

CHAPTER-III

MATERIALS and METHODS

This chapter described about land and people, different materials and methods used for collecting the data and techniques adopted for analysing the data.

LAND

The state of Meghalaya (the Abode of Clouds) is geographically better known as the 'Meghalaya Plateau' or the 'Shillong Plateau' and its state capital is Shillong. It has a total geographical area of 22,489 Sq km and located between 25° 02' N to 26° 06' N latitude and 89° 48' E to 92° 50' E longitudes. At present it has got seven administrative districts, these are Jaintia Hills, Ri-Bhoi, East Khasi Hills, West Khasi Hills, East Garo Hills, West Garo Hills and South Garo Hills. This small state was carved out from Assam and made a full-fledged state on 21st January 1972 and is bounded by 423 kms border with Bangladesh on the south and southwest and the state of Assam on the north and east. Broadly Meghalaya can be divided into two zones, the western zone and the eastern zone.

The state of Meghalaya is directly influenced by the south-west monsoon and the north-east winter wind. During the months of March and April the atmosphere gradually warms up with the advent of spring. From the middle of April the temperature starts rising up to the maximum in June/July. The climate varies both latitudinally and longitudinally, but in general it is the physiography that exerts maximum influence. The western zone of the plateau with lower elevations experiences high temperatures for most part of the year and has a mean maximum of 32.4^oC, while a mean minimum of 12.2^oC. The average rainfall is about 3000mm and is concentrated mainly during the monsoon season. However, in the eastern zone of the plateau, a moderate climate prevails. In Shillong area the mean maximum temperature is about 28^oC, but in winter the mean minimum temperature often goes -3.5^oC. The average rainfall in this zone of the plateau is about 7500 mm and lies in the rain shadow area. While, Cherrapunji and Mawsynram lying about 55 km south of Shillong, receive an annual rainfall of about 14000mm which is the highest amount of rainfall in the world.

Geographical position of Meghalaya has favoured immigration and introduction of different plant species from the neighbouring states of the North Eastern India and also countries like China, Tibet and Burma. As per the State of Forest Report 2003, published by the Forest Survey of India, Meghalaya has a forest cover of 9,496 km², which is 42.34% of the total geographical area of the state. The Meghalayan subtropical forests have been considered among the richest botanical habitats of Asia. These forests received abundant rainfall and support a vast variety of floral and faunal biodiversity. A small portion of the forest area in Meghalaya is under what is known as “sacred groves”, these are small pockets of ancient forests that have been preserved by the communities for hundreds of years due to religious and cultural beliefs. These forests are reserved for religious rituals and generally remain protected from any exploitation. These sacred groves harbour many rare plants and animal species. The Nokrek biosphere reserve and the Balaphakram National Park, both in the West Garo Hills are considered to be the most biodiversity rich sites in Meghalaya. In addition, Meghalaya has three Wildlife Sanctuaries. These are the Nongkhyllem Wildlife Sanctuary, the Siju Sanctuary and the Bagmara Sanctuary, which is also the home of the insect eating pitcher plant *Nepenthes khasiana*. Due to the diverse climatic and topographic conditions, Meghalayan forests support a vast floral diversity, including a large variety of Parasites and Epiphytes, Succulent plants and Shrubs. Two of the most important tree varieties include: Shorea robusta or Sal and the Tectona grandis or teak. Meghalaya is also the home to a large variety of fruits, vegetables, spices and medicinal plants. Meghalayan is also famous for its large variety of orchids nearly 325 of them. Of these the largest variety is found in Mawsmal, Mawmluh and Sohra rim forests in the Khasi hills.

The region has variety of natural vegetation ranging from tropical mixed forests of the Garo hills to pure stands of pine forests in the higher elevation of the plateau. The region has been adversely affected by reckless cutting, grazing and jhum cultivation. In some areas these forests have been completely destroyed while others due to inaccessibility have retained their original character. These have become protected forests. Sal, pine, bamboo, etc., are important varieties of the flora in the plateau. In the western part of Meghalaya, the northern and southern foothills with warm and humid climate are characterised by dense tropical mixed forests with Sal (*Shorea robusta*) and

bamboo as main species of trees. The most important Bamboo species are Dalu and Muli. Other species that are found in the region are Gurga, Haldu, Canes, Agariu, etc. In the higher altitudes, in the Tura range, temperate forests are found with pines and firs as common features. Mixed tropical hardwood forests are found in northern and southern parts of the central upland. The main species are Sal, Nahar, Champa, Gomari etc. Bamboo thickets, Canes and wild bananas occur in many of the hill slopes in the region. Rolling grasslands are found in abundance in the elevation ranging from 900m-1350m above sea level. Pine forests are found above 1350m. Main species of pine are found mixed with willow, magnolia, oak, etc.

Meghalaya also has a large variety of mammals, birds, reptiles and insects. The important mammal species include elephants, bear, civets, mongooses, weasels, rodents, gaur, wild buffalo, deer, wild boar and a number of primates. Meghalaya also has a large variety of bats. The limestone caves in Meghalaya, such as the Siju cave are home to some of the rarest bat species. The prominent bird species in Meghalaya include the Magpie-Robin, the Red-vented Bulbul, the Hill Myna usually found in pairs or in flocks in the hill forests of Meghalaya, the Large Pied Hornbill and the Great Indian, which is the largest bird in Meghalaya. Other birds include the Peacock Pheasant, the Large Indian Parakeet, the Common Green Pigeon and the Blue Jay. Meghalaya is also home to over 250 species of butterflies, nearly a quarter of all the species found in India. The common reptile varieties in Meghalaya are lizards, crocodiles and tortoises. Meghalaya also has a number of snakes including the python, the Copperhead, the Green Tree Racer, the Indian Cobra the King Cobra, the Coral Snake and Vipers.

Basically Meghalaya is an agricultural state. Majority of the population of Meghalaya depend primarily on agriculture for their livelihood. The topography, physical features and land conditions as prevailing in the state provide extremely limited scope for extensive cultivation or to bring additional area under irrigated cultivation. Rice and maize are the major food crops. Wheat has been introduced a few years back and the result is quite encouraging. Potato, jute, mesta, cotton, mustard, arecanut, ginger, turmeric, betelvine, black pepper, tezpata, etc., are some of the cash crops. Orange, pineapple, banana, lemon, guava, litchi, jackfruit and temperate fruits such as plum, pear and peach are some of the important horticultural crops grown in Meghalaya. Apart

from the above crops, the State has achieved success in the cultivation of tea, mushroom and tomato. The State has considerable coal reserves, limestone and industrial clay and is said to possess rich deposits of uranium. It also has a vast untapped hydro-electric power potential. The State's economy is mainly agricultural and 66% of the work force is said to be engaged in this activity. In spite of the fact that the State is endowed with rich natural resources, it remained as a backward State. All efforts need to be made to tap its resources to ensure a sustainable economic development of the State. The State's climatic condition is conducive to the development of horticulture, fruits and vegetables. The industries identified as thrust areas are: Horticulture – Based Units, Biotechnology Based Units, Tissue Culture and Orchid Units, Spices Oleoresin and other Essential Oils Units, Medicinal Plants, Tea and Rubber, Animal Husbandry and Meat Processing Industries, Development of Mineral based Industries, Coal-Based Industries, Limestone Based Industries, Electronics and Information Technology.

THE JAINTIA HILLS DISTRICT

The Jaintia Hills District is a part of Meghalaya. It is situated between 25° 2'N to 25° 45'N latitudes and 92° 5'E to 92° 45'E longitudes. It is bounded on the north and east by the state of Assam, on the south by Bangladesh and on the west by Khasi Hills District. Jaintia Hills cover an area of 3819 sq km (Rural=3,811.20; Urban=7.80) and has a population of 299,108 persons (Rural=274,051; Urban=25,057 and Male=149,891; Female=149,217) (Census of India, 2001). It has got five community rural development blocks, the Laskein, Thadlaskein, Khliehriat, Amlarem and Saipung. Jaintia has got the literacy rate of 51.9% among the seven districts of Meghalaya.

Jaintia Hills District is the second largest district in terms of area and third in terms of population in the state. Jaintia Hills District ranks fifth in terms of urban population which is 8.4% of the district population, and it is one fifth of the state's population. In terms of population per sq.km, Jaintia Hills District also ranks fifth in the state. Jaintia Hills is having highest Sex Ratio (980) which is higher than the state Sex Ratio (972). Thadlaskein C D Block is having the highest population (1,04,620) while Amlarem C D Block is having the lowest population (35,970) in the district. In terms of area, Khliehriat C D block is the largest and Amlarem C D Block is the smallest in the

district. Khliehriat C D Block is having the highest number of villages while Amlarem C D Block has the lowest number of villages in the district. The economy of the district is mainly dependent on agriculture, with 75.73% of the total workers were in the agricultural sector. 33.8% of the total Households in the rural areas of the district availed electricity facility for lighting. Khliehriat C D Block is having the highest number of households while Laskein C D Block has the lowest number of household availing electricity for lighting in the rural area of the district. Nongbah village is the most populated (5,587) and Khyndawaso (2) and Wah Lyngdoh (2) are the least populated villages in the district. The condition of houses in the rural areas of the district is comparatively low, 40.78% of the total households live in good condition, 53.25% live in liveable condition and 5.97% live in dilapidated condition. Percentage of households by types of houses in the rural areas of the district are (i) Permanent 16.47% (ii) Semi Permanent 56.5% (iii) Temporary (Serviceable) 7.08% and (iv) Temporary (Non Serviceable) 19.85%. Percentage of households by type of latrine in the rural areas of the district are (i) Service Latrine 4.12% (ii) Pit Latrine 17.89% (iii) Water Closet 4.57% and (iv) No Latrine 73.42%. Percentage of households by type of fuel used for cooking in the rural areas of the district are (i) Firewood 92.28%, (ii) LPG 1.87% (iii) Kerosene 2.47%. Percentage of households by type of assets in the rural areas of the district are (i) Radio/Transistor 20.51%, (ii) Television 9.54%, (iii) Telephone 1.17% (iv) Bicycle 1.9%, (v) Scooter/Motor Cycle/Moped 0.69%, (vi) Car/Jeep/Van 2.38% (vii) None 74.34% (Census of India, 2001).

Jaintia Hills being a component of the Meghalaya Plateau has its physiographical features almost similar to that of Khasi Hills with a slight difference of a comparably more flat topography having a mild gradient. The hills gently slope toward Brahmaputra Valley of Assam in the North and overlook the gentle plains of Bangladesh in the south. The Marangkshih peak on the Eastern plateau of Jaintia Hills stands majestically at the elevation of 1631m from the mean sea level of Karachi and is the highest peak in the entire District. The general altitude of the District ranges between 1050m to 1350m. The District Headquarters is Jowai, which was established in the year 1972, and lies on the central plateau. Overall, the whole District is full of rugged and undulating terrains with the exception of deep gorges, steep precipices and narrow valleys carved out by the

rivers of Umngot, Myntdu, Lukha, Myntang and a good number of other small streams and rivulets. Jaintia Hills is richly endowed with natural resources, in the by gone days it has a rich collection of flora and fauna. Presently, the age old remarkable eco-system has been disturbed and degraded by various activities such as unscientific mining operations, deforestation, jhum cultivation, soil erosion, out dated agricultural practices, coupled with population pressure, However, with the ban on timber trade imposed by the Supreme Court of India, a little improvement and rejuvenation of barren land is taking place. Remedial measures to improve the looming ecological problem in the forms of extensive afforestation, effective soil conservation and water resources management programmes are being worked out by the concerned government agencies. In addition, wildlife protection, scientific methods for extraction of mineral resources and present-age technology-oriented Educational policy are other efficacious measures which should be urgently adopted.

The climate of Jaintia Hills is cool round the year. The temperature varies between 4.8°C and 31°C. The hottest is during the months of June and July while the coldest is during the month of December. The period of rainfall is during the months of June to September. In August 1998, the highest rainfall was recorded as 1536.2 mm. The lowest rainfall period was January, February and December. The lowest rainfall is recorded as Nil and 18.6 mm in the month of December and February 1998 respectively.

Jaintia Hills is rich in minerals. The occurrence of rich Coal and Limestone deposits is a great boon to those who wish to start any industrial venture based on these two minerals such as the manufacture of Portland cement. Besides coal and limestone deposits, deposits of other minerals like clay, shale, phosphate have also been detected in the District.

PEOPLE

The name “Jaintia” has been in use only when the area came under the British rule in 1835. The name was used to differentiate it from the plain areas of the old Jaintia Kingdom, the capital of which was Jaintiapur, the whole area is in Bangladesh now. The name Jaintia has been derived variously by different authorities. Late S.K. Chatterjee, the noted philologist, suggested that it could be an Aryanized form of the name

“Synteng” by which the people of the Jaintia Hills used to be called till recently. That name has been replaced by the term “Pnar” which the local people prefer. Another authority derived the name from the goddess Jayanti Devi, one of the deities worshipped by the Jaintia royal family when they were converted into Hinduism, probably in the 16th century after consolidating their way over the plain tracts in the south.

The present Jaintia Hills District constituted the nucleus from which the Jaintia Kingdom eventually developed. This kingdom began to play an increasingly important role in the history of the North-eastern region from the 17th century onward. The Jaintia Kings who belonged to the royal family of Sutnga at first ruled in the hills only but gradually extended their territory by military conquests achieved both in the areas to the north and the south, particularly towards the south. It was probably not long after they had transferred the capital from Nartiang in the hills to Jaintiapur in the plains of Sylhet that they became converted to Hinduism. However, they retained their cultural tradition like their kinsmen in the Khasi Hills. The kingdom had generally peaceful relationships with the neighbouring kingdoms of the Ahoms and the Cacharis. But occasionally these relations were marked by conflicts. The hill territory offered comparatively little in these conflicts and virtually remained intact till the very ends of the dynastic rule, that is, till the seizure of the kingdom by the British in 1835. At the height of its power, the Jaintia kingdom was the largest and most powerful of the kingdoms in the area that became known under the British rule as the Khasi and Jaintia Hills District.

The people residing in the central region of Jaintia Hills are called "Pnars" and those living in the southern and northern regions are called as “Wars” and “Bhois” respectively by the Pnar. All the three are collectively known by the generic name: “Jaintias” or “Synteng”, besides the main settlers, Baites also inhabited in the District (*Dey, 2002*). The people living in Jaintia Hills district of Meghalaya are ethno linguistic group of people and are believed to be of Indo-Mongoloid race although speaking a distinct Austric language belonging to the Mon-Khmer group. The main language widely used by the inhabitants of this district is the Pnar Language: which is different in every sense from the Khasi language of the East and West Khasi hills districts of this state of Meghalaya. As is known there is no written script for this language and Khasi language is used for educative purposes. English is the only medium of instruction used

in some schools. Other schools use the vernacular dialect in Roman letter (Khasi dialect Cherra) and English as the medium of instruction. However for high school section, English was adopted as the medium of instruction and Khasi dialect was studied as a vernacular subject. Besides English, Hindi, Nepali, Bengali, Assamese, are spoken by outsiders for communication. A lot of outsiders can speak the Local language pretty well, making work and communication easier.

In the Pnar society the family is the core of social organization. Though it is mother-centred, the authority of the house lies with the eldest maternal uncle; he is the head of the clan and represents the same in any village matters. But marital and other institutional affairs are based on the *matrilineal* system. Thus the system is called matriarchal only by courtesy. Nowadays there has been tremendous change in the way of life of the Jaintia people and it is not uncommon case for a man to live together with his wife and children in separate houses and the house is solely run by the father of the house and not by the uncles.

In Jaintia Hills traditionally, inheritance of real property passes from mother to the youngest daughter called as 'khadduh'. Other sisters also share the property but the youngest one shares more because of her responsibility to the family. The youngest daughter who inherits the property has the obligation, that she must look after the family idols and bear all its puja offerings out of her own pocket. If the youngest daughter changes her religion she loses her position in the family and is succeeded by her next youngest sister as in the case of death. Matrilineal in Jaintia Hills does not mean that the female are more supreme than the males but it is that tracing of descent is done through a female side. The father no doubt is the head and occupies an honoured position in a family. Women are entrusted to take care of property as the legal custodians, the family purse, and valuable, movable and immovable properties. The people are often described to be fond of amusements and happy-going. The cheerful disposition of the people is an attraction to strangers. In general, they are simple, open hearted, honest people with a very good sense of obligations and capable of sincere gratitude. The bond of blood relationship is very strong among them.

The Pnar or the Jaintia people maintained their unique culture and religion called *Niamtre*. The British paramount during the seventeenth century brought about the winds

of change in many aspects of the Jaintia society, a good percentage of the people are embracing Christianity as their religion. Apart from Christians, there are other religions too, like the Unitarians, the Muslims etc. The coming of the Welsh Missionaries brought about significant changes in their value system, beliefs, speech, etiquettes, food habits, life styles and most importantly in the fields of health, education and economic condition. The Economic changes among the Jaintia people have certain affects in the religious and traditional life of the people. Traditionally, if anyone died in the village, the whole village would stop their work and gather at the deceased person's house. People still follow the custom inspite of the hectic schedule of everyday modern life.

Marriage among the Jaintia is an elaborate one though many changes are noticeable due to factors like Christianity, education and exposure to the outside world. Marriage is an important social institution of the Pnars and can be understood both from the social and religious angle. As a social institution, marriage is regarded as a civil contract between the husband and the wife and is strictly exogamous i.e., outside the clans. Further more, the traditional law prohibits not only a marriage within the clan but also a marriage with the paternal uncle or aunt. The Jaintias are also known to practice cross cousin marriage, but it has been considered that it is not advisable for the person to marry his maternal uncle's daughter as long as the uncle is alive. The customary law of marriage prohibits a brother and sister's marriage or within the clan. From the religious point of view, marriage is performed after certain rituals have been observed. Even though the boy and the girl have known each other and consented between themselves to get married, yet their marriage would have to be arranged by their respective clans. Generally, when the boy has reached a marriageable age either his parents or his uncles would make efforts to find a suitable girl for him through friends and relatives or a go-between. When ever the formal meeting of the marriage is to be, the maternal uncle is the one to perform the exchange words then last the religious groups.

The Jaintias are known to have woven their own clothes and the most popular are the *Khyrwang* and the *thoh saru*. The *Khyrwang* is a cloth stripped with white and mauve and is being worn during formal occasions. The *thoh saru* on the other hand is a cloth woven in black, but on a white background, in a check pattern. It is being worn like a sarong and is being used by the people every day. During their everyday work, the

Pnar female wears a wrapper around the head and shoulder, followed by petticoat, where the *yusem* or a kind of a sarong is worn around the body and fastened at the waist. Over this they would wear a *kyrchah* or a piece of cloth, which would be draped below the right hand and then fastened on the left shoulder with a knot. In the case of the men folk, a waist griddle of cotton was worn beneath, where the same is being replaced by the dhoti when their contacts with the people of the plains started. A sleeveless coat was worn and over it a wrapper was suspended. A triangular cap called ka *tupri pynyien* was worn. Ordinarily men wore cotton clothes while the king and other dignitaries would prefer silk. The dhoti has become a part of the tradition of the people. A *muga* shawl and a turban would complete the dress of the men folk. For the coat, waistcoat and the cap, dark materials are usually preferred. Earrings are worn by both men and women and the people were known to have made use of gold and silver. They have used them as rings, earrings, bracelets and bangles (Lamare, 2005).

People of Jaintia hills undertake various occupations nowadays. Some are working as civil servants, engineers, doctors, labourers, cultivators, traders, potters, basketry, business, etc. Originally the main occupation of the Jaintia people is agricultural work and it is being practiced in most villages until now. The Jaintias have a more advanced method of cultivation than many other hill peoples in the north-eastern region of India. The process of converting highland into paddy fields was ever increasing with the demand of the people. Irrigation was known as resorted to whatever sources of water could be turned to use. Their keen interest was in rearing the important livestock for use and profit such as cattle, poultry and pigs. The Jaintia people are industrious and enterprising.

The staple food of the Jaintia people is rice and curry. They consume good quantity of fish, both fresh and dry, and are very fond of most kinds of meat specially pork, beef and venison. Tadpoles, baby hornets and wasps and silkworms are most sought after foods. Earlier people in the rural areas did not like milk, but nowadays milk is being extensively consumed by them because they have realized the food value of milk. They also eat various types of vegetables including the wild varieties, bamboo-shoots and different kinds of edible mushrooms growing in the wild. They are also very

fond of betel-nuts and pan-leaves. They eat many types of fruits such as orange, guavas, mangoes, bananas, litchi, peach, pears, plums, apples, grapes, etc., (DIPR ,2005).

‘Beh-dien-khlam’ is a major festival celebrated in Jaintia Hills by the Pnar during rainy season normally in July or August every year. The festival through its ritual drives away the devil which causes destruction to crops, properties or miseries of people. The three days festival begins with sacrifices to ‘U Mukhal’, food offerings to departed souls of ancestors, chasing away the evils and dancing performance of the young and the old. On the last day in the morning the religious priest called Daloi accompanied by town folk move from house to house beating the roof with sticks to drive away the plague. Later in the afternoon, well decorated rots one each from the different localities brought out to the bank of the pool. Freshly cut poles of great length from the forest are held across the stream. People jump on the poles and break them while dancing in the muddy water of the pool. Later a large pole is placed across the streams and the people dividing them into two parted contenders for the possession of this pole in good humour. The concluding part of the festival is ‘Datlawalor’ much like a game of football which is played between two parties, one representing the upper valley and the other the lower valley of the Myntdu river, with a wooden ball. The party which wins, believes would have better harvest than the other (Dey, 2002). ‘Beh-dien-khlam’ is celebrated only by the niamtre and for the Christian, Christmas is the biggest festival for them.

The Pnars are short in height and males are extremely muscular. The trunk is long in proportion to the rest of the body, and broad at the waist; calves are very highly developed. They are of light brownish complexion. The hazel eyes are not uncommon, especially amongst females. Eyelids are somewhat obliquely set, but not so acutely as among the Chinese and some other Mongols; jaws frequently are prognathous; mouth large, with sometimes rather thick lips; hair black; straight, and worn long, the hair of the people who adopt the old style being caught up in a knot at the back. Some males cut the hair short with the exception of a single knot at the back, which is called *u niuhtrong* or *u niuh’iawbei* (i.e., the grandmother lock). The forepart of the head is often shaven. It is quite an exception to see a beard, although the moustache is not infrequently worn.

This tribal community is of a cheerful nature, peace-loving, hospitable, humorous and sociable (Dkhar, 1996).

The present study is to conduct and collect the sample from the Laskein community block. Laskein community block has an area of about 53.3sq km with a population of 65,726 persons (Male=32,886, Female=32,840). The total households are 10,560 and the villages are 88 in number out of which 77 are the inhabited villages. The sex ratio is 999 and the population density is 119 per sq km. The proportion of scheduled tribe is 97.8% and scheduled caste is 0.1% and the proportion of literates is 41.9% which is found to be the lowest in all the community blocks in the district and it also has the lowest number of household availing electricity for lighting in the rural area of the district. The people inhabited in this area are the Pnars and they speak the dialect of the pnar/synteng of Jaintia Hills only. It is noticed that the highest proportion who retained pnar/synteng as their mother tongue is in Laskein community block and the area has got not more than three villages rich in mineral resources (Census of India, 2001).

DATA COLLECTION

The present data was collected from the Pnar community in the three villages of Jaintia Hills district, the Shangpung, Mookaiaw and Mootyrchiah which are of demographic homogeneity i.e., the villages are exclusively the areas depending on agricultural products as their main source of livelihood though the people are there who engage in other jobs. The field work was carried out during the period of June, 2006 till January, 2007. No statistical sampling technique was applied for the selection of villages or individuals. However an attempt was made to include all the possible houses of the subjects which are in the age group of 8 to 18 years both boys and girls willing to cooperate in the measurements to cover the minimum sample size of 30 in each age groups of different sexes. The total number of subjects is 923 out of which 417 are boys and 506 are girls.

Age (Years)	Boys	Girls	Total
8	32	41	73
9	39	45	84
10	34	48	82
11	39	64	103
12	41	42	83
13	42	52	94
14	41	47	88
15	34	41	75
16	46	42	88
17	31	40	71
18	38	44	82
TOTAL	417	506	923

Table 1: Sample Numbers of Boys and Girls in Age Group wise

Sex	Age	Service	Business	Daily Wage	Dependent	Agriculture	Total
Boys	8	8	1	12	11	0	32
	9	16	4	9	6	4	39
	10	9	1	7	12	5	34
	11	11	2	12	12	2	39
	12	11	4	9	12	5	41
	13	7	3	13	14	5	42
	14	13	1	13	11	3	41
	15	12	1	9	5	7	34
	16	10	4	13	13	6	46
	17	6	3	14	6	2	31
	18	10	3	12	7	6	38
Total	113	27	123	109	45	417	
Girls	8	8	2	15	15	1	41
	9	17	2	11	13	2	45
	10	12	2	18	14	2	48
	11	18	4	17	19	6	64
	12	10	3	10	16	3	42
	13	13	1	23	10	5	52
	14	17	3	12	11	4	47
	15	8	5	13	9	6	41
	16	10	4	16	9	3	42
	17	7	2	12	12	7	40
	18	8	2	16	9	9	44
Total	128	30	163	137	48	506	

Table 1.1: Sample Numbers of Boys and Girls in Age Group wise of Mother's Occupation

Sex	Age (Years)	Illiterate	Primary	Secondary	Tertiary	Total
Boys	8	10	5	12	5	32
	9	13	5	15	6	39
	10	8	9	15	2	34
	11	11	3	16	9	39
	12	13	9	16	3	41
	13	16	5	17	4	42
	14	14	8	14	5	41
	15	13	4	10	7	34
	16	21	5	16	4	46
	17	11	5	13	2	31
18	11	10	14	3	38	
	Total	141	68	158	50	417
Girls	8	15	3	21	2	41
	9	9	6	21	9	45
	10	16	5	24	3	48
	11	22	9	23	10	64
	12	17	5	17	3	42
	13	24	9	14	5	52
	14	16	7	19	5	47
	15	14	4	19	4	41
	16	14	4	19	5	42
	17	17	7	11	5	40
18	14	12	17	1	44	
	Total	178	71	205	52	506

Table 1.2: Sample Numbers of Boys and Girls in Age Group wise of Mother's Education

Sex	Age (Years)	High	Low	Middle	Total
Boys	8	9	13	10	32
	9	11	18	10	39
	10	5	18	11	34
	11	10	20	9	39
	12	8	15	18	41
	13	8	25	9	42
	14	12	19	10	41
	15	9	19	6	34
	16	10	27	9	46
	17	8	14	9	31
18	9	20	9	38	
	Total	99	208	110	417
Girls	8	5	21	15	41
	9	21	16	8	45
	10	10	20	18	48
	11	18	29	17	64
	12	12	16	14	42
	13	8	29	15	52
	14	8	22	17	47
	15	13	17	11	41
	16	12	22	8	42
	17	2	25	13	40
18	8	25	11	44	
	Total	117	242	147	506

Table 1.3: Sample Numbers of Boys and Girls in Age Group wise of Household Income

Sex	Age (Years)	Smallest	Small	Average	Large	Largest	Total
Boys	8	1	9	17	4	1	32
	9	3	15	15	6	0	39
	10	1	9	22	2	0	34
	11	1	10	23	4	1	39
	12	1	11	24	4	1	41
	13	1	11	20	10	0	42
	14	1	10	22	8	0	41
	15	1	6	21	6	0	34
	16	1	15	21	9	0	46
	17	1	14	12	4	0	31
	18	4	9	20	3	2	38
	Total	16	119	217	60	5	417
Girls	8	2	11	25	3	0	41
	9	3	12	27	3	0	45
	10	2	13	24	8	1	48
	11	0	23	32	9	0	64
	12	0	11	26	5	0	42
	13	6	12	22	12	0	52
	14	2	15	22	7	1	47
	15	1	11	22	7	0	41
	16	4	10	19	8	1	42
	17	1	11	20	8	0	40
	18	1	13	21	9	0	44
	Total	22	142	260	79	3	506

Table 1.4: Sample Numbers of Boys and Girls in Age Group wise of Family Size

MEASUREMENTS

In the present study, a cross-sectional method was used in measuring the subjects. The following parameters were taken on each and every subject:

- 1) Weight (kg)
- 2) Height Vertex (cm)
- 3) Sitting Height Vertex (cm)
- 4) Biacromial Diameter (cm)
- 5) Chest Circumference (cm)
- 6) Waist Circumference (cm)
- 7) Hip Circumference (cm)
- 8) Mid Upper-Arm Circumference (cm)
- 9) Calf Circumference (cm)
- 10) Biceps Skinfold (mm)
- 11) Triceps Skinfold (mm)
- 12) Subscapular Skinfold (mm)

- 13) Suprailiac Skinfold (mm) and
- 14) Calf Skinfold (mm)

The above parameters were taken for assessing the growth and nutritional status of the subjects. The age of the children was based on the birth certificates and the birth recorded register from the midwife of the different villages. The date of birth of every subject was converted into the decimal age following the method of decimal age calendar given by Tanner (c.f. Weiner and Lourie, 1981), for example the age group of 8 years included all those subjects whose decimal age falls between 7.500 to 8.499 years.

A total of 14 anthropometric measurements were measured in a total of 923 subjects. Before taking measurements some necessary information had been taken like socio-economic status of the family, food habits, observable clinical deficiencies and the general information on the subjects. All the subjects taken were physically and mentally healthy. Subjects having defects of any abnormal endocrine dysfunction were excluded from the study, such as a case may affect the growth pattern of the subjects. Standard techniques of measurements described by Weiner and Lourie (1981), Sen (1994) and Singh and Bhasin (2006) were followed for taking the anthropometric measurements of the subjects. The techniques may be briefly described as follow:

Weight: The body weight was taken with a standard weighing machine, the subjects were asked to stand on it with an erect posture and light apparel. The weighing machine was checked from time to time with a known standard weight. No deduction was made for the weight of light apparel while taking the final record.

Height Vertex or Stature: It measured the vertical distance between the vertex and the floor. The subject was made to stand erect with the feet running parallel to one another, the heels touching one another, the hands hanging maximum on the sides, the palms touching the thighs and the head oriented on the Frankfurt-horizontal plane (eye-ear plane). Using the anthropometer, the distance between the standing surface and the highest point on the head (vertex) in the mid-sagittal plane was recorded by moving the movable cross-piece.

Sitting Height Vertex: It measured the vertical distance between vertex and plane where subject was sitting. The subject was made to sit erect in a standard sitting position. His/her head was oriented in the Frankfurt-horizontal plane. Using

anthropometer, the distance between the sitting surface and highest point on the head (vertex) in the mid-sagittal plane was recorded by moving the movable cross-piece.

Biacromial Diameter: It measured the straight distance between the two acromion points. The subject was made to stand erect with his heels together and the two acromion points were located from behind the subject with the help of first finger. Using rod compass the horizontal distance between the two acromion points was recorded.

Chest Circumference: It measured the circumference of the chest when the subject was breathing normally. The tape should be held horizontally at the level of nipples passing over the lower scapular angle. The arms of the subject rose before placing the tape round the chest and allowed to remain horizontally. The arms rest normally while taking the recorded measurement.

Waist Circumference: It measured the smallest horizontal circumference in the area between the ribs and iliac crest by moving the tape up and down. The subject was made to stand erect with the abdomen relaxed, the arms at the sides and feet together. The measurement was recorded at extremely thin clothing and at the end of a normal expiration and also without the tape compressing the skin.

Hip Circumference: It measured the widest portion of the hip. The subject was made to stand erect with his arms at sides and feet together. The measurement was recorded from the left side of the subject to get the clear vision of the maximum extension of the buttocks posterior, the tape was placed gently not to have compression on the skin.

Mid-Upper Arm Circumference: It measured the mid-upper arm circumference. The subject was made to stand erect with the hands hanging freely at the sides of the palms facing the thighs. The mid-point was located on the left hand between the acromion point and the lateral point of the epicondyle of the humerus. The measurement was recorded by placing the tape on this mid-point.

Calf Circumference: It measured the maximum calf circumference. The subject was made to sit and the left leg was positioned perpendicularly. The measurement was recorded from the lateral side of the leg where the tape was placing up and down without compression on the skin to get the maximum record.

Biceps Skinfold: It was recorded medially at the mid-point of the upper arm by placing the skinfold caliper jaws at the pinched fold. The subject was on the position of standing comfortably with the upper extremities relaxed at the sides of the body.

Triceps Skinfold: It was recorded laterally at the mid-point of the upper-arm by placing the skinfold caliper jaws at the pinched fold. The subject was on the position of standing comfortably with the upper extremities relaxed at the sides of the body.

Subscapular Skinfold: It was recorded at the side of inferior angle at the left scapula by placing the skinfold caliper jaws on the pinched fold which was taken approximately at 45 degrees to the horizontal plane in the natural cleavage lines of the skin. The subject was standing comfortably erect, with the upper extremities relaxed at the sides of the body.

Suprailiac Skinfold: It was recorded at the pinched fold which picked up approximately one to two centimeters above the medially left anterior superior iliac spine by placing the skinfold caliper jaws. The subject was standing comfortably with the upper extremities relaxed at the sides of the body.

Calf Skinfold: It was recorded medially at the point of maximum circumference of the left calf by placing the skinfold caliper jaws at the pinched fold. The subject was sitting and positioned the leg perpendicularly on the floor.

NUTRITIONAL DEFICIENCIES

Data on some important nutritional deficiencies like oedema, keratomalacia, bitot's spot, pale conjunctiva, epiphyseal enlargement, rickets, ichthyosis, etc. were collected on the basis of those clinical signs described in Jelliffe (1966). The brief definitions of them are as follow:

Oedema: This is the cardinal sign of kwashiorkor, which can be detected by production of a pit, by applying moderate pressure for about three seconds over the lower end of tibia. Oedema can also occur in individuals with severe anemia, nephrotic syndrome and beri beri and should be differentiated.

Keratomelacia: This is a condition of rapid necrosis and liquefaction of full thickness of cornea, leading to prolapsed of iris, resulting in permanent blindness. Vitamin A related corneal involvement (ulcer/keratomelacia) can be differentiated from

other infective conditions of the eye, by the fact that it is painless and the conjunctiva will be muddy white in Vitamin A deficiency. In infective conditions, the eye will be red and swollen.

Bitot's Spot: These are dirty white, foamy and raised spots on the surface of the conjunctiva, generally seen on the outer side of the cornea. They are formed due to accumulation of denuded conjunctival epithelial cells. It may appear as a single spot or as several small spots, which may later unite to form a large triangle patch with base towards cornea. Bitot's spots may be stained black when the children use Kajal. The Bitot's spot may appear in only one eye or both the eyes.

Pale Conjunctiva: This sign is positive if there is pallor of the conjunctival and buccal mucosae. It is principally a clinical reflection of severe anemia.

Epiphysial Enlargement: The expanded articular end of a long bone, developed from a secondary ossification centre, which during the period of growth is either entirely cartilaginous or is separate from the shaft by a cartilaginous disk.

Rickets: It is characterised by the softening of bones in children potentially leading to fractures and deformity. Rickets is among the most frequent childhood diseases in many developing countries. The predominant cause is a vitamin D deficiency, but lack of adequate calcium in the diet may also lead to rickets (cases of severe diarrhea and vomiting may be the cause of the deficiency).

Ichthyosis (Fishskin Disease, Xeroderma): It is characterised by dryness, roughness and thick adherent scalliness of the skin. The outer layer or epidermis of the skin is thick and many show numerous shallow cracks, the surface tending to peel in rather large scales. In mild cases there is merely a persistence of dryness and roughness of the skin surface. This condition appears early in life, and seems to run in families.

INDICES FOR NUTRITIONAL STATUS

1. **BODY MASS INDEX (BMI) FOR AGE:** This index is also known as Quetelet's Index. It is widely used as a measure of fatness, or the nutritional status of populations in both developed and developing countries. It is obtained by dividing the weight in kilograms (kg) by the square of height in meters (m). It can be expressed as: $BMI = \text{Weight (kg)} / [\text{Height (m)}]^2$. The BMI for age is calculated using the Z-Score.

2. **HEIGHT FOR AGE:** Height for age is generally used as an indicator of stunting (shortness), which is, height deficit for a given age in comparison with the standard or reference population. It is calculated by using Z-Score.

3. **WEIGHT FOR AGE:** This anthropometric index indicates generally the weight deficits at a given age in comparison with the reference population. It is calculated by using Z-Score.

Z - SCORE:

The Z-Scores of BMI, height and weight for age was computed, following the LMS method as per the revised international growth references given by the US National Center for Health Statistics (Kuczmarski, et. al., 2000). The mentioned three indices i.e., BMI for age, height for age and weight for age are expressed as a standard deviation or z-score of adolescent's measurement to the median reference population. The LMS parameters are the median (M), the generalized coefficient of variation (S), and the power in the Box-Cox transformation (L), it is computed as follow:

$$Z = \{(X/M) **L\}^{-1/L}S,$$

Where, X is the physical measurement (e.g. weight, length, head circumference, stature or calculated BMI value) and L, M, and S are the reference values, corresponding to a given age in months. (X/M)**L means raising the quantity (X/M) to the Lth power.

The classification for the Z-Scores had been followed as per given by WHO/NCHS. For normal nutrition = >-2, moderate malnutrition = <-2 to -3, severe malnutrition = <-3, the malnutrition of moderate and severe are taken as conditions of wasting (BMI for age), stunting (height for age) and underweight (weight for age).

SOCIO-ECONOMIC AND DEMOGRAPHIC DATA

Data on socio-economic and demographic parameters such as age, family size, birth order, household income and expenditure, occupation of parents, education of parents, religion, ownership of land and other property, types and hours spent for physical activities, including TV viewing, household works, water fetching, load carrying, exercise, food habits, etc has been collected directly from each subject covered under

study. Data in income was cross-checked taking into consideration some aspects of socio-economic conditions like housing condition, types of occupation and monthly expenditure, land owned, type of cooking fuel used, etc.

The main socio-economic variables taken as the factors for the effect of growth and nutrition were the income, education of the mother, occupation of the mother and the family size. The material incomes have been changed into the cash as per the given rate. The income has been calculated into monthly per capita taken in percentile as <50th percentiles the low income group (LIG, < Rs. 1000), 50th-75th percentiles the middle income group (MIG, Rs. 1000 to 1400) and > 75th percentiles the high income groups (HIG, > Rs. 1400). The education of the mother was classified as illiterate (to those who cannot read and write), primary (nursery to class V), secondary (class VI to class X) and tertiary (class X above). The occupation of the mother has been classified under service, business, agriculture, daily wage and dependent, and for the family size has also been classified as smallest (1 to 3 members), small (4 to 6 members), average (7 to 9 members), large (10 to 12 members) and largest (13 to 15 members).

STATISTICAL ANALYSIS

All the data were managed and analysed using SPSS/PC software and GraphPad Prism. An analysis was carried out to present the descriptive statistic on all the anthropometric variables in relation to age groups and sex of the samples. T-test was used to find out the difference between the two means of the age groups and sexes and the chi-square was also used in the categorical values and proportion where ever present. Charts were presented to the different age groups of boys and girls and the model of Preece and Baines (1978) was used for the linear measurement and a fourth degree polynomials and its first derivatives were used for the ponderal measurement. Univariate analysis of variance was used in finding out the significance effect of nutritional factors on the anthropometric variables and 'compare main effects' was used with no adjustment whenever the F-values showed the significances. A binary logistic regression was used in order to find out the effect of nutritional factors on undernutrition. All the analyses were analysed on age groups wise and sexes separately.

The mathematical model proposed by Preece and Baines (1978) is expressed as follows.

$$Y = h_1 - [2(h_1 - h_0)] / [\exp \{s_0(t-\theta)\} + \exp \{s_1(t-\theta)\}]$$

Where Y = anthropometric measurement, t = age (years), s_1 and s_0 = rate constants, θ = time constant, h_1 = final size of a measurement, h_0 = is a measurement at $t = 0$.