				
	Abadan	14	rural	**Kwara**	Oyun	50	medium
	Bayo	15	rural	**09**	Ekiti	51	rural
	Biu	16	urban		Offa	52	urban
	Gubio	17	medium		Ilorin West	53	medium
	Kwaya Kwar	18	rural		Irepodun	54	rural
Kaduna	Makarfi	19	medium	**Imo**	Owerri Municipal	55	urban
04	Kauru	20	rural	**10**	Oru East	56	medium
	Kaduna South	21	urban		Isu	57	rural
	Lere	22	medium		Ohaji/Egbema	58	rural
	Kajuru	23	rural		Aboh-Mbaise	59	urban
					Okigwe	60	medium
Kebbi	Dandi	24	rural		Orsu	61	rural
05	Birnin-Kebbi	25	urban		Njaba	62	rural
	Bagudo	26	medium				
	Gwandu	27	rural	**Bayelsa**	Yenagoa	63	urban
				11	Sagbama	64	medium
Kano	Kano Municipal	28	urban		Ekeremor	65	rural
06	Bichi	29	medium				
	Kura	30	medium	**Akwa-Ibom**	Etinan	66	medium
	Tofa	31	rural	**12**	Ikono	67	medium
	Tudun-Wada	32	urban		Ibesikpo Asutan	68	rural
	Rano	33	medium		Ikot-Ekpene	69	urban
	Gwarzo	34	rural		Itu	70	medium
	Bagwai	35	rural		Nsit-Ubium	71	rural
	Takai	36	rural		Okobo	72	rural

APPENDIX 2-1
INTRODUCTORY LETTER

International Institute of Tropical Agriculture
PMB 5320, Oyo Road
Ibadan, Nigeria

Dear Resident:

Your household has been selected to participate in a survey called Food Consumption and Nutrition Survey 2000-2001, an important and interesting project sponsored by the Federal Government of Nigeria, UNICEF, and the United States Agency for International Development (USAID). You may have heard about the survey on the radio or in your local government area meetings.

The Federal Government and other research and development agencies working in the country are required to collect information about what people eat and drink so that appropriate national food and nutrition policies and programs can be developed. For six months beginning in May 2001 we will be visiting 216 enumeration areas to gather information from 6480 household that have been scientifically selected to represent the nation as a whole. The survey will determine what kinds and amounts of foods people eat. It will also help to answer questions such as: "Are Nigerian diets nutritionally adequate? What is the nutritional status of Nigerians? What is the level of malnutrition and food insecurity in Nigeria?"

In the next few months, an interview team made up of four interviewers each wearing a photo identification card will visit your home and ask some questions about you and your household members. On the basis of the answers to these questions, the interview team may select the mother with an under-five child to answer additional questions about what they eat, take measurements, and collect samples.

All of your answers will be kept strictly confidential. The survey information will be published only in the form of statistical tables and summaries.

Please share this letter with other members of your household. If you have any question about the survey, please ask your interviewer or your community leader.

Sincerely,

Busie Maziya-Dixon
Project Coordinator

APPENDIX 2-2.
SURVEY BROCHURE

FOOD CONSUMPTION AND NUTRITION SURVEY: 2000-2001

What is this survey about?

The Federal Government and other organizations working in Nigeria are interested in collecting information that will help them assist to improve the health and well being of Nigerians. The purpose of the survey is to find out what people eat, the level of malnutrition and food security in the country. The Federal Government of Nigeria, UNICEF, and the United States Agency for International Development (USAID) sponsor this nationwide survey.

How do the Government, and research and development organizations use the information from the survey?

It is used to help the nation in many ways. For example, it will help improve:

Formulation of food and nutrition policies

Food and nutrition education programs

Community-based interventions

Household food security

Health and welfare of the people

What are the major changes in our diets from 1968?

The information to show changes in our diets since 1968 is not available. This survey is vital, as results obtained will indicate any changes on what is eaten.

How was my household selected?

We would like to interview every household in Nigeria, but it would be very expensive. Instead, we randomly select household to represent the total population; we do not know or have information on who lives in each household. During the next 6 months beginning in May 2001 we will visit 216 enumeration areas to gather information from 6480 households which have been scientifically selected to represent the nation as a whole.

Your household was selected randomly from a list of all households in your enumeration area in the LGA. Because your household represents many others throughout the country, your participation is very important. Participation is voluntary; however, because of the way your household was selected, we cannot substitute another household for yours if you do not participate.

How do I know my answers will be kept confidential?

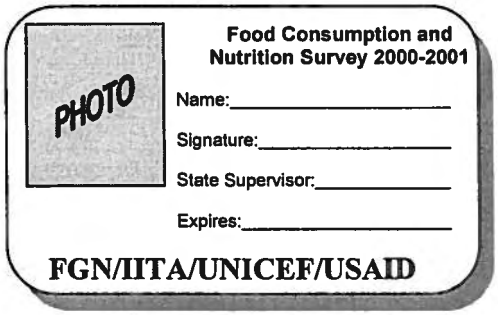
We respect your privacy and we pledge to protect it. The information you give will be published only in statistical summaries and tabulations.

How much time will this take?

The first part (household composition) should take about 15 minutes. If there is someone eligible in your household, the rest of the interview with her will take about 30 minutes.

How will I recognize the interviewer?

The interviewer will be wearing an identification badge that looks like this:



What if I have other questions?

If you have questions about the survey, you may call B. Maziya-Dixon at IITA Ibadan. The telephone number is 02-241-2626 between 7.30 am and 4.30 p.m. Monday through Friday. If you have any comments about any part of the survey, including suggestions for reducing the time it takes to complete, please make them known to the interviewer or state supervisor.

Thank You for Your Participation in This Important Survey

FOOD CONSUMPTION AND NUTRITION SURVEY 2000-2001

APPENDIX 3
HOUSEHOLD LISTING FORM

NIGERIA

Food Consumption and Nutrition Survey 2001

Household Listing Form

International Institute of Tropical Agriculture
United States Department of Agricultural Research Services
United States Agency for International Development
Federal Government of Nigeria
United Nations Children's Fund

Listed by:_____

Page ..... of ... pages
Zone: .....
State: .....
LGA: .....
EA: .....

S/N of Household (a)	Location of House-hold (Street No, Name & Area)	Name of Household Head	Household has Child(ren) < 5 years (Y/N)	Remarks (Specify Land or other identification marks)

Page ..... of ... pages
Listed by:_____

Zone: .....
State: .....
LGA: .....
EA: .....

S/N of Household (a)	Location of House-hold (Street No, Name & Area)	Name of Household Head	Household has Child(ren) < 5 years (Y/N)	Remarks (Specify Land or other identification marks)

APPENDIX 4
SURVEY LOGBOOK

NIGERIA

FOOD CONSUMPTION AND NUTRITION SURVEY 2001

LOGBOOK

Activity_____
Zone _____
State _____
LGA _____

Day/Date	Place (Address)	Time	EA code	Activity	Remarks*	Name/Signature

* Include all that will explain special difficulties encountered and any modalities or solutions adopted.

To be submitted to the State Supervisor

Activity_____
Zone _____
State _____
LGA _____

Day/Date	Place (Address)	Time	EA code	Activity	Remarks*	Name/Signature

* Include all that will explain special difficulties encountered and any modalities or solutions adopted.

To be submitted to the State Supervisor

APPENDIX 5
MONITORING/OBSERVATION FORM

NIGERIA

Food Consumption and Nutrition Survey 2001

MONITORING/OBSERVATION FORM

International Institute of Tropical Agriculture
United States Department of Agricultural Research Services
United States Agency for International Development
Federal Government of Nigeria
United Nations Children's Fund

QUALITY CONTROL PROCEDURES

Observation/Monitoring

Part of your job will be to conduct in-person observations of a survey team performing fieldwork. IITA does not assume that all interviews will be observed in the field. Rather, the monitor will select a survey team for observation that show the most need or as a result of the quality review of the completed work.

General Procedures

It is important to set the stage for the in-person observation so that it will be a pleasant experience for both you and the survey team. The team should never feel that they are being "singled out" for observation but, instead, that it is a privilege and opportunity for the team to perform for you.

By following these simple guidelines, the observation/monitoring visit should run smoothly:

- Talk with the zonal coordinator and the field team about your role as an observer. Explain that you will be there to watch and listen and that IITA is eager to learn how actual fieldwork is proceeding. Assure the field team that you are there to see the "big picture," how the various pieces fit together, how the respondent reacts to the questions, and what problems arise in the field.

  Inform the interview team that you will be making notes during the interview but not to let that distract the interview. Explain that you will discuss the notes with him/her once you leave the respondent's home. Do not make the team feel that they are under a microscope, they may become nervous and not do themselves justice.

- It is important for the team leader/state supervisor to introduce you to the survey team and the respondent. People are naturally suspicious when a stranger approaches their home; more than one stranger makes it doubly difficult to gain co-operation. The state supervisor should introduce

him/herself and add, "This is Mr./Ms (name of person) from our office. He/she is accompanying me today to observe the survey that we are conducting."

- You should remain silent during the interview. Most of the errors or omissions that an interviewer might make are usually small. If you speak up, the flow of the interview will be interrupted, the interviewer will become flustered and, worse yet, the respondent will lose confidence in the teams' professionalism.

- On the other hand, if the interviewer or any member of the survey team does commit an error of major importance, such as selecting the wrong respondent, you should diplomatically correct the error. Do this in a pleasant and non-judgmental way. Make the transition from correcting the error back to the flow of the interviewing process as quickly as possible. Once you have left the respondent's home, you can retrain the team on the procedure that caused the error, if necessary.

After your day in the field, find a comfortable place back at a convenient place to discuss the day's activities with the state supervisor. It's only human nature when being evaluated to remember the negative things and quickly forget all of the pats on the back. Keep that in mind as you critique the day's activities. Take into consideration that the state supervisor may have been unduly nervous having you along as he/she made the rounds with his/her team. On the other hand, any deviation from procedures must be called to the zonal coordinators' attention.

NIGERIA FOOD CONSUMPTION AND NUTRITION SURVEY 2001

OBSERVATION/MONITORING FORM

Date: _____/_____

State:_____

Zone:_____

EA:_____

State supervisor Name_____

Names of interview team_____

_____

CONTACTING THE RESPONDENT

1. Characterize the Interviewers' interaction with the respondent during the introduction

Unprofessional	1	2	3	4	5	Professional
Unprepared	1	2	3	4	5	Prepared
Unorganized	1	2	3	4	5	Organized
Unfriendly	1	2	3	4	5	Friendly

2. Was it necessary for the state supervisor/team leader to use the introductory letter?

Yes_____

No _____

HOUSEHOLD LISTING, SAMPLING AND QUESTIONNAIRE ADMINISTRATION

3. Was the household listing effectively carried out?

Yes_____

No _____

If no, explain:_____

_____

_____

_____

4. Do you consider the exercise properly supervised?

Yes --------

No ---------

If no, explain:_____

_____

_____

_____

5. Were the proper procedures of random sampling of households followed?

Yes_____
No _____

If no, explain indicating key constraints, adequacy or not of supervision:

_____
_____
_____
_____

6. Did the interviewer make a smooth transition from one section of the questionnaire to the next section?

Yes_____
No _____

If no, explain:_____
_____
_____
_____

7. Did the interviewer select the respondent by asking to speak to the person with the most knowledge of food preparation and purchasing for the household?

Yes_____
No _____
Already known _____

If no, explain:_____
_____
_____
_____

8. If the respondent refused to answer any or all of the questions, did the state supervisor/interview team accept the refusal in a pleasant professional manner?

Yes_____
No _____
No refusals_____

9. Did the interviewer appropriately answer any questions the respondent had?

Yes_____
No _____

If no, explain:_____
_____
_____
_____

8. Additional comments:_____

_____

_____

_____

FOOD SECURITY

9. Do you consider the pattern of interviewing and recording in this section as appropriate and satisfactory?

Yes_____

No _____

If no, explain:_____

_____

_____

_____

9. What is the average time it took to complete the session?

_____

_____

_____

11. Additional comments and observations

_____

_____

_____

_____

24 HOUR – DIETARY RECALL

12. Did the interviewer make a smooth transition to the 24-hr dietary recall?

Yes_____

No _____

If no, explain:_____

_____

_____

_____

13. Did the interviewer select an appropriate proxy respondent for the child?

Yes_____

No _____

Proxy not needed_____

If no, explain:_____

_____

_____

_____

11. Did the interviewer allow the respondent to recall food items without interference?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

12. Did the interviewer ask the intake questions in any particular sequence?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

13. Throughout the 24-hr dietary recall section, the interviewer has to use a variety of materials (Food models, FIB and measuring aids); did the interviewer properly use the materials in an organized, effective manner?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

14. Did the interviewer always refer to the FIB for probes?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

15. Please rate the interviewers' skill in using the FIB.

Excellent_____
Good_____
Fair_____
Poor_____

16. Did the interviewer always probe thoroughly?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

17. Did the interviewer appropriately answer any questions the respondent had?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

18. Additional comments on the 24-hr dietary recall section: _____
_____
_____
_____

19. Overall evaluation of the 24-hr dietary recall section interview

Unacceptable 1 2 3 4 5 Excellent

ANTHROPOMETRY

20. Were the height measurements properly measured?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

21. Were the weight measurements properly taken?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

22. Was the length bench properly used?

Yes_____
No_____

If no, explain:_____
_____
_____

23. Were there any problems with the instruments?

Yes_____
No_____

If yes, explain:_____
_____
_____
_____

24. How would you rate the skill of the interviewers in anthropometry?

Excellent_____
Good_____
Fair_____
Poor_____

Additional comments on anthropometry: _____
_____
_____
_____

FOCUS GROUP DISCUSSION

25. Were all the key issues adequately covered?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

26. Were the questions properly structured to result in the possible ranking or quantification of the responses?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

27. How would you rate the performance of the State Supervisor or the facilitator?

Excellent_____
Good_____
Fair_____
Poor_____

COLLECTION AND PROCESSING OF BIOLOGICAL SAMPLES

28. How would you rate the response of respondents to this aspect of the survey?

Highly receptive _____
Receptive_____
Fair_____
Poor_____
Not receptive _____

29. How would you rate the efficiency of the laboratory scientists?

Excellent_____
Good_____
Fair_____
Poor_____

30. Do you consider the logistics and all related arrangements on the ground to ensure that the samples are intact as adequate?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

31. Do you consider this aspect properly supervised?

Yes_____
No_____

If no, explain:_____
_____
_____
_____

OBSERVATIONS TO BE RECORDED AFTER THE INTERVIEW

I. How well did the Interview team:

a. Handle the respondent's questions?

Rambling	1	2	3	4	5	Clear
Uninformative	1	2	3	4	5	Informative

b. Maintain the flow and pace of the Interview?

Poorly	1	2	3	4	5	Very well

c. Read the questions as written?

Poorly	1	2	3	4	5	Very well

d. Probe (without leading)?

Poorly	1	2	3	4	5	Very well

e. Accurately record answers?

Poorly 1 2 3 4 5 Very well

f. Complete Household Call Record entries?

Poorly 1 2 3 4 5 Very well

2. At any time during the interview, did you make suggestions or otherwise intervene?

Yes_____
No_____

3. How many times did you intervene?

_____
Number of times

4. Please describe where you intervened including a description of the problem the interviewer was having.

_____
_____
_____
_____

5. What are the interview team strong points?

_____
_____
_____
_____

6. What areas, if any, need improvement?

_____
_____
_____
_____

7. Other comments:

_____
_____
_____
_____

GENERAL COORDINATION, FINANCIAL MANAGEMENT AND OPERATIONS
Briefly, comment on the following:

Coordination of the survey in the zone state by state:

_____
_____
_____
_____

Financial management:

_____
_____
_____
_____

General Operations:

_____
_____
_____
_____

SUMMARY
A summary report should be written highlighting:

- General situation on the ground
- Problems
- Lessons
- Recommendations for improvement with due emphasis on critical areas needing immediate attention. The report should be submitted to the principal investigator with a copy to the zonal coordinator no later than 1 week after the monitoring exercise.

APPENDIX 6.
BIOLOGICAL SAMPLING RECORD BOOK

NIGERIA

FOOD CONSUMPTION AND NUTRITION SURVEY 2001

BIOLOGICAL SAMPLING RECORD BOOK

Kaduna State

NIGERIA FOOD CONSUMPTION AND NUTRITION SURVEY 2001

BIOLOGICAL SAMPLING RECORD FORM

EA:_____

LGA:_____

S/N	Name	Questionnaire No.	Household No.	FCNS No.	Sample Code	Date

NIGERIA FOOD CONSUMPTION AND NUTRITION SURVEY 2001

BIOLOGICAL SAMPLING RECORD FORM

EA:_____

LGA:_____

S/N	Name	Questionnaire No.	Household No.	FCNS No.	Sample Code	Date

APPENDIX 7.

SUMMARY OF THE ANALYTICAL METHODS FOR SERUM AND URINE SAMPLES

Serum Retinol

Serum vitamin A and E was determined simultaneously using a slightly modified version of the reversed-phase HPLC method as describe by Catignani and Bieri (1983).

Equipment:
The HPLC is equipped with the following: 1) an isocratic pump, 2) an Auto Sampler, 3) a UV /VIS detector, 4) a Delta data system, and 5) a C18
Reversed phase column.

Reagents:
All trans Retinol, alpha tocopherol and tocopherol acetate as
Internal standard from Sigma, n-Hexane, methanol, ethanol and water will be used.

Sample preparation:
Thaw serum to room temperature and mix very well mix. All procedures must be performed in a dark room.
Step1: The proteins are denaturated by placing 250 µl serum and ethanol into a test tube and mixing for 10 sec.
Step 2: Fat-soluble vitamins are extracted by using 2.3 ml hexane. This mixture is mixed using a vortex mixer for 45 sec.
Step 3:The mixture is then centrifuged for 10 minutes at 2500 rpm.
Step 4:The supernatant is then transfer into another test tube and dried under nitrogen.
Step 5: The dried residue is resuspended into 700 µl methanol, for injection into the HPLC system.

Conditions of HPLC system: Normal (Room) temperature
2. Mobile phase: Methanol.
3. Flow rate: 1ml/min.

Calculation: The results of the retinol are calculated in ug/dl and tocopherol in mg/l. The quantification of the compound is performed by internal standard method based on area counts.

Serum Ferritin

Method: Ferritin MAb , Solid Phase Component System for the quantitative determination of ferritin in serum and plasma.

Catalog No. 06B263905, Ferritn Antibody-Coated Tubes.
Catalog No. 06B263915, Ferritin Tracer.
Catalog No. 06B263991, Ferritin Standards.
Supplied and manufactured by ICN Pharmaceuticals, Diagnostic Division, New York.

Assay Procedure:
1. Label 14 Ferritin MAb-coated tubes 1to 14 for the standard curve. Label two Ferritin Mab-Coated Tubes, for each clinical sample and a control to be assayed.
2. Add Ferritin Standard and clinical sample to tubes.
3. Add Ferritin Tracer solution to all tubes. Vortex briefly. Cover the tubes.
4. Incubate the tubes at 37°C in a water bath for 1 hour.
5. Remove the tubes from the water bath and uncover them.
6. Add purified water. Aspirate or decant.
7. Count the radioactivity in the aspirated tubes and total count tubes (if needed) using a gamma counter.

The system used is an Auto Gamma 500C counting system from United Technologies, Packard, IL.

Serum Zinc

Materials and Method:
Model: A .A. PYE Unicone 9090.
Flame: Air / Acetylene.
Wavelength: 213,9 nm.

Assay Procedure:
1. Take 0.5 ml serum and dilute in 6 ml distilled water.
2. Calibrate the Atomic Absorption Spectrophotometer with Zn standard.
3. Read the diluted test sample against the standard.

Urinary Iodine

Method: Urinary Iodine was determined using Ammonium Persulfate Digestion.
All water used in this method must be deionised.

Reagents:
Ammonium persulfate; (dissolve228.2g in 1liter water)
Arsenious acid solution (dissolve in a 1 liter flask, 5g As_2O_3 and 25g NaCl, then add 200ml 5N H_2SO_4. Add water to about 500ml, heat gently with stirring to dissolve, and then cool to room temperature. Dilute with water up to 1liter.
3. Ceric ammonium sulfate solution (dissolve 24g in 1 liter of 3.5 NH_2SO_4 prepared by adding 97ml concentrated H_2SO_4 to water to make 1 liter. Note: This should be made up 24 hours before use and store it in the dark).
4. Iodine Standard: Solution A: - dissolve 0.168g KIO3 in water and make up to 1 liter. This solution is equivalent to 100ug/ml. Store in the refrigerator. Solution B: Dilute 0.5ml of solution A to 100ml with deionized water. This solution is equivalent to 0.5ug/ml. Store reagent in the refrigerator.

Assay Procedure:
Mix urine sample very good and put 250ul in a test tube.
Add 1.0 ml ammonium persulfate solution to each tube and mix very well.

Heat all tubes for 1 hour at 91-95 °C.
Cool tubes to room temperature.
Add 3.5 ml arsenious acid solution to each tube, mix using a vortex mixer and let stand for 15 min.
Add 400 µl ceric ammonium sulfate solution to each tube at 30 sec. time intervals, mixing each using a vortex mixer after addition.
Read absorbance at 420 nm.

Appendix 8-1.
Analysis of Maximum Likelihood Estimates for Stunting

Parameter	Level	DF	Estimate	Error	Level
Intercept		1	-0.3356	0.1656	0.0427
STATE	1	1	1.1	0.1484	<.0001
STATE	2	1	-0.1828	0.1152	0.1127
STATE	3	1	0.1483	0.1009	0.1416
STATE	4	1	0.2175	0.1076	0.0432
STATE	5	1	1.0253	0.1445	<.0001
STATE	6	1	0.4243	0.1024	<.0001
STATE	7	1	-0.4732	0.1544	0.0022
STATE	8	1	-0.0554	0.1576	0.7253
STATE	9	1	-0.1468	0.1399	0.2938
STATE	10	1	-0.9772	0.1405	<.0001
STATE	11	1	-0.8668	0.1693	<.0001
HHead_Sex	1	1	0.1631	0.0741	0.0276
HH_hd_educ	1	1	0.1954	0.0698	0.0051
HH_hd_educ	2	1	0.0644	0.1124	0.5668
HH_hd_educ	3	1	-0.0833	0.0742	0.2616
HH_hd_educ	4	1	0.058	0.1127	0.6069
HH_hd_educ	5	1	-0.1402	0.0778	0.0717
HH_hd_educ	6	1	-0.2484	0.1039	0.0168
ANNUALINCOME	1	1	0.0537	0.0866	0.5349
ANNUALINCOME	2	1	-0.058	0.0783	0.4591
ANNUALINCOME	3	1	0.1062	0.0735	0.1485
ANNUALINCOME	4	1	0.02	0.075	0.7895
ANNUALINCOME	5	1	0.0618	0.0776	0.4256
INSECTICIDES	0	1	0.1335	0.0347	0.0001
BCG	0	1	0.2217	0.0561	<.0001
IMMUMEASLES	0	1	-0.0753	0.0446	0.0916
MALARIA		1	0.0382	0.0157	0.0151
DIARRHEA		1	0.0407	0.0182	0.0256
coughwithoutfe		1	-0.0424	0.0216	0.05
UNTIDY	0	1	-0.1144	0.0732	0.1182
UNTIDY	1	1	0.1867	0.0624	0.0028
PRESERVEFOOD	0	1	-0.2853	0.2192	0.193
PRESERVEFOOD	1	1	0.1143	0.1849	0.5366
PRESERVEFOOD	2	1	0.0962	0.0751	0.2002
PRESERVEFOOD	3	1	-0.0814	0.1107	0.4623
PRESERVEFOOD	4	1	0.3748	0.1062	0.0004
HH_head_Age		1	-0.00865	0.00325	0.0078

Appendix 8-2.
Correspondence Analysis for malnutrition and biochemical deficiencies of child and states

Row Coordinates			
State	Identitiy	Dim1	Dim2
Nasarawa	1	0.18	0.2371
Taraba	2	-0.0285	0.0259
Borno	3	-0.0423	0.0607
Kaduna	4	-0.1427	-0.0747
Kebbi	5	-0.1047	-0.0455
Kano	6	-0.0904	-0.0294
Osun	7	-0.1716	-0.092
Edo	8	-0.0976	-0.021
Kwara	9	-0.1555	-0.1294
Imo	i	0.2455	0.2935
Bayelsa	y	1.1534	-0.2394
Akwa_Ibom	k	-0.1453	-0.0569
Column Coordinates			
IDENTITIY		Dim1	Dim2
BMI	B	-0.0282	-0.0368
Iron	F	-0.0798	0.014
Zinc	Z	-0.0785	-0.1042
Iodine	I	-0.0585	0.0024
Vitamin	E	-0.0328	0.0237
Vitamin	A	-0.141	-0.0208
Stunting	S	0.0871	0.6
Wasting	W	1.8117	-0.2191
Underweight	U	0.72	0.6538

APPENDIX 8-3
TABLE OF STATE BY MALNUTRITION PROBABILITIES

Table F1. Table of state by stunting probabilities

Frequency	unclass	Very H	High	Very L	Low	Total
1	63	29	163	0	14	269
2	110	2	120	43	224	499
3	136	0	243	28	255	662
4	45	0	181	36	188	450
5	50	188	151	0	6	395
6	160	11	534	11	106	822
7	124	0	6	236	164	530
8	194	4	19	113	214	544
9	67	0	4	92	165	328
10	138	0	0	393	10	541
11	15	0	1	227	11	254
12	118	0	34	167	351	670
Total	1220	234	1456	1346	1708	5964

Table F2. Table of state by wasting probability

Frequency	unclassified	High	Very	Low	Total
1	68	0	200	1	269
2	120	0	379	0	499
3	156	0	504	2	662
4	50	0	398	2	450
5	82	0	313	0	395
6	166	0	631	25	822
7	132	0	398	0	530
8	211	1	329	3	544
9	76	0	252	0	328
10	149	0	392	0	541
11	22	0	232	0	254
12	122	0	539	9	670
Total	1354	1	4567	42	5964

Table F3. Table of state by underweight probability

Frequency	Unclassified	1 Very H	2 High	3 Very L	4 Low	Total
1	68	0	0	165	36	269
2	120	1	18	188	172	499
3	155	0	30	147	330	662
4	49	0	1	233	167	450
5	82	3	81	47	182	395
6	164	0	93	115	450	822
7	132	0	3	372	23	530
8	210	0	2	320	12	544
9	75	0	0	238	15	328
10	148	0	0	380	13	541
11	22	0	2	221	9	254
12	122	0	0	521	27	670
Total	1347	4	230	2947	1436	5964

Table F4. Table of state by vitamin A deficiency probability

Frequency	unclassified	1 Very H	2 High	3 Very L	4 Low	Total
1	68	0	0	199	2	269
2	120	0	19	197	163	499
3	156	0	66	121	319	662
4	50	0	0	339	61	450
5	82	1	70	13	229	395
6	166	0	0	367	289	822
7	132	0	41	83	274	530
8	211	1	81	49	202	544
9	76	0	0	252	0	328
10	149	0	0	389	3	541
11	22	0	0	232	0	254
12	122	0	0	548	0	670
Total	1354	2	277	2789	1542	5964

Table F5. Table of state by vitamin E deficiency probability

Frequency	unclassified	Very	High	Very	Low	Total
1	68	180	21	0	0	269
2	120	305	61	1	12	499
3	156	443	60	0	3	662
4	50	254	98	7	41	450
5	82	299	14	0	0	395
6	166	603	52	0	1	822
7	132	381	13	0	4	530
8	211	315	17	0	1	544
9	76	179	31	16	26	328
10	149	324	45	2	21	541
11	22	135	65	3	29	254
12	122	406	97	3	42	670
Total	1354	3824	574	32	180	5964

Table F6. Table of state by iron deficiency probability

Frequency	unclassified	Very	High	Very	Low	Total
1	68	0	0	197	4	269
2	120	1	77	28	273	499
3	155	2	336	1	168	662
4	49	0	27	194	180	450
5	82	5	196	1	111	395
6	164	0	351	1	306	822
7	132	0	54	84	260	530
8	210	1	128	7	198	544
9	75	0	0	253	0	328
10	148	0	1	303	89	541
11	22	0	5	127	100	254
12	122	0	0	546	2	670
Total	1347	9	1175	1742	1691	5964

Table F7. Table of state by zinc deficiency probability

Frequency	Unclassified	Very	High	Very	Low	Total
1	68	0	13	55	133	269
2	120	1	104	20	254	499
3	155	4	153	36	314	662
4	49	12	359	0	30	450
5	82	257	56	0	0	395
6	164	81	552	0	25	822
7	132	0	49	11	338	530
8	210	0	257	0	77	544
9	75	75	175	0	3	328
10	148	0	0	385	8	541
11	22	4	105	1	122	254
12	122	0	4	485	59	670
Total	1347	434	1827	993	1363	5964

Table F8. Table of state by iodine deficiency probability

Frequency	unclassified	Very	High	Total
1	68	149	52	269
2	120	377	2	499
3	155	507	0	662
4	49	400	1	450
5	82	313	0	395
6	164	658	0	822
7	132	388	10	530
8	210	334	0	544
9	75	251	2	328
10	148	361	32	541
11	22	37	195	254
12	122	548	0	670
Total	1347	4323	294	5964

APPENDIX 8-4
Fitting BMI: Malnourished versus Not Malnourished
(Obese groups excluded)

Type III Analysis of Effects				
			Wald	
Effect	DF	Chi-Square	Pr> ChiSq	
STATE	11	78.1551	<.0001	
vitamin_E	1	6.3714	0.0116	
	Analysis	of	Maximum	Likelihood
			Standar d	
Parameter	DF	Estimate	Error	Pr> ChiSq
Intercept	1	-1.4711	0.1328	<.0001
STATE	1	-0.3078	0.2218	0.1653
STATE	2	0.2606	0.1358	0.055
STATE	3	0.5715	0.1076	<.0001
STATE	4	-0.2572	0.1669	0.1234
STATE	5	-0.2968	0.1757	0.0912
STATE	6	0.6696	0.0965	<.0001
STATE	7	-0.0671	0.146	0.6457
STATE	8	-0.2032	0.1556	0.1915
STATE	9	0.0303	0.1797	0.8659
STATE	10	-0.128	0.1574	0.4161
STATE	11	-0.3013	0.222	0.1748
vitamin_E	1	-0.0427	0.0169	0.0116

APPENDIX 8-5
Fitting BMI: Malnourished versus Not Malnourished
(Malnourished group excluded)

Effect	Wald DF	Chi-Square	Pr> ChiSq	
STATE	11	40.1865	<.0001	
vitamin_E	1	8.5505	0.0035	
Iron	1	5.1067	0.0238	
zinc	1	2.1547	0.1421	
Parameter	DF	Estimate	Standard Error	Pr> ChiSq
Intercept	1	-1.6779	0.1686	<.0001
STATE	1	0.2894	0.1447	0.0455
STATE	2	0.2039	0.1154	0.0773
STATE	3	-0.2016	0.1125	0.0732
STATE	4	0.1261	0.1211	0.2977
STATE	5	-0.2315	0.1397	0.0975
STATE	6	-0.2963	0.1066	0.0054
STATE	7	-0.1979	0.1253	0.1142
STATE	8	0.00903	0.1192	0.9396
STATE	9	0.2879	0.1412	0.0414
STATE	10	0.3505	0.1063	0.001
STATE	11	-0.2055	0.166	0.2158
vitamin_E	1	0.0372	0.0127	0.0035
Iron	1	-0.00104	0.000462	0.0238
zinc	1	0.00181	0.00123	0.1421

APPENDIX 8-6

Type III Analysis of Effects for BMI in the humid forest zone Response Profile

Response profile			
Ordered Value	BMI_code		Total Frequency
1	Malnourished		191
2	Normal_Range		1335
3	Obese	Grade1	282
4	Obese	Grade2	67
	Type III Analysis of Effects (MODEL 1-AEZ 3)		
Effect	DF	Wald Chi-Square	Pr> ChiSq
STATE	4	20.2	0.0005
ANNUALINCOME	5	23.8	0.0002
PRIMSWATER	6	33.5	<.0001
hhsize	1	6.64	0.01
	Type III Analysis of Effects (MODEL 2-AEZ 3		
Effect	DF	Wald Chi-Square	P> ChiSq
STATE	4	15.8	0.0033
HH_hd_education	6	13.3	0.0386
PRIMSWATER	6	34.8	<.0001
hhsize	1	10.3	0.0013

APPENDIX 8-7

Maximum Likelihood Estimates for Model 1 for the humid forest zone

Parameter	DF	Estimate	Standard Error	Chi-Square		Pr> ChiSq
Intercept		1	-2.3806	0.2451	94.3502	<.0001
Intercept2		1	1.4318	0.2417	35.0811	<.0001
Intercept3		1	3.3103	0.263	158.4629	<.0001
STATE	7	1	0.298	0.1078	7.6405	0.0057
STATE	8	1	-0.1126	0.1064	1.12	0.2899
STATE	10	1	-0.3939	0.1086	13.1457	0.0003
STATE	11	1	0.0319	0.132	0.0583	0.8091
ANNUALINCOME	1	1	0.4028	0.1219	10.9133	0.001
ANNUALINCOME	2	1	0.0855	0.1283	0.4437	0.5054
ANNUALINCOME	3	1	0.0678	0.1339	0.2564	0.6126
ANNUALINCOME	4	1	0.0718	0.1293	0.3087	0.5785
ANNUALINCOME	5	1	-0.3411	0.1294	6.9522	0.0084
PRIMSWATER	1	1	-0.5039	0.4477	1.2668	0.2604
PRIMSWATER	2	1	0.548	0.2178	6.333	0.0119
PRIMSWATER	3	1	0.807	0.2488	10.5168	0.0012
PRIMSWATER	4	1	0.439	0.233	3.5485	0.0596
PRIMSWATER	5	1	0.028	0.2258	0.0154	0.9012
PRIMSWATER	6	1	0.8391	0.2547	10.8548	0.001
hhsize		1	-0.0559	0.0217	6.6372	0.01

Appendix 8-7. Addendum: Maximum Likelihood Estimates for Education Extracted from Model 2

Parameter	DF	Estimate	Standard Error	Chi-Square	Pr> ChiSq
HH_hd_education 1	1	0.0876	0.1562	0.3146	0.5749
HH_hd_education 2	1	0.2963	0.1758	2.8409	0.0919
HH_hd_education 3	1	-0.1218	0.1273	0.9158	0.3386
HH_hd_education 4	1	-0.0436	0.1638	0.0708	0.7901
HH_hd_education 5	1	-0.1912	0.1309	2.1323	0.1442
HH_hd_education 6	1	-0.4573	0.165	7.6854	0.0056