CHAPTER VI

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The present Ph. D. Dissertation entitled ‘Ecology, Conflict and Adaptation of the Jarawa in Andaman Islands’ pertains to the study of form and process of human adaptation of the Jarawa to an island ecosystem, technology and strategy of resource utilisation, analysis of foraging behaviour, and impact of contact and conflict on the Jarawa and their resource base, and how the Jarawa are adapting themselves to the changing situation. Adaptation of the Jarawa to their environment is a process involving technology and strategy employed by them for harnessing the biophysical resources of the ecosystem.

The present study is fundamental as well as applied in nature. Fundamental because it shows how the hunting and gathering based immediate return economy of a hunter-gatherer group functions in an island environment, which has both terrestrial and aquatic resources. In addition, it reveals the pattern and process of adaptation of a hunting-gathering group like the Jarawa to the island environment. Since the Jarawa economy has a close approximation to the economy of classical forager, it helps in understanding the foraging strategy and behaviour of a hunter-gatherer group. The study also illustrate that when human groups like the Jarawa are exposed to the technologically advanced group having production based economy, what are the impacts on their resources base, health, population, habits and material culture. Equally significant is how primitive groups like the Jarawa cope up with the changing situation in the aftermath of their exposure to the new people and changing environment. Vulnerability of such human groups to the changed conditions, in terms of their survival as hunter-gatherers, and as biological unit, is of great concern to the
The study is of applied nature because it deals with the impacts of contacts and conflicts with respect to the Jarawa in pre and post-Independence period. More importantly it also reveals how in post hostility phase (after 1997) the Jarawa as a hunter-gatherer community may soon face survival threat in terms of erosion of their resource base, introduction of new diseases and their addiction to intoxicants. It will help the planners in preparing and implementing plan for the betterment of the Jarawa. It also helps to look into the problems of post-hostility phase in which the Jarawa as a hunter-gatherer community are facing threat to their survival and may meet the fate of their counter part like Onges and Great Andamanese. Thus, it can be said that the study is basically fundamental in nature but it has applied implications as well.

Entire study has been organised into Six Chapters. The introduction to the Ph.D. Dissertation is presented in the First Chapter in which the literature review, objectives of the study, research questions, study area, data base (both primary and secondary data) and methodology have been discussed. The Second Chapter deals with natural environment of the Andaman Islands, which is the habitat of the four Negrito people including the Jarawa. This Chapter highlights the biophysical richness of the Island ecosystem (both terrestrial and aquatic) from which the Jarawa derive various plant and animal resources for their sustenance; and now in the post-hostility
phase, the same resource base is getting taxed by the Non-Jarawa in terms of illegal exploitation of certain resources from it.

The next three chapters are crux of the Dissertation. The Third Chapter begins with detailed information about the demarcation of the 'Jarawa Reserve', population and hunting-gathering activities of the Jarawa and their different territorial groups. The ecology of the Jarawa has been discussed in terms of their perception of the resources of the Island ecosystem in different physiographic zones and assemblage of resources in each physiographic zone. A detailed inventory of the terrestrial and aquatic resources in terms of edible and non-edible resources has been prepared, fulfilling the objective number one of the present study. The edible items of the Jarawa have been put under three categories as per the importance and uses like major, supplementary and minor food items. Seasonality of resources has been discussed through season-wise variations in availability of resources in the habitat, and seasonal variations in gathering of plant and animal resources from both land and water. In addition, the importance of metal, particularly iron, implements and utensils has been discussed. Since the Government has settled the Non-Jarawa people in the Islands, their economic activities have also been discussed in relation to plant and animal resources. Further, it points out a pertinent fact that since many resources are common between the Jarawa and the Non-Jarawa, it was the cause of conflict in the past and it is a cause of concern at present i.e., after 1997 (post-hostility). It is so because the resources of the Jarawa territory are coming under stress, particularly in those areas which are close to settlements of the Non-Jarawa, due to increased exploitation of the resources on the part of the Non-Jarawa in the post-hostility phase.
Adaptation of the Jarawa to the island environment and their response in terms of technology and strategy employed by them for the collection and utilisation of resources have been discussed in Fourth Chapter, as per the objective number two of the Thesis. The stress is on the foraging strategy of the Jarawa, which is a collective response to the island environment for harnessing its resources spread over space and time. The foraging strategy of the Jarawa has been discussed in detail with the help of location of camps, movement pattern, selection of resources, foraging methods, image search, role specialisation and sharing. The importance of the ecological edges in the location of camps in the process of food collection has also been described. The ecological context of the subsistence activity of the Jarawa has been worked out with the help of input–output analysis. The analysis explains that as a hunting-gathering community for how many days a week an economically active Jarawa works and what is the ratio of hunting and gathering in relation to total time devoted. It is followed by analysis of foraging behaviour of the Jarawa in relation to optimal foraging theory to understand that whether the hunting behaviour of the Jarawa conforms to that of a hunter-gatherer or not. Lastly, the work, resource and population relationship has been analysed.

The Chapter Fifth gives a detailed account of the history of contact and conflict in pre and post-Independence period. The reasons responsible for the change in the attitude of the Jarawa towards the Non-Jarawa in different phases have been described. Both the positive as well as negative impacts of the contact in the post-hostility phase (i.e., after 1997) have been dealt with in relation to resources, health, material culture, food, addiction to intoxicants and barter trade. It is followed by adaptation of the Jarawa to the changing environment, and how they are coping up
with the new situation. This Chapter fulfils the third objective set for the present investigation.

Summary and main findings of the study are given in the Sixth Chapter, which also include conclusions derived from it. Difficulties faced in carrying out the present study, limitation of the research and scope of further research on the topic have been incorporated in this Chapter. The last Chapter is followed by an exhaustive list of references, appendix and glossary.

6.1 SUMMARY

Floating in an splendid isolation east of the Indian mainland, the Andaman and Nicobar groups of Island are situated between 6° and 14° North latitudes and between 93° and 94° East longitudes in the eastern part of the Bay of Bengal. The Islands cover an area about 8,293 sq km. The Andaman group of islands are home to four Asiatic hunter-gatherer groups, viz., the Great Andamanese, Onges, Jarawa and the Sentinelese. The Sentinelese are inhabited in the North Sentinelese Island, the Onges in the Little Andaman, the Great Andamanese in the Strait Island and the Jarawa in the western part of the South and Middle Andaman Islands. The Jarawa territory, known as ‘Jarawa Reserve’, covers an area of 765 sq km. In addition to the aboriginal Negrito groups, the Non-Negrito people known as later settlers also inhabit the Andaman Islands.

The Andaman Islands have tropical climate which approximates the equatorial type in the south. The insular position of the Islands in the Bay of Bengal, location in
the tropical zone along the path of travelling storms and cyclones, elongated curved shape and the dominant controls of southwest and northeast monsoons have altogether created a distinct physical environment and have also shaped the human mosaic/fabric of the Islands. The wet topical climate has average annual rainfall of 3400 mm and mean annual temperature of 26°C. This is responsible for luxuriant growth of tropical rain forests which are extremely diverse floristically but is poor in terrestrial fauna, but it is compensated by rich and diverse organic life of the marine ecosystem. The Jarawa rely upon both terrestrial and aquatic resources to fulfil their food and other requirements. The Non-Jarawa also exploit to some extent these resources to fulfil their needs. The total population of the Jarawa is 265 as per the last survey (2002).

There are three territorial subgroups of the Jarawa, namely the Tanmand group, Thidong group and Boiab group. The Tanmand group inhabits the southern part of the Middle Andaman, while Thidong and Boiab groups inhabit the northern and southern parts of the South Andaman Island, respectively.

As the Jarawa have access to both terrestrial as well as aquatic resources it provides them a ‘broad resource base’ and that ensures them varied and rich food, and a balanced diet. At cognitive level, they categorise the resource base spread over four physiographic zones namely coastal area, marshy area, plain land and forested hilly area. Since each of these zones has different assemblage of biophysical resources, it helps them meet their all needs including food.

The availability and density of the resources is influenced by the seasons, and that in turn govern peak of specific hunting and gathering activities directed towards collection of a particular food resource. There are three major seasons in the Island,
which correspond with the availability of certain major resources. In the dry summer (mid-March to mid-May), wild jackfruit is abundantly available in the forested hills, incidentally pig hunting is minimum in this season. During rainy season (mid-May to November), the thrust is on pig hunting and collection of seeds of *Cycus rumphii and Nipa fruticans* as both are available in plenty. Gathering of honey and turtle eggs followed by pig hunting is at peak in winter season from December to mid-March. Though the Jarawa collect number of edible items from the Island ecosystem, the major food items consumed by them are limited in number. Therefore, according to order of importance the food items can be divided in to three categories- *major, minor* and *supplementary foods*. The major edible plant resources of the Jarawa comprise of *Dioscorea* (tubers), fruits and seeds of *Artocarpus chaplasa* (jackfruits), *Nipa fruticans* and seeds of *Cycus rumphii*, though the availability of many of these is seasonal. Among the animal resources, the major edible items are flesh of wild pig, fish, and bivalve shells, and the honey and turtle eggs. Of these, the flesh of the game animals is most preferred food of the Jarawa, and within that meat of the wild pig. Curiously enough, the Jarawa do not hunt deer that is abundantly available in their territory. This is probably because the deer is an exotic species, introduced by the British, hence does not figure in their traditional food items. The availability of many of these resources is subject to season; however, the wide resource base of the Jarawa helps them to overcome the shortage of a specific resource in a particular season or particular area or particular year. Nevertheless, there are certain resources that are available round the year and easy to collect, these are called ‘key stone resources’ for the Jarawa, and comprise of certain species of shell particularly bivalve shells, few species of fish and tubers.
To meet non-edible requirements, the Jarawa make use of about 85 species of plants mainly for construction of huts, implement making, ornamentation, medicinal purpose and as honeybee repellents. The ochre, red and white, is another valuable item for them. The ochre paste is applied on the body either for medicinal purpose or in relation to any rituals or for decorating the body. Though iron implements and utensils are extensively used by the Jarawa, these are not naturally available in the Jarawa territory, hence procured from different sources. In fact, iron is of cardinal importance to them for making many foraging implements like arrowheads and digging rods. In the past, they used to collect iron from jetsam, parts of broken ships washed ashore or from the settlement areas of the Non-Jarawa. After 1997, the Andaman Adim Janjati Vikas Samiti (AAJVS) make a regular supply of iron pieces, along with hammer, chisel and metal utensils to the Jarawa.

The Non-Jarawa also make use of resources of the Jarawa territory. Of these, first group consists of those persons who were brought to the Andaman Island as convicts and in due course of time settled here. In the second group are included the refugees from erstwhile East Bengal who were settled in post-Independence (i.e., after the partition) period between 1955 and 1960. As the Non-Jarawa to some extent depend on the resources of the Island ecosystem, many of the resources have become common to the Jarawa. It was the point of conflict between both the groups in the past and a cause of concern in the present as the resource extraction by the Non-Jarawa is detrimental to the Jarawa in many ways. The reason being the former have much developed tools and technology than the Jarawa. Even more, in long run it may affect the resource density of the ecosystem as well, thus the very survival of the Jarawa.
In the foraging strategy of the Jarawa, locations of the camp and movement pattern play a significant role in the adaptation of the Jarawa to the Island environment. In descending order as per size, the camps of the Jarawa can be put into three categories – permanent, semi-permanent and temporary. The functions of the first two camps are almost similar. These are large camps which remain occupied for longer period of time, i.e., one to three months and hence, serve as the base camps. The third type is a lean-to-type hut where they spend a day or two in course of their logical movement from one place to another. The location of a camp is determined by combination of three factors viz., ecological edges, proximity to drinking water along with easy availability of one of the edible resources, and season. The Jarawa locate the camps at the ecological edges (transitional areas between two physiographic zones) to have access to the resources of two or more than two ecological zones. At the ecological edges, the setting of camp is again governed by the two factors; firstly the proximity to drinking water and secondly the availability of one of the resources in plenty so that it could be gathered with least efforts and time. In case of the inland sites, generally the easily available resource is the bivalve shell followed by fish; and in case of the coastal sites it is different species of molluscs and fish that determine location of camps.

Seasons also play a decisive role in the location of the camp along the coast and in the forests. During the rainy season the preferred locations for permanent campsites are sheltered bays and creeks and raised grounds inside the forests, but the western coast is avoided as the sea remains turbulent due to southwest monsoon winds. With onset of winter season both seaward and landward locations are preferred for setting up the camps. The underlying strategy is to harness the abundantly available seasonal resources namely honey followed by turtle eggs. While the former
is available in the forests, the latter is found along the coast on sandy beaches. During the dry summer the camps are usually located a bit away from the coast in the forests with the purpose of gathering honey and jackfruits. As such the ideal location is generally inside the forest so that the both the resources could be exploited.

To carry out the hunting-gathering activities, movements of the Jarawa are strategically planned and executed to ensure optimum returns. It enables the Jarawa to collect the resources spread over space and time (season). Their movements oscillate between coasts and the forests depending on the seasons that determine not only the availability of resources but also the sea conditions on the western coast. There are two types of movement: residential and logistical. In case of residential movement, the entire group move from one place to another in their territory. Logistical movement, on the other hand, is the movement to and from a base campsite by an individual or a group.

At any given point of time, the Jarawa have between two to three permanent base camps in an area, from where all the logistic movements are made. The field work in three different seasons has revealed that the one-day trip of the Jarawa is within a radius of 10 km. Initially, the resources available at the least distance from the camp are exploited. With the thinning of resources in the vicinity, they travel longer distances to exploit the distant resources. However, in case of pig hunting the strategy of exploitation of an area in a sequential manner (i.e., first the nearest resources) is not applicable. Further, when the movement requires covering of more than 10 km, then they either stay overnight in the forest or organise longer foraging expeditions ranging from a few days to two weeks.
Movement pattern of the Jarawa is also controlled by the seasons. During the summer season when the wild jackfruits and seeds of *Cucus rumphii* are available in plenty, the movement of the Jarawa is oriented towards the collection of these resources. Since the former is available in the forest while latter is found in the creek, the movement of the Jarawa oscillate between creek and forest. During summer season, less numbers of logistical movements are made compared to other seasons because the gathering and processing of jackfruits require them to stay at a place for about 4 to 5 days at a stretch when they are away from the base camp. With the onset of southwest monsoon, it becomes virtually impossible to exploit the sea resources on the western coast as the sea remains rough and turbulent. Since it is the season of the collection of *Cycus rumphii* and pig hunting, both of which are found inland, the movement of the Jarawa is confined mainly within the forests. Maximum numbers of logistical movements are made during this season, as the pig is a mobile prey.

During the cool dry season, the western seas usually remain calm. Since it is also the season when turtles lay eggs on sandy beaches and honey is available in the forests, the movements of the Jarawa are oriented towards exploitation of both the resources. The stay of a family is comparatively longer, ranging from a minimum of four days to maximum of fifteen days at the base camp from where the daily foraging expeditions are made. The information dissemination pertaining to whereabouts of a group is very important in movement pattern of the Jarawa. This kind of information dissemination serves as a means of ensuring subsistence security and reduces the chance of many groups converging at the same place for the resources, without knowing about other groups.
Selection of resources is also a part of the foraging strategy. There are 221 plant and animal species eaten by the Jarawa, out of which 136 are plant species and 85 are animal species. Despite the wide edible resource base, the Jarawa tend to eat only the most palatable and abundantly available food items. However, exception is flesh of the game animals (wild pig, monitor lizard, turtle) which is the most desired food item though not available in abundance.

Hunting, fishing and gathering are three means of getting food. The technology used by the Jarawa in their foraging pursuits are simple and it comprises of simple implements like bow and arrow, pointed wooden stick and iron rod, fishing net, basket, bucket and knife. In their foraging pursuits, the meticulous execution of strategy undoubtedly enhances the chances of getting targeted prey. Besides location of camps and movement pattern, the foraging strategy of the Jarawa comprises of foraging methods, image search, role specialization and sharing. In course of hunting, the Jarawa follow three types of foraging methods that include- ambushing the prey while hunter is stationary, killing the prey when it is stationary but the hunter is mobile, and killing the prey when both hunter and prey are mobile. The first two are pursued individually while the third one is followed both individually and in groups.

Fishing provides an excellent opportunity for the examination of foraging methods, and tools and techniques employed by the Jarawa. This is precisely because the prey is small, quick, and has capacity of escaping away in the water. The usual fishing sites are the coastal areas, creeks, swamps and dammed-off channels. In fact, fishing is carried out generally during low tide. The males do fishing with bow and arrows while the females with hand net and pointed wooden stick and iron rod.
Group fishing is generally carried out in dammed off channels, creeks and marshy areas during the low tide. Though both men and women take part in fishing, predominance of women is found in this activity. The success rate in terms of catch is certainly very high in group fishing. However, in both individual and group fishing, the probability that an individual fish will be encountered is directly related to the number of persons fishing in the area, and it is inversely related to the size of the area. In gathering activities, except the collection of the grub larvae, no strategy is employed as such. The grub larvae are collected from the rotting trees.

Search image is another strategy followed by the Jarawa. They seek a certain species or set of species within a particular environment using a definite strategy. While searching for one category of prey the Jarawa seldom divert their attention to another prey. That means one kind of prey at a time. Again, this behaviour presumably enhances the effectiveness with which the targeted category of prey is pursued.

There is clear division of labour in the Jarawa society for every type of work. Hunting is exclusively carried out by the Jarawa males. Though the females do not hunt wild pigs, they do hunt small animals like snails, molluscs and monitor lizards. Most of the fishing and collection of bivalve shell are done by the women. In fact, most of the gathering is done by the women folk, though men also take part in it.

Sharing is another strategy of assuring supply of food to all the members of the group. The edible resources gathered and brought to the camps are shared
systematically among the constituent members or families. While the meat of the
game animals is shared among the constituent families of a camp, sharing of other
resources is intra-family. The sharing of the flesh of game animal is considered
necessary because for the individual hunter, food sharing is really a way of storing
food for future; his generosity gives him a claim in future on surplus of other hunters.

In order to find out that how much effort is put in the foraging, an Input-
Output analysis has been carried out. It shows that the Jarawa work between 3.7 to 3.9
days a week. It implies that they have sufficient time left for leisure, including
socialisation. Limited days of work give them sufficient time for leisure and social
activities, which is an indication of their successful adaptation to the environment.
The less number of man-days in a week point to the fact that the Jarawa are still able
to successfully pursue hunting-gathering way of life. It is further supported by the
hunting behaviour of the Jarawa, which suggests that the Jarawa are still a hunter-
gatherer group as the hunting behaviour of the Jarawa conforms to the hunting
behaviour of a forager and they do not manipulate the encounter frequency of prey
animals. This answers the research question number one that how far the Jarawa are
truly a hunting-gathering community.

The Jarawa have been living in the Andaman Islands since time immemorial.
The nature and impact of the contacts have been different in different periods of time
and so has been the Jarawa adaptation to the changing situation. The Jarawa contacts
with Non-Jarawa can be broadly put under three time periods viz., pre-colonial,
colonial and post-Independence.
The information about the Andaman archipelago and its inhabitants are found in the account of travellers, traders and sailors, in which the islanders are mentioned as barbaric. However, a documented account of contact with Negrito groups including Jarawa is available only after the British occupation of the Islands. The first occupation (First Penal Settlement) of the Islands by the British was short for from 1789 to 1796, and that time the Andaman Islands were inhabited by thirteen Negrito groups. Of them, ten belonged to Great Andamanese group, while other three groups were the Jarawa, Sentinelese and the Onges. Except the Sentinelese and the Onges who occupied North Sentinel and Little Andaman Islands respectively, the other eleven groups were living in different parts of South, Middle and North Andaman Islands. The Jarawa were in the Rutland Islands along with few other groups. All these groups had their well defined territories and inter-group war was prevalent among them. The British considered all of them to be the same. However, due to prevalence of tropical diseases, particularly malaria, the British vacated the islands.

Again in 1858, the Islands were occupied for the second time for the purpose of having penal settlement mainly for freedom fighters. As expected, skirmishes with different groups immediately started taking place immediately after the establishment of the Second Penal Settlement because the occupation of the territory and clearing of the forest and extraction of resources were treated as intrusion in the territory of the indigenous islanders. It may be noted that during the initial period of the Second Penal Settlement, these groups put-up the resistance. Despite the approved policy of the Court of Directors of protecting the aborigines, the cruel and vindictive policy of the British officials posted in the area generated among the aborigines a definite hostility against the British and a grim determination to drive them out from their habitat. It resulted in a series of attacks by them on the settlement of the British. The
most important and most organised of them was the attack of 17th May, 1859. Soon
the Great Andamanese were subdued as the bows and arrows were no answer to fire
arms. Like Great Andamanese, the Onges were also subdued by 1886 following the
policy of punitive action and gift giving. The Sentinelese were not disturbed as they
were away from main Andaman Islands inhabiting the North Sentinel Island.

The Jarawa were the second to display protest. The first recorded attack by the
Jarawa on the settlement of the British was in 1872. The situation took a turn for
worse in the following years and the hostility scaled-up. The reasons, which forced
the Jarawa to be hostile, were intrusion in their territory, punitive action against them
by the British and the employing of the Great Andamanese, which happened to be
their traditional enemy of the Jarawa, against them by the British. British followed
some reconciliatory approach toward the aborigines between 1880 and 1900 when the
Portman was the Officer-in-Charge of the relation with aborigine. However, after his
retirement, the reconciliatory approach toward the aborigines was abandoned and
more punitive expeditions were carried out against the Jarawa, which resulted in to
killing of many Jarawa.

The nature of contacts in post-Independence phase witnessed certain changes
and had impacts of some events, which followed the Independence. In the first major
change, the policy of sending punitive expedition was abandoned, and the habitat of
the Jarawa was declared as a restricted territory and named as ‘Jarawa Reserve’. But
other events that took place kept the Jarawa suspicious of the intentions of the Non-
Jarawa.
The second major event was the rehabilitation of the refugees from erstwhile East Bengal in different parts of the Andaman Islands. Of total refugee families, 2,328 families having a total population of 10,018 were rehabilitated in different parts of the South and Middle Andaman, which was a direct invasion in the Jarawa territory. Consequently, the Jarawa resorted to occasional raids on the villages of the settlers. The construction of Andaman Trunk Road (ATR) was third event (1970-1986) as it passed through the ‘Jarawa Reserve’. The Jarawa vehemently opposed it by attacking the workers’ temporary settlements and damaging the vehicles engaged in the construction. In those skirmishes, both Jarawa and Non-Jarawa were killed. The construction of roads facilitated forestry operation in the ‘Jarawa Reserves’, which was resented by the Jarawa.

During the end of the 1960s, the local Administration initiated the policy of befriending the Jarawa by organising intermittent gift giving operations to their habitat. The first success was witnessed in 1974 when a group of Jarawa came out without arms and showed friendly gesture. This success encouraged the Administration to follow the policy of ‘contact missions’ with renewed vigour. After a gap of almost two and a half decades, the friendly contact mission finally bore the fruits in October 1997, when the Jarawa came out in open without any weapon. It was the watershed event as thereafter the Jarawa became friendly with Non-Jarawa.

The impacts of the contacts on the Negrito groups during the colonial period were devastating. It led to the complete elimination of seven out ten groups of the Great Andamanese by 1947. Now only three groups are surviving viz., Aka-Chari, Aka-Jeu and Aka-Bea. Their populations declined from strong 3500 in 1858 to 23 in
1951, which further fell to 19 in 1961. Similarly, the Onges too suffered decline in number from 700 in 1858 to 150 in 1951 and 93 in 1983. The population of the Jarawa also declined by half from 600 in 1858 to approximately 300 in 1951. The war with British was the one of the major factors for decline of population of the Negrito groups followed by introduction of new diseases like measles, syphilis, influenza and small pox, which proved fatal for them. Traditional warfare among different Negrito groups was another cause, though not very significant. The Jarawa, unlike their counterparts, did not suffer from any diseases during colonial period because there was no prolonged contact between them and the British or other groups. In addition to decline of population of the Negrito groups, the contact led to redefining of territories of different groups and the Jarawa who once occupied a part of the Rutland Island finally moved upward and occupied the parts of the South, Middle and North Andaman Islands.

In the post-Independence period, the major impacts of the Non-Jarawa have been on the size of the territory, resources base and health of the Jarawa. The rehabilitation of the 2,328 refugees families from the erstwhile East Bengal in South, Middle and North Andaman Islands, and giving of 10 acres of land to each of these families resulted in the sizeable decrease in the functional resource area of the Jarawa if not the formal territory. The Gazette notification of 1979 curtailed the Jarawa territory as it excluded many areas from it.

The rehabilitation of the refugee population in the Islands led to the illegal extraction of resources from and encroachment in the Jarawa territory. The major resources mainly extracted were forest produce and timber, poaching of deer and wild
pig and fishing. However, extractions of these resources were under control due to the overt display of hostility by the Jarawa. In the post-hostility phase (after 1997), the absence of hostility has resulted in many fold increase in illegal extraction of resources by the Non-Jarawa. Those areas of the 'Jarawa Reserve', which are close to the villages of the settlers, have begun showing the sign of depletion of edible resources, though the resources health in interior areas is still satisfactory. This answers the research question number two related with impact of the increased taxation by the Non-Jarawa on the Jarawa and their habitat.

There have been many direct or indirect influence of the Andaman Trunk Road (ATR) on the Jarawa and their habitat. Firstly, it has effectively cut off their free access to eastern coast resulting in loss of resource base. Secondly, in order to repair the road, fuel wood is cut from the forests of the Jarawa territory. Thirdly, the Road had facilitated forestry operations in Reserve until 1996. Fourthly, in post-hostility phase the stretch of the ATR that passes through the 'Jarawa Reserve' has become the contact point of tourists and vehicle operators with the Jarawa, which has led to introduction of non-traditional foods and new kind of diseases among the Jarawa.

The post hostility phase has witnessed spread of certain diseases like measles, community acquired pneumonia, skin infection and upper respiratory tract infection among the Jarawa. The cause of the skin infection is largely attributed to the wearing of the used clothes given by the tourists and villagers. Besides, most of the Jarawa, particularly male Jarawa, have become addicted to chewing of tobacco and paan (betel leaves).
As a response to the changed situation, the Jarawa now locate their camps along the ATR also as it gives them access to non-traditional food items, clothes and tobacco, which they get from tourists and drivers. They also make use of the vehicles plying on ATR to travel long distances in search of food items. Similarly, while camping near the coast or creek, they avail of boats during shifting of camps or while going on foraging trips of more than a day. These are the survival strategies adopted by the Jarawa to adjust to changing environment due to the arrival of the Non-Jarawa on the scene; an answer to the research question number three.

Unlike earlier times when they had to roam along the coast or stealthy come to the settlements of the settlers during the night for getting metal implements, now the Jarawa demand the iron and the metal utensils from the staff of the AAJVS who are posted there. Further, the raw materials used in the making of some of the implements have changed. Earlier the Jarawa were using bark fibre only for making of fishing nets and basket. Now they are using nylon thread too.

The Jarawa have now accepted the medical intervention and have no hesitation in accepting any kind of medicines either orally or externally. It has helped in treating many of the newly introduced diseases. More importantly, they have allowed themselves to be medically tested or examined. It has led to the revelation of the fact that many of the Jarawa are healthy carrier of Hepatitis B, and in friendly contact situation, it may be lethal to the Non-Jarawa. In addition to Hepatitis B, the Jarawa were also found to be suffering from Hepato megaley and Spleeno Magaly.
6.2 MAJOR FINDINGS

Based on the present study, some findings have been derived. These are pertaining to the major theme of the Ph.D. research, i.e., adaptation of the Jarawa to the environment of the Andaman Island Ecosystem. The major findings have been mentioned below under certain relevant sub-headings for the sake of clarity.

6.2.1 Habitat and Resource Inventory

1. The Jarawa are one of the four Negrito human groups inhabiting the Andaman group of Island. The ecological niche of the Jarawa is called as ‘Jarawa Reserve’ or ‘Jarawa territory’ spread over nearly 765 sq km of area.

2. There are three territorial groups among the Jarawa, who inhabit the Boiab, Thidong and Tanmad territories of the Middle and South Andaman Islands. Each group has exclusive rights over its territory, and the other groups are forbidden to gather any resources from it. It means a strong sense of ownership and possession of resources exists at group level, which ensures sustainable subsistence and survival. The same is applicable to the Jarawa human group as a whole since they are traditionally used to defend their territory from being exploited by the Non-Jarawa. This, in fact, has governed their behaviour towards the outsiders, right through the known history.

3. As per the last count in 2002, the total population of the Jarawa is 265 persons, out of which 84 are in Boiab, 78 in Thidong and 103 in Tanmad territories.

4. The hunter-gatherer Jarawa eke out their livelihood through collection of roots, tubers and fruits, and hunting and fishing activities.

5. The Jarawa has a ‘broad resource base’, which is inclusive of both terrestrial and aquatic resources, ensures their subsistence in all seasons with adequate diet.
6. At cognitive level, the resource base is divided into five zones—pilleh (sea shore), tagidh (marshy area), chanhanap (plain land), tinon (thick forest area) and wa (fresh water bodies and streams), from which specific resources are gathered in different seasons of the year to maintain their survival.

7. Of the total resources used by the Jarawa, so far about 136 species of plants have been identified, of which 54 are edible and remaining non-edible. The major plant food includes tubers (*Diascorea sp.*), *Cycus rumphii*, jackfruits, and *Nipa fruticans*.

8. The pig, monitor lizard and turtle are game animals of the Jarawa.

9. They have a dietary preference for meat, fish and molluscs, but pig is the most preferred one. Honey is another important food item.

10. The ‘key stone resources’ are the molluscs, fish and tuber (*Diascorea sp.*).

11. In fact, the Jarawa rely upon a limited range of plants and animals to fulfil the bulk of their calorific requirements.

12. Hunting is an exclusively male activity while there is predominance of females in gathering activities. Interestingly, the Jarawa do not hunt the deer, as it is an exotic species.

13. Both males and females do fishing using different means but the success rate is directly related with the number of the person fishing in an area, size of the area and size and density of fish in that area.

14. The availability and collection of many of the edible resources are season specific. However, the seasonality is not applicable in case of pig though it is hunted most in rainy season when it has maximum fat due to availability of plenty of food.

15. There are three broad resource seasons: (i) Dry summer in which wild jackfruit collection is at peak along with honey; (ii) Rainy season in which thrust is on pig hunting and collection of the seeds of *Cycus rumphii* and *Nipa fruticans*; and (iii)
winter season which is meant for collection of honey and turtle eggs, followed by pig hunting.

16. The Jarawa get iron tools and metal utensils from the AAJVS and at times, they procure these items from settlements. However, in the past they used to collect iron from jetsam, i.e., broken ships washed ashore.

17. Sharing of flesh of the prey (game) animals at constituent families level and other foraged items at intra-family level is a strategy of better survival for all.

18. Though cultivation is the primary activity of the settlers, they do extract timber and minor forest produces, hunt wild pigs and deer, and catch crab, sea cucumber, lobster and prawn from the ‘Jarawa Reserve’, means sharing the resource base of the Jarawa.

6.2.2 Foraging Strategy

19. Selections of the site for location of the camps (chadda), the number of camps in an area and movement pattern of the Jarawa within their territory are part of the foraging strategy.

20. The permanent and semi-permanent camps are of large size and remain occupied for longer period than the temporary camps. Hence, the former two types of camps serve as ‘base camps’.

21. Location of the base camps of the Jarawa is governed by combination of factors - ecological edges, proximity to drinking water, easy availability of one of the edible resources and season.

22. Now the camps are also located along the ATR to avail various benefits.
23. Surprisingly, despite living in an island environment the Jarawa do not have well built canoes like that of the Sentinelese, Onge, and the Great Andamanese.

24. Seasons play a decisive role in the location of the camp along the coast and inside the forests. The underlying strategy is to exploit both the terrestrial and aquatic resources.

25. The Jarawa make two type of movement i.e., residential and logistical.

26. The foraging expeditions are never more than 15 days at a stretch.

27. There is division of labour to carry out different activities related with food gathering. Hunting is exclusively a male activity; about 29 per cent of the total adult male population are involved in it, which account for 30 percent of the total man-days of work, while most of the fishing is done by the females.

28. The input-output analysis shows that the average value of Index of Subsistence Effort for the Jarawa is 0.295. The average work input varies between 3.7 to 3.9 days a week. About 3.1 to 3.3 days in a week are left for leisure, socializing, and other activities.

29. Testing of the Jarawa hunting behaviour conforms to the hunting behaviour of a true hunter-gatherer forager as prey is encountered sequentially as a Poisson process. This answers the research question number one that how far the Jarawa are a true hunter-gatherer.

30. The net acquisition of resources in case of the Jarawa is satisfactory because on an average an adult Jarawa get approximately 2,500 KCal from the major resources alone. If the minor resources were also included then it would well be around 2,800 KCal.
6.2.3 Impact of Contacts

31. The later half of the year 1997 was the watershed in the Jarawa history as it marked the end of the hostility between the Jarawa and the Non-Jarawa.

32. In the post-hostility phase, the poaching by the Non-Jarawa people inside the Jarawa territory has increased. As a result, the Jarawa are competing with the poachers for those resources that are common to both.

33. Though the resource density in the interior of the forests is still adequate to support the foraging pursuit of the Jarawa, there is thinning and receding of the resources base in the area close to the settlements of the Non-Jarawa. It is more discernible in case of fish and pig density.

34. The Jarawa have fallen prey to some of the vices of the Non-Jarawa, e.g., addiction to paan and tobacco.

35. A barter trade is emerging between the Jarawa and the Non-Jarawa particularly tourists, where in the Jarawa exchange hunting implements, honey and resin for paan and tobacco. There is some sort of barter system existing between the Jarawa and the poachers also wherein the poachers offer paan, and tobacco and eatables to buy safe passage in the forest to exploit the resources of the Jarawa territory.

36. In recent times there have been out breaks of various communicable diseases like community-acquired pneumonia (1998) and measles (1999), which were absent before the friendly and free mixing of the Jarawa with the Non-Jarawa. Many cases of P. falciparum malaria (2000-2001) were also reported recently.

37. Skin diseases have spread after 1997, primarily due to wearing of used clothes given by the Non-Jarawa, and not washing of these clothes by the Jarawa.
38. Now the Jarawa make use of boat (motorized canoe operated by the Non-Jarawa) during the shifting of their huts along the coastal area and while camping at the roadside they make use of the vehicles plying on the road to cover longer distances in search of edible and no-edible resources.

39. Nowadays the Jarawa get a regular supply of iron from the AAJVS (Andaman Adim Janjati Vikas Samiti). The Jarawa can now be seen using hammer, chisel, sharpening file, and makeshift anvil for making hunting and fishing implements. In addition, they also get the cooking and storing utensils.

40. Now they use nylon threads along with traditional bark thread for making nets.

41. Though the Jarawa observe and gather information about some foraging techniques of the Non-Jarawa, like the use of snare to catch pig or use of line and hook for fishing, they are yet to adopt these methods.

42. Now the Jarawa have no hesitation in accepting any kind medicines either orally or externally (which have external application). There is a positive change in their hospital behaviour also as they are not wary of the other patients.

43. They have started eating non-traditional foods containing salts and spices, which have caused high blood pressure among few of them, particularly among those who frequently visit the hospital, jetty and the settlements.

44. Recently some of the Jarawas, particularly young boys, have picked-up Hindi. Even the broken knowledge of Hindi on the part of the Jarawa has proved very useful in case of medical treatment also as both the Jarawa and the medical attendant or Doctors are able to make each other understand.
6.3 CONCLUSIONS

The present study on ecology of the Jarawa has been able to reveal intricacies of the form and processes of their adaptation to environment of Island ecosystem of the Andaman. It has brought to light response of a hunter-gatherer human group to the wet tropical Island ecosystem that has its own potential and constraints on their survival. Based on the study following conclusions may be drawn.

- The Jarawa of Andaman Islands are one of the few remaining hunter-gatherers in the world whose subsistence economy is still in the elementary form, which approximates the economy of the classical hunter-gatherers, for it is based on extraction and the consumption of most of the immediate resources available in their habitat.

- The hunting, fishing and gathering activities are pursued with an in-depth indigenous knowledge of the ecosystem pertaining to edible and non-edible plant and animal species; different seasons and associated phenomena like rainfall, fruiting, flowering, regeneration of terrestrial and marine plants and animals, availability of resources; nature and characteristics of the coastal and shallow seas; and others.

- The subsistence activities are accomplished with intelligently designed strategy related to selection of sites for location of camps in different seasons and physiographic zones; timing, number and distance of foraging movements; selection of prey; image perception; division of labour; inter and intra-family sharing of gathered food items; and proper use of different tools and technology to ensure maximum returns from minimum efforts.

- The collection of food is subject to availability and density of food resources in particular zone and season and the distance from the camp.
• First of all, resources in the immediate vicinity of the camps are harvested then the distant ones, so that enough resources are available for longer time and regeneration of resources also go on in the already harvested area.

• They try to eat a balanced diet comprising of both plant and animal food items that provide them with sufficient carbohydrate, fat, glucose, nutrients, minerals etc. Though flesh of game animals is preferred, the key stone resources consist of plant food items and small animals which are perennially available.

• The Input-Output analysis reveals that there are still sufficient resources in the interior of the Jarawa habitat to support the hunting and gathering subsistence activities as exhibited by the less number of man-days in a week. It gives them sufficient time for leisure related activities which is one of the important preconditions for the happy survival of a foraging group.

• The hunting behaviour of the Jarawa conforms to the basic premise of the Optimal Foraging Theory by following a Poisson distribution curve. It shows that the Jarawa do not manipulate the frequency encounter of the game animal and thus, their hunting behaviour exhibits the hunting behaviour of a classical hunter-gatherer.

• In the post-hostility phase decline in the density of resources in the areas close to villages of the Non-Jarawa has been observed due to poaching and illegal extraction of resources. These are initial warning symptoms which need to be addressed immediately, because erosion of the resource base will force them to work for longer period per day/ week, which is undesired in any hunting-gathering society the world over.

• If the thinning and decline in resources base continues unabated, it would soon force them to be dependent on the dole given by the Government/Local
Administration as it happens in case of the Great Andamanese and the Onges-the Negrito neighbours of the Jarawa in the Andaman group of Islands.

- The friendly contacts after 1997 have some negative impacts on the Jarawa, e.g., spread of many communicable diseases like skin infection, measles and community acquired pneumonia. In addition, they have become addicted to paan and tobacco.

- The Jarawa are trying to adapt themselves to the changed situation as a part of their survival strategy like using the vehicles and boats plying on the roads and sea to reduce the distance, accepting the medical treatment and learning many of the material traits of the Non-Jarawa. But their failure to learn new techniques and use of new tools, which are used by the Non-Jarawa and which would make them survive in the situation when there is less density of resources in their habitat, is a matter of great concern.

- There are three major concerns which need immediate attention. These are related with the health problems, eroding resource base and lack of interest among the Jarawa youth in learning new techniques of hunting and gathering used by the Non-Jarawa; all having direct bearing on their survival as a pure hunter-gatherer group and the survival of the Jarawa as a human group adapted to typical island environment.
6.3.1 Limitation of Study

Any scientific research, however detailed it may be, can not cover all the aspects with the problem. In fact, it is only a link in the long chain of research to find the truth. The present Ph. D. research work has been completed in respect to fulfilling of all the objectives and answering the research questions. However, there are limitations in terms of the points that could not be covered in the present. In view of the investigator following are the limitations of the present work.

The island ecology, conflict and adaptation of the Jarawa, who inhabit the western parts of the South and Middle Andaman, have been probed into with the help of both primary and secondary data. The primary data have been collected through field work between 1998 and 2004. The study gives the first hand information about resource inventory of the edible and non-edible resources of the Jarawa, seasonality of resources, major food items of the Jarawa, their foraging behaviour and adaptation of the Jarawa to the changing situation. However, the resource inventory is far from complete as there are many minor resources used by the Jarawa but could not be observed. Movement pattern and foraging behaviour are largely based on the detailed study of only three months. In the absence of other detailed studies on the Jarawa it was difficult to correlate many of the observations and findings on these aspects. All the more, collection of information on the above stated aspects, in fact, requires a team work, because there is all possibility that alone one may not collect all the information about all three territorial groups of the Jarawa at a time. In order to know many aspects related with present topic a detailed field work spread over twelve months is required. Moreover, data have to be gathered about all three groups at a time in the same year.
The ignorance about the Jarawa language was one of the major handicaps of the investigator in the initial phase in collection of authentic data. In fact, there was no one who knew the Jarawa language to act as interpreter. Later with great effort a broken Jarawa language could be learnt. The dense tropical rain forest with thick undergrowth particularly of canes coupled with presence of leaches had made the field work hazardous and this may be considered limitation imposed by the environment. Besides, there is no logistic support available in the forests to stay for a long field work. Nevertheless, it was interesting to conduct the present research within these constraints. Main limitations of the present study are listed below.

1. The Jarawa use many terrestrial and aquatic resources, but only a limited number of the resources could be observed and only that have been discussed in the present study. The study lack sufficient data on edible marine resources and minor resources as well. Similarly, the seasonality of major edible plant resources has been discussed but there is lack of data on seasonality of minor edible plant products as well as marine animal resources.

2. Though the factors influencing location of the camps have been studied but the present study lack detailed information on the minimum distance between two camps and pattern of setting up of camps in a particular season. Reoccupation of the same camp is also related with regeneration capacity of the resources, but the present study lacks information on the renewable characteristics of the plant and animal resources.
3. The Input-Output analysis has helped find out work week of a Jarawa i.e., how many days in a week an economically active Jarawa works, but how many hours a day is spent towards foraging could not be calculated due to lack of sufficient data.

4. Perception plays an important role in the human adaptation to environment. Though the Jarawa’s perception of the four physiographic zones and its resources has been briefly discussed but a detailed information on the Jarawa perception of the environment related with potentiality and constraints on adaptation could not be gathered due many inevitable reasons.

5. Though sharing of food items has been discussed, the study lacks enough quantitative data on it, particularly sharing of flesh of game animal among constituent families of a band.

6.3.2 Scope for Further Research

The present investigation on the human ecology of the Jarawa is a maiden study as no prior study has been conducted on the Jarawa’s adaptation to the island environment, impact of contact and conflict and adaptation to the changing situation. Though the aim of the study was limited to prepare an inventory of resources as perceived by the Jara, analysis of Jarawa adaptation by finding out technology and strategy of resource utilisation, and to examine the impact of contact on the resource base and adaptation of the Jarawa, it has opened up several new vistas that require a detailed scientific investigation as listed below:
1. The entire resource potential of the Island ecosystem is yet to be identified and
documented. In addition, a complete inventory of the resources used by the Jarawa
is required to be prepared in order to find out the total resources available in
Island ecosystem and how many of these are used by the Jarawa.

2. At the same time, it is also necessary to find out environmental constraints (like
endemic diseases, natural hazards, wild life menace etc.) on the human adaptation,
and how many of these have been overcome by the Jarawa.

3. Regeneration rates of major and supplementary resources used by the Jarawa
required to be investigated and have to be correlated with movement pattern/cycle
of the Jarawa, i.e., after how many days they occupy the abandoned camps. It
would throw light on the fact that how far the Jarawa are an eco-friendly group,
have indigenous knowledge about the nuances of ecology and environment and
the degradation of the ecosystem.

4. Except a few, seasonality of all major and supplementary resources, particularly
of the marine life, is not fully known. Its investigation will definitely throw light
on aspects related with location of huts and movement pattern. Further, it would
give information on the nutritional aspect of the Jarawa and their calorie intake.

5. The net gathering rate of all the resources in terms of man-hour in a day needs to
be calculated. This will reveal that on an average how many hours a day an
economically active Jarawa works to eke out livelihood. It, in turn, would help
find out how close they are to the concept of ‘original affluent society’.

6. Sharing, particularly the flesh of the game animals like wild pig, monitor lizard
and turtle, is a part of the survival strategy of the Jarawa. The quantitative
information pertaining to inter-family distribution of meat is required to be
calculated.
7. There is a need to map the exact ecological niche of the Jarawa territory for it plays an important role in demarcation of territory, location of the huts, movement patterns, and density of different plant and animal resources.

8. In the hunting–gathering society, the man-nature-spirit relationship needs to be investigated. A holistic study on such relationship is necessary to find out the organic relationship among the three factors. There is very little information on the spiritual world of the Jarawa too, and that needs to be probed.

Undoubtedly, detailed investigation on these points will help in understanding the intricacies of human adaptation of the Jarawa to Island environment, but keeping the present restrictions on visits to the Jarawa territory in mind it appears to be a difficult task if not impossible. However, there remains curiosity to understand the hunter-gatherer response to island environment, and present work is a sincere effort in that direction. If, by chance, unfortunately the Jarawa also meet the fate like that their neighbours have met, then the present dissertation may probably become an authentic and only source of information on the Jarawa human group and their hunting-gathering way of life in an island ecosystem.