

**DIET SURVEY AND NUTRITIONAL STATUS
ASSESSMENT OF JARAWAS**

(I) INTRODUCTION

The Jarawas, apparently maintain good health. Food is the most essential determinant of physical health and mental development. Food intake pattern and food behavior of the Jarawas were observed during the present survey / study. No study has so far attempted to quantify the intake of various types of food consumed by the Jarawas, their approximate food values and consequent nutritional status. There is also no work on the clinical assessment of the deficiency diseases, on basis of nutrition anthropometric indices or by laboratory diagnosis. The present study includes an assessment of the food security *vis-à-vis* the food behaviour of the Jarawas in which, at least a quasi-quantitative estimation of the intake of various types of food and their food values (energy and other macro and micronutrients) has been made. The study also includes the nutritional status of the Jarawas in terms of anthropometrics indices, deficiency diseases and also the morbidity profile that undermine the nutritional status. Laboratory estimations for routine blood parameters and serological status give indirectly the health and nutritional status of the Jarawas.

(II) METHOD

The survey was conducted in three phases in three seasons: post monsoon (from December to January, 2002), dry season (April to May, 2002) and monsoon (August to September 2002).

Sample Size :- As the total no. of the Jarawas was below 300, it was envisaged that they would be covered universally. However, it was possible to cover 251 of them out of 266 (maximum number that could be contacted during 3 surveys), i.e. 94.4%. They were found to be distributed in 66 families. The diet survey was aimed to cover 50% of all the families but actually covered 30 families, i.e. 45.6% of the families.

A. Diet survey

The 1st phase :

It was envisaged to conduct the food intake survey by weighing of raw food materials that a family would consume throughout a day. However, weighing of food consumed by a family or an individual Jarawa was not possible in most cases. It was also difficult to ascertain how a particular food item was shared in a family. Moreover, domestic animals (dog) receiving a share of some food while a Jarawa was eating could not also be accounted for. However, through observational method the investigators made a guesstimate of the weight of the various food consumed in a family. Some foods such as boar (cleaned and dressed) shared by a group of Jarawas was weighed. In case of honey, a very popular food item, the amount of honey before and after consumption from a wooden vessel could be ascertained. The actual consumption was found out after subtracting the weight of a similar vessel. In

case of items like bananas or any other fruit, the number of item consumed was counted and then taking the weight of a single item the total amount consumed was estimated.

The 2nd phase :

During the 2nd phase of the survey some investigators used the food balance sheet method. These involve weighing of all food items found in a family at a fixed hour (in the morning) in two consecutive days, the difference between the two weights gave the amount of food consumed. Further, the observational method employed in the 1st phase of the survey was also used. However, food received from outsiders often created difficulties in the actual assessment of food eaten.

The 3rd phase :

In the third phase of the survey a different approach was adopted. Stock of raw and cooked food (when permitted) were weighed in the morning (6 AM to 7 AM), at mid-day (12 Noon to 1 PM) and in the evening (around 6 PM) for four consecutive days. The difference in weight of an item, if fully consumed in a day – between two successive weights recorded, was the amount consumed during the day. For the items not fully consumed before the team left in the evening, the difference in weight of the first day and the morning weight of the next day was the weight of the food consumed on the previous day. In this phase of the survey, no alien food, such as bananas were allowed from outsiders to be given to the Jarawas. Even then in some areas the Jarawas themselves collected some alien food such as biscuits, rice, banana, etc. and consumed them. Edible part of raw food items was also calculated in this phase of the survey. A separate format was developed and field test for this type of diet survey was carried out.

Food consumed by young children :

A special effort was made to survey the food consumed by individual young children in a family during the 3rd phase. Some investigators were specially advised to closely follow the food intake of young children throughout the day. However, food taken by young children after the team left the site in the evening could not be taken into the account. Some children were found to eat some kind of fruits at random which also, could not be counted. While eating they were spitting out a part of the fruit. This also posed difficulty in ascertaining the exact amount of fruit consumed.

Food consumed during hunting/gathering :

It was also not possible by the investigating team to follow a Jarawa as he went out for hunting or gathering food. Therefore, food if any consumed during hunting / gathering activities could not be taken in account.

Exclusive breast-feeding :

In the third phase of the survey the breast feeding by nursing Jarawa mothers was closely followed from morning till evening. As the teams left in the evening whether a nursing mother had given any food other than breast milk after the evening, could not be ascertained.

Water usage pattern :

In the third phase of the survey water usage pattern was closely followed. Appropriate questionnaires were developed for all these contingencies.

Energy expenditure of young children :

No assessment by using special equipments could be carried out to measure the energy expenditure of the young children. However, the investigators observed closely the various activities of the young children throughout the day. The energy expenditure of the young children was worked out by comparing the activities of the Jarawa children with the activities of the non-tribal young children for whom energy requirements are known. Various sports, games played by non-tribal young children were compared with mounting, climbing and gathering activities of the Jarawa children.

Limitations of the Diet Survey

- Food values of food items, like certain roots and tubers, fish, monitor lizard, molluscs, larvae of wood borer and wild fruits, like *gin*, *tangal*, *omiin*, *betfal*, *loke*, *cowfal*, etc. which the Jarawas eat are not known. In some cases food values of similar food items from the manual of nutritive value of Indian foods by the ICMR (1) was used. The assessment therefore could be approximate values only.
- The present diet survey could not include the food, if any, consumed during hunting and gathering. Only foods taken at home were observed and taken into account and therefore there may be an underestimation to certain extent.
- In case of foods, which could not be weighed, the weight or volume, was assumed on the basis of experience in nutrition surveys elsewhere. Therefore weight of food is a guestimate of food intake.

B. Clinical Assessment of Deficiency Diseases

The following deficiency diseases were looked for among the Jarawas:

- (i) Protein calorie malnutrition in young children by signs and symptoms of Kwashiorker and Marasmus (including loss of subcutaneous fat).
- (ii) Toad skin for deficiency of **essential fatty acids**.
- (iii) Xerosis and Bitot's on conjunctivae – for **vitamin A deficiency**.
- (iv) Cheilosis and Angular scar in mouth – for **riboflavin or vitamin B complex deficiency**.
- (v) Calf muscle tenderness – **for vitamin B₁ deficiency**.
- (vi) Spongy and bleeding gum – **for vitamin C deficiency**.
- (vii) Thyroid enlargement (grades 0, 1 & 2) – **for iodine deficiency**.
- (viii) Mottled enamel of teeth – **for excess fluoride consumption**.
- (ix) Cavity in teeth (Dental caries) – **for fluoride deficiency**.
- (x) Symmetrical dermatitis in the body – **for niacin deficiency**.
- (xi) Pigeon chest, bowing of legs and ricket rosary – **for vitamin D deficiency**.
- (xii) Night blindness (functional defect) – **for vitamin A deficiency** (It was dropped after the first phase, as it was found that the Jarawas fail to respond to questions offered to them to elicit information on night blindness).
- (xiii) Pallor of the inner side of lower eyelid – **for anaemia**.
- (xiv) Oedema **for anaemia, protein under nutrition**.

C. Anthropometry (Height and weight measurements)

Heights and weights were directly measured and therefore these were the two reliable indicators of the nutritional and health status.

Height was measured by an anthropometric rod correct upto 0.5 cm and body weight by a footrest weighing machine correct upto 0.25 kg or the least weight that can be measured according to the marking of the machine used.

The most reliable index was therefore **weight for height** for children and the Body Mass Index (BMI), which are age-independent indicators for adults.

$$\text{BMI} = \frac{\text{Weight in Kg}}{(\text{Height in metre})^2}$$

The age and sex specific mean heights and weights of the Jarawas are not known. It was also difficult to ascertain the correct age. Moreover, number of persons of a particular age is also small. Therefore, age group specific mean weight and height was obtained. The BMI classifications were used to bring out the chronic energy deficiency status of the adult (≥ 18 years of age) Jarawas. The following was the classifications of CED according to the BMI.

CED Classifications according to BMI (2)

BMI	Presumptive Diagnosis
< 16.0	CED grade III (Severe)
> 16.0 – 17.0	CED grade II (Moderate)
> 17.0 – 18.5	CED grade I (Mild)
> 18.5 – 20.0	Low weight normal
> 20.0 – 25.0	Normal
> 25.0	Obese

In case of children < 18 years of age weight for height indicator was used following the guidelines given by the WHO (Ref. 3) for heights from 49 cm – 137 cm for girls and 49 cm – 145 cm for boys.

D. Laboratory Investigations

The following laboratory investigations related to the nutritional status or food related diseases were carried out in the pathological laboratory of the G.B Pant Hospital, Port Blair using standard methods and techniques with the help of kits of reputed company in an auto-analyzer.

- The following indicators were used to assess **hypertension and coronary heart diseases (CHD)**.
 1. Serum cholesterol.
 2. Serum HDL (High density lipo protein).
 3. Serum LDL (Low density lipo protein).
 4. Serum triglyceride.

- The following were estimated to assess the **body iron status**. Their low levels indicate low iron status, which eventually leads to iron deficiency anemia.
 - (i) Serum ferritin.
 - (ii) Serum iron
- Directly **hemoglobin status** was ascertained by estimating Hemoglobin by cell counter method (MS4) in the 3rd phase of the survey.
- **Liver function** was assessed by estimating.
 1. Serum glutamate oxaloacetate transaminase (SGOT).
 2. Serum glutamate pyruvat transaminase (SGPT).
- **Protein status** of the body was assessed by estimating.
 - Serum protein.

E. Age Determination

Approximate age was determined as follows:

- Children: By the erupted and fallen teeth.
- Adult men and women : From the physical growth and other age specific signs and symptoms.

For women, at times the number of pregnancies and spacing of children helped in confirming some of the other parameters.

F. Activity Type

Following is the list of activities usually performed by the Jarawas throughout a day.

- (i) Gathering of plant foods including honey.
- (ii) Hunting of animals (boars, birds) and carrying the hunted animals (boars) back home.
- (iii) Hunting and gathering of fish, including molluscs.
- (iv) Cooking, building of shelter, collection of building materials, collection of water.
- (v) Preparation of weapons/equipments.
- (vi) Visits if any to habitations in villages to get food items (banana, etc.).

- (vii) Climbing up and down the terrain and trees
- (viii) Collection of fuels (wood, leaves)

However, Jarawa spend long hours idly and lazily, if their food demand is met. According to terrain conditions and type of activities as mentioned above, adults were assumed to be **moderately active**.

G. Other Observational Studies

Other observational studies were done by close observation and physical check up by the investigators on site.

(III) RESULTS

a) Demography

Table 1 shows the frequency distribution of the surveyed population according to the broad age groups. Tables 2a and 2b summarize the data on family size and family type. The average family size was close to 4 (3.83).

b) Anthropometry

Instead of age specific mean body weight and height the data were developed on **age group-wise** mean body weight and height, as, age determination lacked accuracy. For this reason age group-wise derivation of result could be more acceptable. Table 3a and 3b present the data on age group-wise mean body weight and height of the Jarawas both males and females respectively. The growth curves (figs. 1 and 2) using the same data indicate a good growth rate. These data corroborate with those of the adult Jarawas and Onges found elsewhere (4 and 5).

BMI data (Table – 4) indicated that the adult females were better off than the adult males in respect of chronic energy deficiency situation probably because energy expenditures of females were less than those of males. In respect of weight for height most of the young children were above Mean – 2 S.D. Only a few children were <Mean – 2 S.D. and <Mean – 3 S.D. indicating that most of them had good growth (Table 5a and 5b) and indicated that most (94.1%) of the young children were not subnormal.

c) Food Intake

Food intake of the Jarawas consists of mainly animal origin like pig meat and fat, fishes, crabs, prawns, molluscs, turtle eggs and oil, larvae of wood borer and honey, etc. Plant food consists of various wild roots, tubers and wild fruits.

Table 14 summarizes different types of food consumed on the days of the survey. It is found that the common food in three areas was different in three seasons. However, in the Kadamtala area almost all varieties of food were available. Non-tribal alien foods such as biscuits, bread and rice were found to be given to the Jarawas by the visitors. The curiosity of young children in receiving alien foods may in the long run lead to acceptance of those foods for regular consumption. This change in food behavior may not prove beneficial as such foods contain refined flour, sugar, salt, etc. to which the Jarawas are not accustomed. Table 15 presents the data of edible percentage of various raw foods consumed by the Jarawas. These figures help calculation of nutrients of the food consumed.

A complete lack of leafy vegetables intake should have posed health problem apparently among the Jarawas. Whether this makes the Jarawa diet unbalanced or otherwise is an open question. The Jarawas are maintaining their health and nutritional status without the consumption of green leafy vegetables, milk and milk products. Therefore it stands out that the various food items consumed by the Jarawas constitute a balanced diet for them. The micronutrients, namely, vitamin C, carotene, vitamin K, folic acid, calcium, sodium, iron, zinc, etc. of leafy vegetables and calcium and phosphorus and protein of milk and milk products are possibly compensated by various **animal food** and **wild fruits** consumed abundantly by the Jarawas.

Fruit intake: The Jarawas were found to collect and consume various wild fruits, namely, *omin*, seeds of jackfruit, *tooya*, *tokano*, *guava*, *omin*, *quanantho*, etc. (Table 14). Jarawas preserve jackfruit seeds for use during the lean period.

Mean intakes of energy, protein, fat and some vitamins and minerals per/acu/day among the Jarawas have been given in tables 16, 17 and 18.

d) Nutrient Intake

Energy intake: Adult Jarawas were assumed to be moderately active. In that respect when RDA (recommended dietary allowance) of energy as recommended by the ICMR for Indians was applied, a significant percentage (approx. 10%) of the families had energy intake less than 50% of RDA. The BMI data also show that about 15% of the adults had chronic energy

deficiency (CED). Energy intake was however satisfactory for 84% of the families and in some families (approx. 6 %) energy was much above RDA. This also corroborates with the obesity status from BMI. Table 19 presents data on dietary energy and protein intakes in relation to height and weight of the young children between 4-9 years. It is found that the nutritional status by weight for height (NCHS Standard) of these children was satisfactory.

Protein intake: Mean protein intake was in the range of 50- 80 gm/acu/day. Dietary protein was mainly from animal source and therefore had high biological value. Considering the short stature and lower body weight of the Jarawas these levels of protein intake may be taken as **satisfactory** (Table 16).

Animal fat intake: The main providers of energy was the animal fat, honey and coconut. It was found that during the period of the survey large percentages of families and all members in a family, except very young children who were breast fed, consumed pig fat in large quantities. Turtle fat was also found to be consumed in the Kadamtala area. However the lipid profile was normal for most of the Jarawas (Table 16).

Calcium intake: The calcium intake was variable according to seasons because of variation in consumption of foods such as small fishes, crabs, molluscs and prawn, etc. Low intake of calcium in certain seasons could have lead to osteoporosis, but as the Jarawas consume a lot of animal food rich in vitamin D and phosphorus these are expected to help better absorption of calcium and phosphorus and better bone mineralisation, even with somewhat low calcium intake (Table 17) during certain times of the year.

Salt, Sugar, Oil, Spices and Condiments

No salt, sugar, oil, spices and condiments were found to be used by the Jarawas with their raw or cooked foods, although they are in touch with non-tribals, use at times modern medicines and also eat processed food, Alien food, if consumed by them regularly, may change their food habit and may affect their health adversely as they may not be used to them physiologically.

e) Food Security of Jarawas

Food security of the Jarawas is an important question to address. In case the food security is challenged, the Jarawas would like to come down to peripheral or non-tribal areas to collect foods that non-tribals consume. This may affect the food behaviour as well as health and nutritional status of the Jarawas. Food security of a community is at safe level when the total food availability in terms of various food groups is well above the total food requirement.

f) Total Requirement of Energy and other Nutrients of Jarawas

The total requirements of energy and all macro as well as micronutrients of the Jarawas have been calculated on the basis that their RDAs are the same as for other persons in the society (ICMR).

Total No. of Jarawas	Total ACU*	Energy (Kcal)	Protein (Kg)	Fat (Kg)	Calcium (Kg)
266	248.5	2.36x10 ⁸	5.44x10 ³	1.8x10 ³	3.63

Iron (Kg)	B1 (Kg)	B2 (Kg)	Niacin (Kg)	Vit-C (Kg)	Folic Acid (gm)	Vit-A (gm)	Vit-B12 (gm)
2.54	0.11	0.13	14.5	3.63	9.0	54.0	0.09

* Adult Jarawas have been taken to be moderately active. Extra ACUs for pregnant and lactating mothers have been taken into consideration.

Total Requirement of Various Food Groups as Available in Jarawa Areas

Diet survey has shown that the Jarawas do not take green leafy vegetables, milk or milk products, sugar & jaggery, oil seeds, cereals and pulses. They mainly depend on wild pig meat, pig fat, sea fishes of various types, wild roots and tubers, honey, variety of wild fruits, jackfruits and seeds, larvae, monitor lizards, turtle eggs, etc. Availability of pig varies from season to season. Therefore diets of the Jarawas are divided into two types : (i) pig meat dominant diet; (ii) non-pig meat diet. From the diet survey, the following two diets are prepared (Table 27 & 28) comprising of a variety of food groups, as available in Jarawa areas that are likely to give the adequate energy and protein and also other macro and micro nutrients. It is generally found that a diet comprising of a variety of food groups, if adequate in Energy and Protein, generally takes care of all other macro and micro nutrients. It is also observed that if pig meat is not available on a day, the Jarawas would like to take fish / seafood and eggs.

The energy and protein of these two types of diets have been calculated based on average nutritive values (energy, protein) cited in the literature for the particular food group. Food groups of pig meat diet and those of non-pig meat diet are assumed to be consumed for 200 days (little over six months in a year) and 165 days, respectively in a year (Table – 29).

Based on these calculations, it is found that the total requirements of energy and protein for the whole Jarawa population (266) as per the diet charts corroborate well with the total requirements calculated according to RDA (Table – 30).

g) Adequacy of Availability

The required availability of food should not fall short of required food consumption. The resource surveys by B.S.I. and Z.S.I have indicated the availability of food resources both plants as well as animals in Jarawa area. The report (Table 31) maps out availability of plant resources of edible food in terms of Abundant and Plenty while the report (Table 32) has categorized availability of animal food as Abundant, Common and Occasional. As this classification is conceptual in character, it needs to be ascertained whether required quantity as per various food groups would be available to Jarawas from their forest and coastal water. It may be mentioned in this context that alien food are offered to Jarawas mostly to young Jarawas along ATR. Jarawas have developed taste for bananas and coconut which are sometime offered by contact persons.

h) Deficiency Diseases

Except pallor (an indicator of anaemia) and glossitis (B-complex deficiency) in a few cases, no other overt deficiency signs and symptoms were detected. This indirectly indicates that the Jarawa, diets are satisfactory in terms of vitamins and minerals (Table – 20).

i) Meal Pattern

No meal pattern, such as breakfast, lunch, evening meal and dinner, were found. Young children were found to eat fruits at random.

j) Cooking Practices

The Jarawas were found to practise boiling, roasting or baking. They were also found to cook the same item in different ways. Cooking practices of some common food items observed during the survey are tabulated in Table 26

k) Breast Feeding Practices

Colostrum was fed to a new-born baby. The infants below 6 months of age were mainly fed breast milk. In addition, plain water, slices of pig fat and honey were given.

l) Food Fads and Fallacies

Some foods like pig meat, honey and lizard were avoided and some food like fish was preferred by some Jarawa women during pregnancy or after delivery (Table – 25). It was also observed that at the time of fever they avoided pig meat / fat but consumed extract of pig meat, just as soups, which may be considered as a good practice.

m) Domestic Food Storage Practices

The Jarawas often store foods, which are collected in excess of consumption. They also store food for lean periods. One such food is *omin* which they consume when more delicious foods are not available. They are found to store pig meat by smoking after hanging the pieces over the fire. Pig fats were also stored in bottles. Honey is stored in wooden pots. Seeds of jackfruit are stored to be consumed during lean periods.

n) Water Usage Pattern

Most families kept 10 to 15 liters of water in plastic pots. Consumption of drinking water ranged from 200 to 500 ml per adult with average intake of 1.5 liter per day (range 1.5 to 2.5 liter /day/person). Nearby streams and nullahs were the main sources for water. Water for cooking was collected from the same sources. Water was drunk directly by touching the mouth at the rim of the pot. They used wooden basket for storing water in the past.

o) Serum Parameters

Serum parameters (Tables 6 to 12) indicated that fat related parameters, namely, **cholesterol**, **triglyceride**, **LDL** (Low density lipo protein) and **HDL** (High density lipid), **cholesterol** were normal for most of them. These parameters are related to fat intake. Increased fat intake increases cholesterol and triglyceride levels in serum thereby increasing the risk of coronary heart disease (CHD). Increase in the serum level of LDL is more risky for CHD. Whereas increase in HDL cholesterol is good against CHD. **Although animal fat intake was very high among the Jarawas but serum parameters remained within normal limits**, which signifies that they might have a better fat metabolizing capacity. **Serum glutamate oxaloacetate transaminase** (SGOT) and **serum glutamate pyruvate transaminase** (SGPT) were within normal limits for most of the Jarawas indicating that the organic function including liver was in good condition. Blood **glucose** levels estimated from random blood samples were found to be in the normal range for most indicating that Jarawas did not have a diabetic problem.

Serum Protein, Ferritin, Iron, and Haemoglobin

Serum proteins levels being normal for most of the subjects indicated good protein nutrition and liver function. **Serum ferritin**, a compound for storage of usable

iron in the body increases with iron intake. This being normal for most of the Jarawas indicated that iron nutrition was good. However, caution must be applied to interpret the serum ferritin data as it increases with inflammatory conditions. The data of serum iron and hemoglobin levels indicated good iron status of the subject. It is therefore apparent that the iron intake status as obtained from the diet survey is not a complete reflection of the nutritional status of the dietary either because iron-values of Jarawa, foods are not known and/or the diets taken outside the house or outside the hours of the survey could not be taken into account, or iron taken by Jarawas from their food has, a much higher bio-availability compared to that of cereal-based average Indian diets for which RDA is 28 mg/acu/day (2). **Heamoglobin status of Jarawas** (WHO criteria) was estimated to know the prevalence of anemia among the Jarawas. The result shows that 29% Jarawas suffered from anemia of which 87.5% were mildly anemic and 10% had moderate anemia. Only 2.5% had severe anemia. The data suggests sufficient nutritional iron intake from pig meat. (Table 21 and 22).

(IV). SUMMARY OF FINDINGS

1. The Jarawas of Andaman Islands consume a lot of pig meat, fat, honey, larvae of woodborer, marine fish, crab, mollusc and various wild fruits, roots and tubers. Their **food security** has not been challenged so far. However seasonally they migrate from one place to other, mainly within Jarawa areas, in search of ample food. The **adequacy** of food intake is evident from the fact that the anthropometric indices are within normal limits for most of the Jarawas.
2. Except **anemia** and **glossitis** in a few cases, the signs and symptoms of other deficiency diseases were not observed among the Jarawas, indicating a satisfactory food and nutrient situation. Laboratory estimation of Haemoglobin as indicator indicates overall anaemia prevalence of 29.1% in pregnant women out of which only one pregnant women had severe anaemia (<7gm% Hb) confounding factors of anaemia, such as malaria, hookworm, ARI may be looked out.
3. The **animal fat consumption** is very **high** but the fat related serum indicators were within **normal** limits for most of the Jawaras.
4. The Jarawas have mainly three types of **cooking practices**: boiling, roasting and baking. The culinary practices of the Jarawas for both animal and plant foods help to obtain clean edible parts.
5. The Jarawas, specially young **children**, have **curiosity** about **alien foods** offered by visitors. In the long run the curiosity may turn into acceptance, which is unwanted.
6. **Quantitative requirements** of food of various types have been estimated through the nutrition survey. The survey reports of the Botanical Survey of

India and of the Zoological Survey of India indicate a **qualitative** abundance of natural food sources available in Jarawa areas. These two organizations may have to confirm whether natural resources available are adequate to meet the quantified requirement.

7. The Jarawas are found to have developed a taste for banana and coconut, two **alien food**. It has to be looked into whether it is necessary to **develop** some natural food sources eg: plantation of banana and coconut in Jarawa areas to augment their food security.
8. More **clean water** sources needs to be identified
9. The usual concept of **balanced diet can not** be applied to the Jarawas. They take no green leafy vegetables, vegetables, milk, spices, etc.
10. **Morbidity factors** among the Jarawas, such as malaria, ARI, Hepatitis, diarrhoeal diseases which tell upon the nutritional status and also all confounders of anaemia, may be taken care of by environmental and other support systems backed by increased access to medical and health care facilities.
11. Examinations indicated that the **nutritional status of the Jarawas was not less satisfactory** and is better than that of the non-Jarawas, which, in turn, indicated that :
 - (i) food was not unbalanced to a significant extent.
 - (ii) food security may not be a problem.

However, emphasis should be given to protect the natural food resources available in Jarawa areas from the alien hands. Some natural sources of food, such as plantain and coconut, may be developed in Jarawa areas in order to augment the food availability and strengthen their food security further.

(V) FUTURE RESEARCH NEEDS

1. **Food values** of all Jarawa food should be estimated in reputed national laboratories along with anti-nutritive / anti-fertility factors and natural toxicants.
2. **Fat metabolism** among the Jarawas should constitute a special area of study.
3. **RDA's** of nutrients should be determined for the Jarawas specially to consider a **balanced diet**.
4. A Negrito standard of height and weight according to age should be made available or developed.
5. Longitudinal study (done at least once in every year) for at least the next five years covering food intake pattern, food availability, nutritional status, etc. will give a dependable emerging picture of the food and nutritional security of the Jarawas, who are now at the crossroad of being exposed to the civilized world with a changing lifestyle.

A monitoring team may be developed to oversee the implementation of the recommendations given.

DIET AND NUTRITION TABLES

Table - 1

Frequency distribution of the surveyed population of Jarawas of Andaman Islands according to Broad Age Groups

Age group	Number of persons								Sex Ratio
	Male				Female				
	KT	T	JR	All	KT	T	JR	All	
0-11 month	2	2	3	7	4	2	1	7	100.0
1-3 years	-	-	2	2	3	-	-	3	66.7
4-5 years	3	3	4	10	3	4	1	8	80.0
6-14 years	16	17	9	42	16	15	14	45	107.1
15-44 years	22	15	19	56	29	19	11	59	105.4
45 and above	6	3	1	10	0	1	1	2	20.0
Total	49	40	38	127	55	41	28	124	97.6

Sex ratio: Female / Male x 100, multiplication factor was taken as 100, because the total population was far below 1000

Table – 2a

Distribution of Jarawa population according to family type

Family Type	Tirur	Jirkatang	Kadamtala	Total (n)
Nuclear	14 (66.7)	13 (76.5)	16 (57.1)	43 (65.5)
Joint	7 (33.3)	4 (23.5)	12 (42.9)	23 (34.5)
Total	21 (31.9)	17 (25.7)	28 (42.4)	66 (100.0)

Numbers in bracket are percentage

Table – 2b

Distribution of Jarawa population according to the family size

Family type	Total families	Total persons	Family size	Over all family size (3 rd phase)	Over all family size (1st and 2 nd phase combined)
Nuclear	43	148	3.44	3.85	3.83
Joint	23	103	4.48		
Total	66	251	3.85		

Table – 3a

Age groupwise mean body weight (kg) and height (cm) of Jarawa males of Andaman Islands.

Age group (years)	Number (n)	Mean height (cm)	Mean weight (kg)
0-1	6	53.3	5.25
1-3	4	72.25	9
4-6	18	110.3	16.7
7-9	13	112.1	18.5
10-12	15	127.7	25.4
13-18	15	139.3	33.4
19-24	17	153	46.05
25 and above	39	153.7 (SD 45.86)	46.5 (SD 45.4)

SD= Standard Deviation.

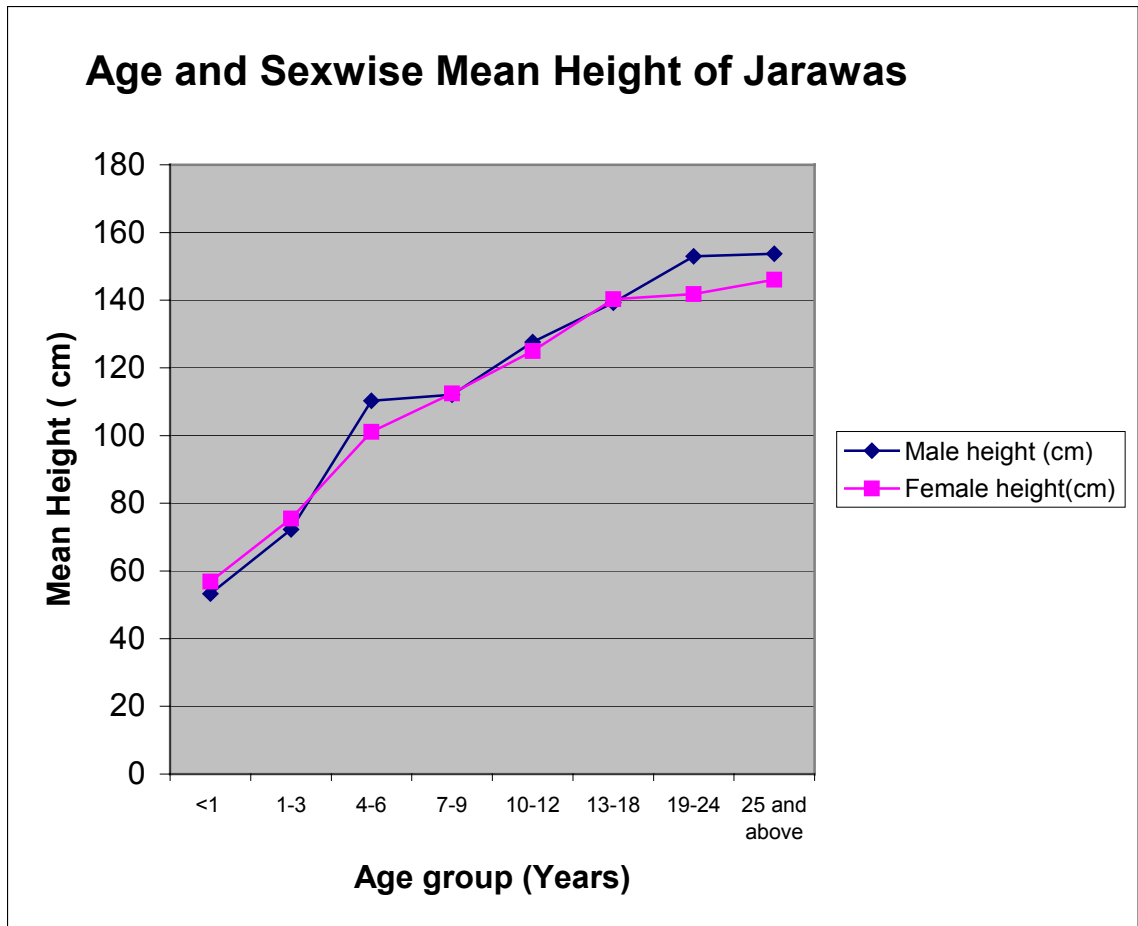


Table 3b

Age groupwise of mean body weight (kg) and height (cm) of Jarawa females in Andaman Islands.

Age group (years)	Number (n)	Mean height (cm)	Mean weight (kg)
0-1	7	56.85	4.9
1-3	3	75.5	8.5
4-6	14	101.07	15.07
7-9	10	112.4	19.25
10-12	21	125	26.5
13-18	19	140.3	37.5
19-24	12	141.8	41.3
25 and above	36	146.1 (SD6.2)	43.8(SD 5.6)

Table – 4

Frequency and Percentage Distribution of Jarawa Adults above 18 years According to BMI.

Nutritional Status from BMI	Male		Female		Total (Male + female)	
	Number	Percent	Number	Percent	Number	Percent
Obese	0	0	5	9.5	5	4.5
Normal & Low Normal	46	79.4	42	79.2	88	79.3
CED-I	8	13.8	6	11.3	14	12.6
CED-II	3	5.2	-	-	3	2.7
CED-III	1	1.6	-	-	1	0.9
Total	58	100	53	100	111	100

Note: Two males have lost weight since the 2nd phase of the survey which reduced no. of obese a makes to nil.

Table – 5a

Nutritional Status of young children of less than 18 years of age by weight for heights of 55 and 137 cm for girls, 55cm to 145cms for boys.

Total Number	<Mean – 3 S.D Sever malnutrition	<Mean – 2S.D mild to moderate malnutrition	>= Mean –2 S.D normal
107	0(0)	01 (.9)	106 (99)

Figures in brackets are percentage.

Table – 5b

Nutritional Status of young children (6 month to 60 month) according to MUAC by WHO criteria

Total Number	<Mean – 3 S.D	<Mean – 2S.D	>= Mean –2 S.D
17	0(0%)	1(5.9%)	16(94.1%)

Table: 6
Distribution of Jarawas by Serum Cholesterol level

Place	IInd phase				IIIrd phase			
	N	Low	Normal	High	N	Low	Normal	high
TIRUR	44	8	35(80)	1	36	5	29(81)	2
JIRKATANG	33	1	30(91)	2	43	0	42(98)	1
KADAMTALA	43	8	34(79)	1	59	13	45(76)	1
Total	120	17(14.2)	99(82.5)	4(3.3)	138	18(13)	116(84)	4(3)

Figures in the brackets are the percentage.

Note: low= <130mg%, normal=130-220mg%, high>220mg%

Table: 7
Distribution of Jarawas by Serum triglycerides level

Area	2 nd phase				3 rd phase			
	N	Low	Normal	High	N	Low	Normal	High
TIRUR	44	0	43(98)	1	36	0	34(94)	2(6)
JIRKATANG	33	5	22(67)	6	43	0	40(93)	3(7)
KADAMTALA	43	4	29(67)	10	59	0	57(96)	2(4)
Total	120	9(7.5)	94(78.3)	17(14.2)	138	0	131(95)	7(5)

Figures in brackets are the percentage.

Normal (60-150) mg/dl

Table: 8
Area and phase distribution of Jarawas by Serum HDL Cholesterol level

Area	2 nd Phase			3 rd Phase		
	N	Normal	High	N	Normal	High
TIRUR	44	41(93)	3	36	24(67)	12 (33)
JIRKATANG	33	32(97)	1	43	21(49)	22 (51)
KADAMTALA	43	39(91)	4	59	41(69)	18 (31)
Total	120	112(93.3)	8(6.7)	138	86 (62.3)	52 (37.3)

Figures in brackets are the percentage.

Table: 9
Area and phasewise distribution of Jarawas by Serum LDL Cholesterol level

Area	2 nd phase			3 rd phase		
	N	Normal	High	N	Normal	High
TIRUR	44	42(95)	2	36	34(94)	2
JIRKATANG	33	30(91)	3	43	43(100)	0
KADAMTALA	43	42(98)	1	59	59(100)	0
Total	120	114(95)	6(5)	138	136(98.2)	2(1.8)

Numbers in brackets are the percentage.

Table: 10
Distribution of Jarawas by Serum ferritin level

Sex	2 nd phase				3 rd phase			
	N	Low	Normal	High	N	Low	Normal	High
Male	62	3	59(95)	-	70	0	65(93)	5
Female	58	-	56(96)	2	68	5	63(93)	0
Total	120	3(2.5)	115(95.8)	2(1.7)	138	5(4)	128(92)	5(4)

Numbers in brackets are the percentage.

Normal: Male (32-501) ng/ml, female (3.5-223.5)

Table: 11
Distribution of Jarawas by Serum iron level

Sex	2 nd phase				3 rd phase			
	N	Low	Normal	High	N	Low	Normal	High
Male	62	16	45(37.5)	1	70	4	54	12
Female	58	1	55(45.8)	2	68	6	57	5
Total	120	17(14.1)	100(83.3)	3(2.5)	138	10(7)	111(80)	17(13)

Numbers in brackets are the percentage.

Normal: Male (60-160)µg/dl, female (37-145) µg/dl.

Table: 12
Distribution of Jarawas according to Serum-Protein level

Place/S. Protein	2 nd phase				3 rd phase			
	N	Normal	Low	High	N	Normal	Low	High
TIRUR	44	32	12	0	36	31	1	4
JIRKATANG	33	17	15	1	43	30	6	7
KADAMTALA	43	26	15	2	59	45	7	7
Total	120	75(62.5)	42(35)	3(2.5)	138	106(77)	14(10)	18(13)

Numbers in bracket are percentage

Note : Normal = 6.6 to 8.6 gm%, Low < 6.6 gm%, High > 8.6 gm%

Table: 13
Sex and areawise distribution of anemia (W.H.O criteria)

Area/age group	n	Normal			Anemic		
		Male	Female	Total	Male	female	total
TIRUR							
sex		Male	Female	Total	Male	female	total
6m –6yrs	3	2	1	3(100)	0	0	0
6yrs-14yrs	18	5	5	10(55)	4	4 (22.5)	8(45)
15 and above	15	4	6	10(66)	0	5 (33)	5(34)
total	36	11(30)	12(33)	23(63)	4(11)	9(25)	13(37)
Jirkatang							
6m –6yrsz	3	1	2	3(100)	0	0	0
6yrs-14yrs	9	4	4	8(89)	0	1	1(11)
15 and above	31	13	8	21(68)	7 (22.5)	3 (9.6)	10(32)
Total	43	18(42)	14(33)	32(75)	7(16)*	4(9)	11(25)
Kadamtala							
6m –6yrsz	12	8	2	10(83)	0	2 (17)	2(17)
6yrs-14yrs	13	8	3	11(85)	0	2 (15)	2(15)
15 and above	34	12	13	25(74)	3 (8)	6 (18)	9(26)
Total	59	28(48)	18(30)	46(78)	3(5)	10(17)	13(22)

(Numbers in brackets are percentages)

Table – 14

Percentage distribution of families consuming various types of raw foods in three different areas during three phases of survey

ANIMAL FOOD	Kadamtala			Tirur			Jirkatang		
	1 st	2 nd	3 rd	1 st	2 nd	3 rd	1 st	2 nd	3 rd
1) Pork muscle	100	80	70	100	25	100	87.5	76.6	85.6
2) Port fat	100	80	70	100	25	83.3	85	75	44.4
3) Turtle egg	47.8	13.3	30	0	0	0	0	0	20
4) Turtle fat (or oil)	0	0	10	0	0	0	0	0	20
5) Small fish	56.5	6.7	40	86.7	87.5	20	0	0	11.1
6) Larva of wood borer	0	20	20	0	0	33.3	0	0	77.8
7) Honey	95.5	80	60	80	100	50	0	91.6	77.8
8) Crab	0	0	10	46.7	0	16.7	0	8.3	0
9) Pig Liver	0	0	10	86.7	100	0	0	0	0
10) Molluscs	73.9	6.7	0	85.6	100	0	62.5	0	0
11) Prawn	34.8	6.7	0	6.7	0	0	0	0	0
PLANT FOOD									
a) Fruits:-									
1) Omin	0	0	100	0	0	0	0	91.6	33.3
2) Aab (seed of jack fruit)	0	73.3	40	0	87.5	0	0	0	11.1
3) Plantain green	100	86.7	50	100	75	0	75	100	33.3
4) Ripe banana	100	85	50	75	75	50	75	75	33.3
5) Tooya (Fruit)	0	0	10	0	0	0	0	0	44.4
6) Quanantho	0	0	10	0	0	0	0	0	11.1
7) Guava	0	0	20	0	0	0	0	0	0
8) Tokano	0	0	10	0	0	0	0	0	0
9) Gub	0	73.3	0	0	0	0	0	0	0
10) Betfal	0	50	0	50	0	0	0	50	0
11) Gin	13.3	100	0	0	50	0	0	75	0
b) Roots & Tubers:-									
1) Chew	0	0	70	0	50	50	87.5	8.3	44.4
2) Wagh	30.4	6.7	0	0	0	0	0	50	
c) Nut:-									
2) Coconut	0	0	10	0	0	0	0	0	0
d) Processed food:-									
1) Biscuit	50	0	50	50	50	66.7	50	75	33.3
2) Bread	0	0	0	30	50	16.7	0	0	44.4
3) Rice	0	0	0	0	0	0	0	0	33.3

Note: 1st phase= post monsoon season, 2nd phase = dry season, 3rd phase= monsoon season.

Table – 15

Edible Part Percentage of Raw Food Consumed by Jarawas

Name of the food	Type	Edible Part (in %)
1. Honey	Animal	100
2. Honey comb	Animal	60
3. Pig fat/ oil	Animal	100
4. Pig meat	Animal	100
5. Bethen	Larva	100
6. Molus with shell	Animal	20
7. Omin	Fruit	100
8. Tooya	Fruit	24
9. Banana (Green)	Fruit	70
10. Banana (Ripe)	Fruit	90
11. Honey (Pod)	Animal	90
12. Chew	Root/ Tuber	80
13. Turtle egg	Animal	90
14. Aab (Jackfruit seed)	Fruit	100
15. Tokano	Fruit	20
16. Small fish	Animal	100
17. Crab	Animal	22
18. Guava	Fruit	100
19. Turtle fat	Animal	100
20. Monitor lizard	Animal	70

Table – 16

Mean Intake of Energy, Protein and Fat of Jarawas per ACU

ITEM	RDA	MEAN INTAKE			
		Tirur	Jirkatang	Kadamtala	All
Energy (Kcal/day)	2425	2770	2421	2436	2502
Protein (gm/day)	60	79	45	54	56
Fat (gm/day)	(20) 54*	195	111	138	140

- This includes invisible fat
- The figure in bracket for frank fat.

Table – 17

Mean Intake of Calcium and Iron of Jarawas per ACU

ITEM	RDA	MEAN INTAKE			
		Tirur	Jirkatang	Kadamtala	All
Calcium (mg/day)	400	208	119	306	211
Iron (mg/day)	28	11	16	9	11.9

Table – 18

Mean Intake of B1, B2, Niacin and Vitamin C of Jarawas per ACU

ITEM	RDA	MEAN INTAKE			
		Tirur	Jirkatang	Kadamtala	All
B1 (mg/day)	1.2	2.39	3.12	1.14	2.11
B2 (mg/day)	1.4	3.59	1.78	0.33	1.52
Niacin (mg/day)	16	75.93	42.88	17.33	45.73
Vitamin C (mg/day)	40	55.2	63.26	98.7	76.95

Table – 19

Dietary intake of individual children by way of observation throughout the day (6 A.M to 6 P.M) with reference to nutritional status by anthropometry

Sl.No.	Age (years)	Sex	Energy (k cal)	Protein (gm)	Height (cm)	Weight (kg)	Nutritional status by weight for height (NCHS Standard)
1	8	M	1684	112	112	17.5	> median –2SD
2	4	M	1573	84	96	12.5	> median –2SD
3	6	M	1180	21	101	14	> median –2SD
4	6	M	1511	70	106	14.5	> median –2SD
5	7	M	1801	31	104	17	> median –1SD
6	6	M	1563	54	98	15	> median –1SD
7	8	M	1868	18.4	110	19	> median
8	5	F	1046	39.6	110	16.5	> median –2SD
9	9	F	1684	112	115	19	> median –1SD
10	5	F	1573	84	98	15	> median
11	4	F	1484	79.5	97	14.5	> median
12	6	F	1570	93.7	111	16	> median –2SD
13	5	F	1342	56	96	13	> median –2SD
14	7	F	1541	88	106	16	> median –1SD
15	9	F	1743	52	124	23	> median

16	8	F	1876	84	113	20	> median
17	6	F	1899	95	104	19.5	> median +1SD

Table – 20

Prevalence of Deficiency Diseases

AREAS	Total N	PALLOR			GLOSSITIS		
		No. of subjects	Male	Female	No. of subjects	Male	Female
Tirur	81	6	1	5	1	0	1
Jirkatang	66	10	2	8	2	0	2
Kadamtala	104	18	5	13	0	0	0
Total	251	34 (13.5)	8(3.0)	26(10.5)	3	0	3 (1.5)

Figures in the brackets are percentage prevalence

Table – 21

Distribution of Jarawas by anemia status (W.H.O. criteria)

Age group	*1 st phase n=114	2 nd phase n= 120	3 rd phase n= 138
6 month- 6 year	3 (2.6)	2 (1.7)	2 (1.4)
6-14 years	20 (17.5)	19 (16.6)	14 (10.1)
Adult male	20 (17.5)	4 (3.3)	11 (7.8)
Adult female (NP)	20 (17.5)	6 (5)	7 (5)
Adult female (P)	2 (1.8)	2 (1.7)	6 (4.3)
Total	65(57)	33(27.5)	40(29)

Numbers in brackets are percentages

* Anemia prevalence is high in first phase because method applied for hemoglobin estimation was **Shahlis Method**.

Table – 22

Distribution of Jarawas by grades of anemia

Grade of anemia	1 st phase	2 nd phase	3 rd phase
Mild	43 (66)	14(42)	35(87.5)
Moderate	22(33)	18(54)	4(10)
Severe	0	1(4)	1(2.5)
Total	65(57)	33(27.5)	40(29)

Numbers in brackets are percentages

Table : 23

Age group and areawise distribution of Jarawas by blood sugar status
(3rd phase)

Grades	Tirur n = 36				Jirkatang n = 43				Kadamtala n = 59			
	<10 yrs	11-24 yrs	>25 Yrs	Total	<10 yrs	11-24 yrs	>25 yrs	Total	<10 yrs	11-24 yrs	>25 yrs	Total
Low	3	2	0	5 (14)	5	1	0	6 (14)	10	2	2	14 (24)
Normal	14	6	11	31 (86)	2	22	13	37 (86)	9	16	20	45 (76)
High	0	0	0	0	0	0	0	0	0	0	0	0

Figures in bracket are the percentage.

Note: low= <70mg%,normal =70-139mg%,high=>140mg%

Table: 24

Blood glucose level (Dry season)

Grades	Tirur n = 44				Jirkatang n = 33				Kadamtala n = 43			
	<10 yrs	11-24 yrs	>25 Yrs	Total	<10 yrs	11-24 yrs	>25 yrs	Total	<10 yrs	11-24 yrs	>25 yrs	Total
Low	3	0	0	3(7)	2	0	0	2(6)	6	2	2	10 (23)
Normal	10	19	12	41 (93)	9	13	9	31 (94)	5	17	11	33 (77)
High	0	0	0	0	0	0	0	0	0	0	0	0

Figures in bracket are the percentage.

Note: low= <70mg%,normal =70-139mg%,high=>140mg%

Table: 25

Food fads as observed in the first , second and third phases of survey.

Food	Avoid	Prefer
Pig	During pregnancy	
Fish		During pregnancy
Honey	During pregnancy and after delivery	
Lizard	During pregnancy	

Table: 26

Cooking practice (common to all phases of the Survey)

Food items	Boiling	Roasting	Baking
Pig meat	Yes	Yes	Yes
Fish	Yes	No	Yes
Mollucs	Yes	No	Yes
Roots and tubers	Yes	Yes	No
Seeds of wild fruits	Yes	Yes	No
Banana green	Yes	Yes	No

Table - 27 : Diet of Jarawas

Sl. No.	Item	Type – I : Pigmeat Dominant Diet		
		Amount (gm)	Energy (Kcal)	Protein (gm)
1.	Pig meat	350	400	65
2.	Pig fat	150	1350	-
3.	Honey	150	478	-
4.	Roots & Tubers	150	105	1.8
5.	Fruits	125	99	1.37
	Total		2432	67.34

Table - 28 : Diets of Jarawas

Sl. No.	Item	Type – II : Other Diet		
		Amount (gm)	Energy (Kcal)	Protein (gm)
1.	Roots & Tubers	250	175	3.0
2.	Fish / Sea Food	250	252.5	52.5
3.	Turtle Eggs	50	60.2*	6.0*
4.	Larvae / Mullusc	100	97.0	10.5
5.	Pig fat (Stored)	120	1080	-

6.	Honey	250	767	-
7.	Fruits	125	99	1.37
	Total		2530	73

* Turtle eggs compensation is supposed to be nil when fish consumption is high.

Table - 29 : Total annual requirement of various food groups consumed by Jarawas				
Sl. No.	Item	Type – I & II Diet		
		Annual Requirement for total Population (kg x 10 ⁴)	Total Energy (K cal x 10 ⁸)	Total Protein (kg x 10 ³)
1.	Roots & Tubers	1.77	0.12	0.212
2.	Honey	1.77	0.56	0.053
3.	Pig meat	1.74	.198	3.131
4.	Pig fat	1.2	1.11	-
5.	Fish / Sea food	1.02	0.092	1.845
6.	Larvae / other animal food	0.41	0.036	0.738
7.	Fruits	1.1	0.089	0.124
8.	Turtle egg & other egg	0.20	0.035	0.272
	Total		2.23	6.4

Table – 30 : Total annual requirement of energy and protein from diet chart and according to RDA		
	From Diet Chart	According to RDA
Energy (Kcal)	2.23 x 10 ⁸	2.36 x 10 ⁸
Protein (Kg)	6.4 x 10 ³	5.44 x 10 ³

Table – 31 : Plant resource of edible food for Jarawas					
Sl. No.	Species Name	No. of Species	Adequacy Status		
			I	II	III
1.	Tubers	4	A	A	A
2.	Tender Shoot	5	A ₍₁₎	A ₍₁₎	A ₍₃₎ P ₍₁₎
3.	Fruits	38	A ₍₁₇₎ P ₍₁₎	A ₍₂₀₎ P ₍₅₎	A ₍₁₆₎ P ₍₁₃₎
4.	Seeds	3			
	a) Jackfruit Seeds		A	A	-
	b) Cycus Rumphii		A	A	P
	c) Khatafal		A	A	P
5.	Dhani fal	1	P	P	P

A = Abundant, P = Plenty, Figures in parenthesis indicate No. of Species.

Table - 32 : Animal resource of edible food for Jarawas					
Sl. No.	Species Name	No. of Species	Avalibility Status		
			A	C	O
1.	Mamals		(1)	(1)	-
	Wild Pig	(2)			
	Sea Cow	1			
2.	Aves	(9)	-	(9)	-
3.	Reptalia	(3)	-	(3)	
4.	Pisces	(108)	(19)	(73)	(16)
5.	Molluscas	(26)	(11)	(11)	(4)
6.	Crustacea	(15)	(2)	(13)	-
7.	Insecta	(3)	-	(3)	-

A = Adequate, C = Common, O = Occasional.