

REVIEW OF LITERATURE

The review of literature for the present study “**Effect of Interventions on Vitamin A and Iron Nutritional Status among Primitive Tribal Children in Nilgiris District**” undertaken is presented under the following headings:

- A. Tribals in India and the Nilgiris**
- B. Health and Nutritional Status of Tribals**
- C. Vitamin A and Iron Nutritional Status of PTG Children**
- D. Methods of Assessing Nutritional Status among Tribal Children**
- E. Strategies to Combat Malnutrition among PTG Children**

A. Tribals in India and The Nilgiris

Over 84 million people belonging to 533 communities are identified as members of Scheduled tribes (India Ministry of Tribal Affairs, 2004), constituting 8.6 per cent of the total Indian population (Census, 2011) (Figure 1). Through a constitutional mandate formulated in 1950, Scheduled Tribes have been formally recognized as a distinct community in India (Ministry of Tribal Affairs, 2004).

There are about 635 tribal groups and subgroups distributed in different pockets including 75 primitive communities throughout the country, who have been designated as ‘primitive’ based on pre-agricultural level of technology, low level of literacy, stagnant or diminishing population size, relative seclusion (isolation) from the mainstream of population, economical and educational backwardness, extreme poverty, dwelling in remote inaccessible hilly terrains, maintenance of constant touch with the natural environment unaffected by the ongoing developmental processes in India. There is a consensus that these scheduled tribes are the descendants of aboriginal population in India (Bhasin and Walter, 2001).

India, as a whole, has long been characterized with considerable heterogeneity in terms of religion, territory, language, and caste. During the colonial period, the British enumerated and classified India’s population into groups and categories, one of which was the category of the tribal or adivasi (indigenous people). Prior to outside intervention, many tribal populations had self - regulating economic and political systems.

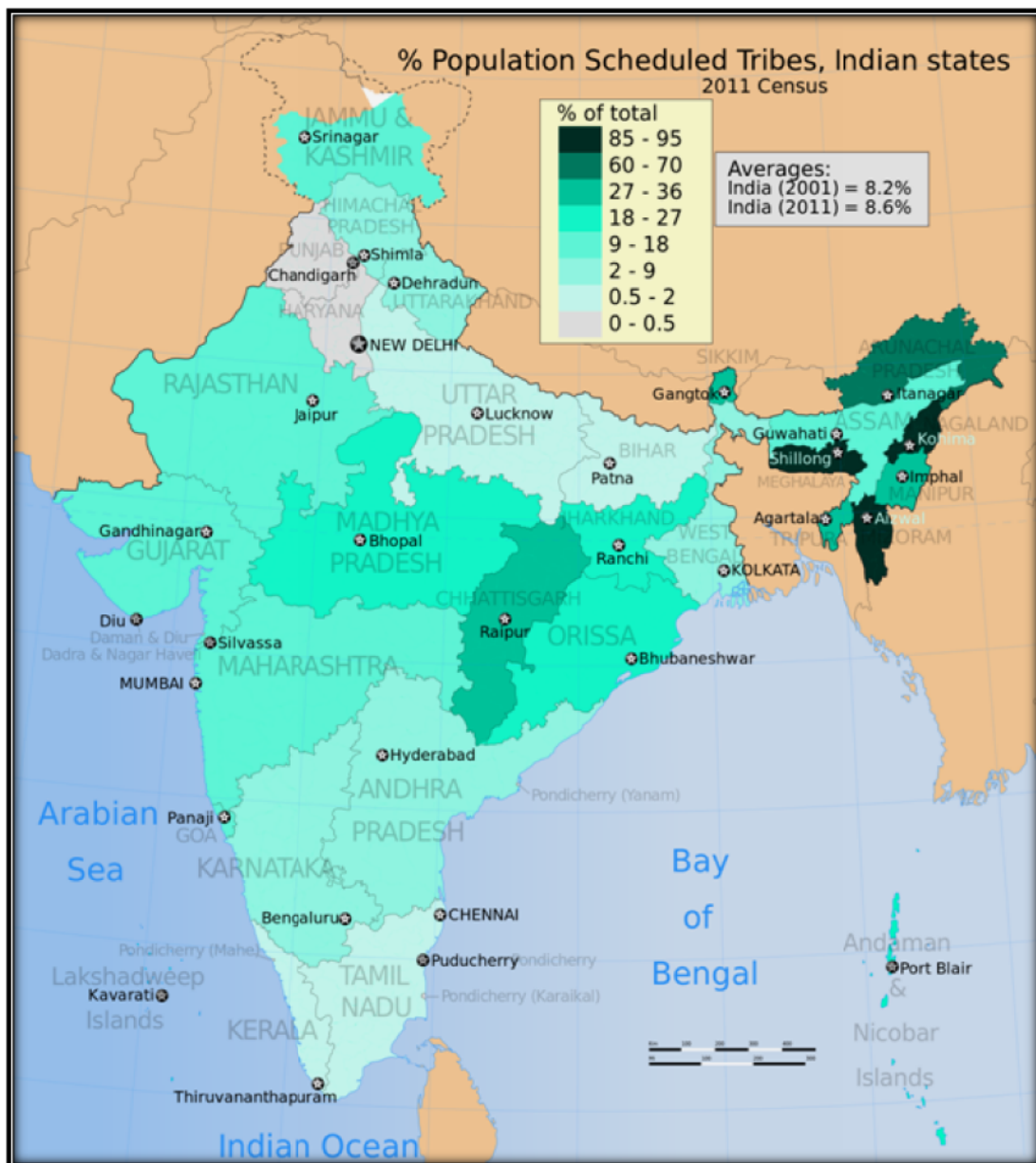


Figure 1
Tribal population in the country

The tribes are greatly dependent on the forest for their daily needs, including food, shelter, instruments, medicine, and even clothing. With the policy of national development, however, the exploitation of minerals and forest altered the relationship between the tribes with the natural environment. As a result, tribal populations were forced into relinquishing those resources that had been the foundations of their existence, and what followed was the gradual governmental and societal castigation of tribal as a whole. Nowadays, the word “tribal” often brings to mind images of half - naked men and women, arrows and spears in their hands, combined with myths of savagery

and cannibalism. Thus, a limited knowledge of tribals in India has translated into a widespread propagation of false information and stigmatization of the approximately 100 million persons enumerated as members of Scheduled Tribes, comprising of about 10 to 15 per cent of India's population.

The Indian government identifies communities as Scheduled Tribes based on a community's "primitive traits, distinctive culture, shyness with the public at large, geographical isolation and social and economic backwardness" (India Ministry of Tribal Affairs, 2004), with substantial variations in each of these dimensions with respect to different Scheduled tribe communities (Basu, 2000). While "Scheduled Tribes" is an administrative term adopted by the Government of India, the term "Adivasis" (meaning "original inhabitants" in Sanskrit) is often used to describe the different communities that belong to Scheduled Tribes. The Adivasis are thought to be the earliest settlers in, and the original inhabitants of, the Indian peninsula, with their presence dating back to before the Aryan colonization (Thapar, 1990). The distinct identity of Adivasis has many aspects: language, religion, a profound bond linking the individual to the community and to nature, minimal dependence on money and markets, a tradition of community-level self-government, and an egalitarian culture that rejects the rigid social hierarchy of the Hindu caste system (Minority Rights Group, 1999), all of which closely approximate the indigenous definition articulated at the international level (Stephens *et al.*, 2006). Since the formal recognition of Scheduled Tribes in 1950, the proportion of individuals of Scheduled Tribes in the total Indian population has increased from 5.3 per cent (1951) to 8.2 per cent (2001) (India Ministry of Tribal Affairs, 2004).

Barring the states of Haryana, Punjab, Delhi and UT of Chandigarh, all other states have tribal population. Majority population in some states in the North-East viz. Arunachal Pradesh, Mizoram, Meghalaya, Nagaland and UTs of Dadra and Nagar Haveli and Lakshdweep are tribals. In the States of Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa, Rajasthan, Jharkhand and Gujarat, though the tribals do not constitute the majority, yet their population is substantial. In fact, about three-fourth of the India's Scheduled Tribe population is concentrated in these States. Even in these states/UTs, in pockets, which have been declared as Scheduled Area or MADA area (cluster of more than 10,000 tribal population with tribal being majority of the population) or clusters (similar to MADA but tribal population being more than 5000), the tribal population constitutes a majority.

The distribution of the tribal population in different States/ UTs of India is shown below:-

State	% Scheduled Tribes to Country Population
Madhya Pradesh	14.51
Maharashtra	10.17
Orissa	9.66
Gujarat	8.87
Rajasthan	8.42
Jharkhand	8.40
Chhattisgarh	7.85
Andhra Pradesh	5.96
West Bengal	5.23
Karnataka	4.11
Assam	3.92
Meghalaya	2.36
Nagaland	2.10
Jammu and Kashmir	1.31
Tripura	1.18
Mizoram	1.00
Bihar	0.90
Manipur	0.88
Arunachal Pradesh	0.84
Tamil Nadu	0.77
Kerala	0.43
Uttarakhand	0.30
Himachal Pradesh	0.29
Dadra & Nagar Haveli	0.16
Sikkim	0.13
Uttar Pradesh	0.13

While the tribal population in some states is low when calculated as the percentage of the total tribal population of India, in the state or UT itself, within the state, the tribal population constitutes the majority (e.g. in Lakshadweep, Mizoram, Nagaland,

Meghalaya, Arunachal Pradesh and Dadra and Nagar Haveli) or a very sizeable segment (Chhattisgarh, Tripura, Jharkhand, Orissa, Sikkim, Madhya Pradesh).

The main concentration of tribal people, however, is in the central tribal belt in the middle part of the India and in the north-eastern states. These correspond to underdeveloped areas. There are over 700 such tribal groups. Tribal groups are at different stages of social, economic and educational development. Some tribal communities have adopted a main stream way of life. At the other end of the spectrum, there are certain scheduled tribes (75 in number) known as Primitive Tribal Groups (PTGs), characterized by very low literacy, subsistence economy and pre-agriculture level of technology. The diversity in ethno-lingual make-up, faith, culture, customs, socio-economic, cultural, educational levels etc. is both enormous and outstanding. Over the years, displacement and rapid acculturation of this population has led to changes in their socio-cultural and value systems. Moreover, Primitive Tribal Groups (75 in numbers), are characterized by a low rate of population growth, a pre-agricultural level of technology and extremely low levels of literacy. Special programs for their initiation to settled life, agriculture besides education, health and awareness building are arranged mainly through the district level offices and in some cases through agency or projects.

While describing "The Nilgiris as a Region", Mandelbaum (1989) has aptly pointed out, "The people and the terrain of the Nilgiri plateau are interested in their region because of their unusual characteristics. Throughout three principle periods, aboriginal, colonial and National Independence, the Nilgiri region has constituted a singular and singularly instructive enclave, a distinctive locale as perceived by observers as well as by its inhabitants". Hockings (1989) adds that 'In broad ecological terms, the Nilgiri region has undergone a drastic and quite irreversible transformation since the advent of the British more than a century a half ago".

There are six tribal communities in the Nilgiris and the spatial distribution of all the six tribal communities (Plate 1) in Nilgiri District is uneven. At the higher altitudes of the Nilgiri hills are the Thodas and Kotas, in the middle range of the hills, Kurumbas and Irulas, whereas Paniyas and Kattunayakans are to be found at foothills of the Nilgiri hills. The spatial distribution reveals the fact that ethnically Thodas and Kotas do not have any contact with Paniyas and Kattunayakans because of the distance between their settlements. Thodas are found to be at higher altitudes, chiefly in and around



Thoda Family



A Kota woman potter



Irulas



Kurumbas



Kattu Naickar Family



Paniya Couple

Plate 1. Primitive Tribal Groups in Nilgiris District

Udhagamandalam and Kotagiri. Kotas are also found to be at a higher altitude around Udhagamandalam, Kundah, Coonor and Kotagiri Taluks. Kota settlements are mostly away from Thoda settlements. Kurumbas are divided on the basis of occupation and residence into five groups; Aalu or Paalu Kurumbas live in Coonor and Kotagiri Taluks; Betta Kurumbas and Jenu Kurumbas live inside or near Mudumalai Wild Life Sanctuary in Gudalur Taluk; Mullu Kurumbas live in Pandalur Taluks; Urali Kurumbas live in Gudalur and Pandalur Taluks.

Thodas are a purely pastoral people, who live on the produce of their herds of huge buffaloes and gifts of grain from the other tribes; they claim to be the original inhabitants of the hills and lords of the soil. They are much taller and fairer than the general run of the inhabitants of South India, in dress, appearance and language they differ widely from their neighbors, have attractively dignified and fearless manners when conversing with Europeans; and practice and unusual customs, such as polyandry, infanticide and buffalo sacrifice at their funerals” (Francis,1908).

According to a Kota legend, the Kota, the Thoda and the Kurumba were real brothers and they were the earliest inhabitants of the Nilgiri hills. These three, as the legend goes, were created from three drops of the God's (Kambatrayan) perspiration. Their separation took place when the God once asked them what they wanted; one of them said , 'Give me talents of art and he became a Kota, who later proved to be an able blacksmith, musician, hunter, potter and rope and umbrella maker; another said, Give me buffaloes who can be my friend, relative and savior' and he became a Toda dairy- man; 'Give me the power to destroy those whom I do not like' said the third brother who became a Kurumba, possessing powers of sorcery and black magic which the other two dreaded. According to a belief of the Kota, some centuries ago when the Badaga were taking refuge in the Nilgiri hills from the oppressions of Tipu Sultan in Mysore, the Kota, in order to protect them, got themselves distributed in different geographic regions of the Nilgiris, and subsequently smaller units in each region merged together and thus the seven present villages were established” (Verghese, 1969).

According to Luiz (1962) Irulas, their name is reported to have originated from their own description of their colour as Irula (dark). They are of medium height, long armed and have curly hair, prominent cheek bones and narrow noses. In early years they avoided cropping the hair and using anything made of leather. Even now they refrain and object to visitors using anything made of leather within their huts. The Irula tribes of

Tamilnadu occupy the lower slopes and forests at the base of the Nilgiri hills. The Irula is a South Dravidian primitive aboriginal tribal community, spread over the three southern states of Tamilnadu, Kerala and Karnataka and is divided into several endogamous subgroups mainly based on their linguistic variations (Lakshminarayana, 2006). Irulas are one of the poorest tribal communities with a population of 2.1 lakhs concentrated mainly in North Eastern Tamilnadu. They are similar to the Kurumbas in many ways. They produce honey, fruits, herbs, roots, gum, dyes and trade them with the people in the plains. In the recent times the Irulas help in catching snakes and collect the snake venom (www.indianetzone.com).

The Kurumba people are dark skinned, well built and of moderate height. They were hunters traditionally, shifting cultivators, effective sorcerers but now they have accepted a variety of income generative economic activities (Kapp, 1985). Nair (1911) distinguishes between Jain Kurumbas and Kattunayakans: however he states that they are identical except for that the latter eat monkey's flesh, do not collect honey and take food at the farmer's house, whereas the former differ in these particulars. Ayyappan (1948) also holds almost the same view. As per 2001 census, the total population of the Kurumbas is 5498 (2707 males and 2791 females) and their literacy rate is 49.03 per cent. Luiz (1962) stated that, "it is possible that their name originated from the Tamil word, "Kurumbu" (mischief) because in their savage state they were very arrogant and mischievous". This statement is not accepted by the youth of the Kurumbas. In his study, Parthasarathy (2003) identified five distinctive Kurumbas in the Nilgiri district on the basis of region of residence, language spoken and variety of cultural traits. These groups are named as Alu or palu Kurumbas, Betta Kurumbas, Jenu or Teen Kurumbas and Urali Kurumbas. Alu Kurumbas are found in the taluks of Coonoor and Kotagiri, Betta Kurumbas and Jenu Kurumbas inhabit in Mudumalai sanctuary, Mullu Kurumbas are found in Pandalur taluk whereas Urali Kurumbas are distributed in the taluks of Gudalur and Pandalur. The Kurumbas settlement is called as mottam represents cluster of many huts inside the forest. They are non-vegetarians. The Kurumbas are divided into two endogenous divisions, which are further divided into many clans. They practice cross cousin marriage. Their life cycle rituals are simple and they follow rigid pollution. They follow the custom of burial with elaborate funeral rites which differ according to sex, age and rank. They follow the patrilineal rule of succession. The Kurumbas are hunters, forest food gatherers, shifting cultivators, effective sorcerers by which they heal the diseases. Now the Kurumbas have adapted to labour work on the forms of coffee, tea and

vegetable. A few Kurumbas also become experts in basket weaving. They recognize a community headman called "maniyagara" who presides the Kurumba tribal council. The Kurumbas were animists and totemists, now believe Hindu religion and worship local deities, "Kumba devaru" and "Karupade thayi". Kurumbas have oral tradition that flows through songs, tales and rhymes. Their dances are two types; gantes attam and yenna attam and their musical instruments are referred by them as Kolu, tambate, arae, bugiru etc.

Paniyas are traditionally hunter-gatherers, by way of their complete dependence on the forest, as provider of their dwellings, and almost all their material (and probably cultural and spiritual) needs. Paniyas (which literally means workers in local usage) are found in Gudalur taluk and many more in Kerala. The Paniyas emerge from under a subtle form of bonded labour in the past decades and are slowly rehabilitated through various government schemes. They are scattered throughout Gudalur taluk and are one of the most backward tribal community. Under an age-old system, most of the Paniyas were working under local landowners for low wages with little or no liberty to work for others for competitive wages. After independence, however, the majority of the Paniyas broke away from their masters and started working as casual agricultural labourers, bamboo cutters and estate labourers. The Paniyas, by and large, live in poverty irrespective of whether they are bonded or not. The usage of tobacco among the Paniya tribes is high, compared with the other tribes in the Nilgiri Hills. Francis (1908) in his "The Nilgiris: Madras district Gazetteers remarks that, "The Paniyan are a short, dark-skinned Tribe with broad nosed and such curly hair that they are popularly (but erroneously) supposed to be of African descent". Census of India (1891) reported that. "The Paniyas are said to have features of the African type, but there does not appear to be any other evidence in favour of their African descent". Luiz (1962) opines that, "the Paniyas are an African Tribe that came into India after a shipwreck on the West Coast. Their cephalic and nasal indices indicate a resemblance to the long- armed African Negroes and Kapires.

The Kattunayakans are a very vile and backward, Kanarese speaking tribe, similar in customs and manners to the Jenu Kurumbas. They are usually employed as labourers by the immigrant castes such as the Gounders and Nayars in Wyanad. Each group has got a 'hettan' (grand father) as its leader. The name of the chief god is 'Masti'. Even grown up individuals among them do not know the four cardinal points or age to count beyond twenty. They shift their residence and own no land (Aiyappan, 1948).

B. Health and Nutritional Status of Tribals

Tribal communities, in general, and the primitive tribal groups in particular are highly disease prone, and do not have required access to basic health facilities. They are mostly exploited, neglected, and vulnerable to various diseases with high degree of malnutrition, morbidity and mortality (Balgir, 2000). Their misery is compounded by poverty, illiteracy, ignorance of the causes of diseases, hostile environment, poor sanitation, lack of safe drinking water and blind beliefs (Balgir, 2007). Tribal population is particularly vulnerable to under nutrition, because of their geographical isolation, socio-economic disadvantage and inadequate health facilities (Helegson, 2006). As a result of geographical and social barriers, relatively few primary and specialty care health facilities exist in tribal areas, and gaping disparities in health status of tribals, as compared to those in metropolitan areas, are evident. Along with a plethora of infectious diseases including malaria, tuberculosis, polio, and cholera, malnutrition and gastrointestinal disorders are pervasive among tribal populations, and stark deficiencies have been detected in gross amounts of calcium, iron, vitamin A, vitamin C, and animal protein. Certain tribal groups such as the Onges, Jarawas, and Shompens of the Andaman and Nicobar Islands are facing extinction due to endemic diseases, venereal diseases, and an unusually low sex ratio. Indigenous people (tribals) are amongst the poorest and most marginalized population groups experiencing extreme levels of health deprivation (Willis *et al.*, 2004). The suboptimal health status of indigenous peoples and the health inequalities between indigenous and non-indigenous populations reflect a fundamental failure to ensure the freedom of indigenous peoples to fully realize their human, socio-economic, and political capabilities (Sen, 1999).

Importantly, the health and wealth disparities between indigenous and non indigenous populations are universal (Stephens *et al.*, 2005; Bristow, 2003). However, research on, indigenous health remains inadequate (Stephens *et al.*, 2005), even though this gap is beginning to be bridged in developed countries (Hetzl, 2001; Brannley *et al.*, 2005; Wilson *et al.*, 2002). While the unfavorable health status of indigenous peoples in developed countries has been shown across a range of outcomes, including mortality (Brannley *et al.*, 2004), disease (Hand *et al.*, 2001), health behaviors (Frank *et al.*, 2000; Gaiser, 1984), and health care (Finger, 2003; Johnston and Coory, 2005), there are few systematic accounts of the health of indigenous people in developing countries (Seale *et al.*, 2002; Escobar *et al.*, 2001).

Existing research on indigenous health in India, as in many developing countries (Abu *et al.*, 2004; Granich *et al.*, 1999; Hsu, 1990), is restricted to specific indigenous groups (Kate, 2001; Friedman and Somani, 2002). The ability to meaningfully generalize the extent and nature of indigenous health patterns in India, consequently, remains limited. Using a nationally representative sample, we investigate the extent to which the indigenous/non-indigenous health divide is a reflection of the differences in socioeconomic well-being between indigenous and non-indigenous groups. If differential distribution of socioeconomic resources accounts for indigenous/non-indigenous health inequalities, this would emphasize the need to redress the pervasive and chronic socioeconomic inequalities between the indigenous and non-indigenous groups. Furthermore, the extent to which socioeconomic well-being predicts health outcomes within indigenous populations are to be considered. If health inequalities are fundamentally social in nature (Berkman and Kawachi, 2000; Wilkinson, 1999), and have less to do with being indigenous, we should expect a socioeconomic gradient in health even within this marginalized population. The patterns of indigenous health deprivation and heterogeneity are investigated for mortality and tobacco and alcohol consumption. The public health relevance of tobacco and alcohol use in India has been well documented (Shimkhada and Peabody, 2003; WHO Tobacco or Health Programme, 1997; WHO, 2002; Rahman, 2002; Rodgers *et al.*, 2004; Subramanian *et al.*, 2004; 2005; John, 2005; Neufeld *et al.*, 2005).

Health care facilities though scarce and remote in tribal areas are important for their wellbeing. The primary health care infrastructure provides the first level of contact between the population and health care providers and forms the common pathway for implementation of all the health and family welfare programs. It provides integrated, promotive, preventive, curative and rehabilitative services to the population close to their hearth and home. A majority of the health care needs of the tribal population are taken care of either by the trained health personnel at the primary health care level or by their own traditional indigenous health practitioners at village level. Those requiring specialized care are referred to secondary and tertiary sector. The tribal population is not a homogenous one. There are wide variations with regard to education and health status, access and utilization of health services among the tribal populations (Balgir, 2000).

Keeping in view that most of the tribal habitation is concentrated in far flung areas, forestland, hills and remote villages, and in order to remove the imbalances and provide better health care and family welfare services to scheduled tribes, the population

coverage norms of establishment of rural infrastructure have been relaxed. The primitive tribes in India have distinct health problems, mainly governed by multidimensional factors such as habitat, difficult terrains, varied ecological niches, illiteracy, poverty, isolation, superstitions and deforestation. The tribal people in India have their own life styles, food habits, beliefs, traditions and socio-cultural activities. The health and nutritional problems of the vast tribal populations are varied because of bewildering diversity in their socio-economic, cultural and ecological settings (Balgir, 2000). However, data analysis in view of their ecological, ethnological, cultural and biological diversity is lacking in India.

Education, especially the female education, is generally considered a key factor to development. Female education is believed to have a great influence on the maternal and child health as it enhances the knowledge and skills of the mother concerning age at marriage, contraception, nutrition, prevention and treatment of diseases. This also means that the higher infant and child mortality rates among the poorly educated mothers are due to their poor hygienic practices. Moreover, maternal education is related to child health because it reduces the cost of public health related to information on health technology. It is expected that the increase in literacy rate of a community would reduce the fertility, morbidity and child mortality or in other words, improve the health status of the community as a whole. Mortality decline can be achieved by widely distributed public health services such as information technology, immunization, sanitation, nutrition, adding preventive and curative services to improve the maternal and child health. Lack of proper health education, poverty, faulty feeding habits and irrational beliefs aggravate the health and nutritional status of these underprivileged people in India (Balgir, 2000).

According to NNMB report (2000-01), the state of Orissa occupies a unique position in the tribal map of India having 62 scheduled tribes including 13 primitive tribes continues to have the second highest position for under nutrition among the ten states of India. While comparing the aggregate figures for CED, i.e. BMI less than 18.5 in adult men and women in ten states, the level of CED was higher in Orissa. The prevalence of CED in adult men in the state was 38.6 per cent as compared to aggregate of 37.4 per cent, whereas, the CED for adult women was 46 per cent against 39.3 per cent of aggregate. As malnutrition is known to lead susceptibility to infectious diseases to death, the mortality rate in primitive tribes may be attributed to malnutrition. Four primitive tribes, namely, Bondo (16%), Didayi (19%), Juang (25.1%) and Kutia Kondh (26.6%) showed severe malnutrition (based on Gomez classification) as mentioned above, respectively in

Malkangiri (Bondo and Didayi), Keonjhar (Juang) and Kandhamal (Kutia Kondh) districts of Orissa.

According to Rao *et al.*, (2002), the most common Vitamin A nutritional deficiency signs observed among three tribes of Andaman and Nicobar islands were conjunctival xerosis and Bitots's spots. RMRC (2003-2004) reports that Vitamin A Deficiency in the form of Bitot's spot, conjunctival xerosis and night blindness was observed in 8.9, 25.9 and 11.4 per cent Bondo; 13.7, 24.2 and 27.6 per cent Didayi; 14.9, 17.9 and 7.4 per cent Juanga; and 3.4, 12.6 and 6.9 per cent Kondha tribes, respectively. However, other micronutrient deficiencies like iodine deficiency (goiter), vitamin B complex deficiency (in the form of angular stomatitis) were not encountered. Similarly a high percentage of Vitamin A Deficiency was observed in 24.4 per cent of Birhor tribes and 53.3 per cent of Sahariya tribes of Madhya Pradesh. Goitre was also observed in 3.4 per cent of these tribes. Severe anemia (Hb < 7 g/dl) ranged from 0.6 to 2.3 per cent, moderate (Hb 7-9 g/dl) from 7.4 to 13.6 per cent and mild (Hb 9-11 g/dl) 30.7 to 48.2 per cent in the above primitive tribes. Anemia was more common among females than males. The majority (51.2%) of these tribals showed microcytic and hypochromic blood picture suggestive of Iron Deficiency Anemia. There was a positive correlation between hookworm infestation and anemia due to indiscriminate defecation, bare foot and lack of health awareness. Drug administration intervention revealed reduction in worm infestation (51.2%) and improvement of anemia (34.8%) in individuals belonging to above tribes. The CED was also found very high in Lanjia Saura (89.4%) and Kutia Kondh (88.9%) of Rayagada district of Orissa.

C. Vitamin A and Iron Nutritional Status of PTG Children

Prevalence of clinical form of Vitamin A Deficiency is seen in countries like India, Iraq, Yemen and some parts of Africa. Severe subclinical form of Vitamin A Deficiency is observed in Pakistan, Afganistan, Myanmar, Brazil, Peru, Colombia, Mexico, Moderate form of Vitamin A Deficiency is reported in China, Bolivia, Egypt and mild subclinical form of Vitamin A Deficiency is encountered in Saudi Arabia, Libia and Turkey. Vitamin A Deficiency is under control in Australia, Russia, United States of America, Canada, Alaska, Greenland.

The prevalence of VAD among preschool (0- 5 years) and school going children (6 -14years) was studied by examining the clinical signs / symptoms of VAD such as night blindness, Bitot's Spot and conjunctival xerosis.

The Global level prevalence of Vitamin A Deficiency among children is given in Figure 2.

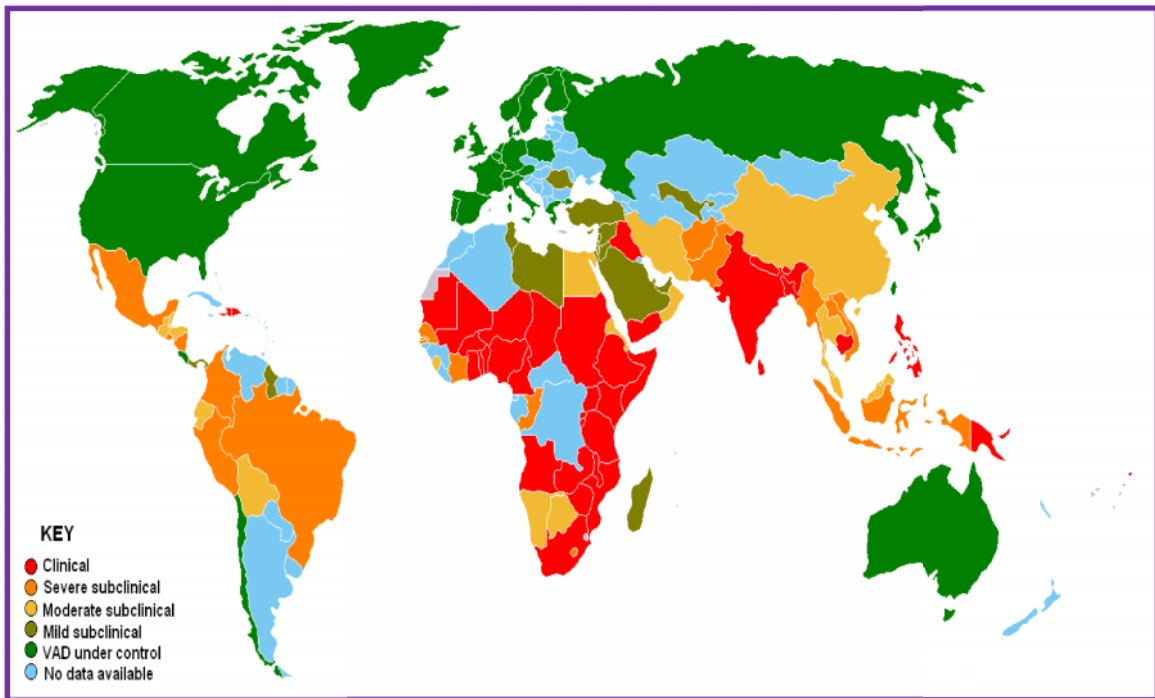


Figure 2
Global Prevalence of Vitamin A Deficiency

NNMB (2003) reports on the prevalence of malnutrition among the general population revealed that the overall prevalence of Bitot's spots was 0.8 per cent among 1-5 year children. VAD is the problem of public health significance, in all the states except Kerala and Orissa. The prevalence of Bitot's spots was comparable to that observed in the earlier NNMB survey (2002) (0.8per cent) and the district micronutrient survey of ICMR (0.7per cent). The overall prevalence of night blindness was about 0.3per cent and that of conjunctival xerosis was about 1.8 per cent.

When reassessed among the preschool children, the prevalence of night blindness decreased from 11.2 to 7.4 per cent in Bondo, 2.6 to 2.3 per cent in Didayi, 7.8 to 5.7 per cent in Juanga and 7.6 to 5.2 per cent in Kandha; conjunctival xerosis was reduced from 24.8 to 17.2 per cent in Bondo, 24.1 to 18.3 per cent in Didayi, 18.4 to 13.2 per cent in Juanga and 14.6 to 9.8 per cent in Kandha and Bitot's spot was reduced from 9.2 to 6.4 per cent in Bondo, 13.8 to 9.2 per cent in Didayi, 13.9 to 9.4 per cent per cent in Juanga and 4.8 to 2.9 per cent in Kandha; while amongst the school going children the night blindness was reduced from 7.6 to 5.4 per cent in Bondo, 2.7 to

2.1 per cent in Didayi, 3.6 to 2.1 per cent in Juanga and 4.2 to 2.6 per cent in Kandha, conjunctival xerosis was reduced from 21.6 to 15.2 per cent in Bondo, 19.3 to 13.8 per cent in Didayi, 12.3 to 8.8 per cent in Juanga and 16.8 to 11.4 per cent in Kandha and Bitot's spot reduced from 7.1 to 4.3 per cent in Bondo, 9.8 to 5.2 per cent in Didayi, 7.8 to 5.1 per cent in Juanga and 5.9 to 3.8 per cent in Kandha studied tribes. Arlappa *et al.*, (2011) found that the prevalence of Bitot's spots, an objective sign of clinical VAD, was 0.6 per cent and was significantly ($p < 0.01$) higher among 3-5 year old rural children of West Bengal. A study in Ashram school Gond children of Kalahandi district showed visible conjunctival pallor of 34.3 per cent, vitamin A deficiency 15.2 per cent, Vitamin B deficiency of 15.6 per cent, iodine deficiency of 17.4 per cent, scabies 27.2 per cent and dental caries of 20 per cent (Balgir *et al.*, 2002).

Global level prevalence of IDA among children is given in Figure 3

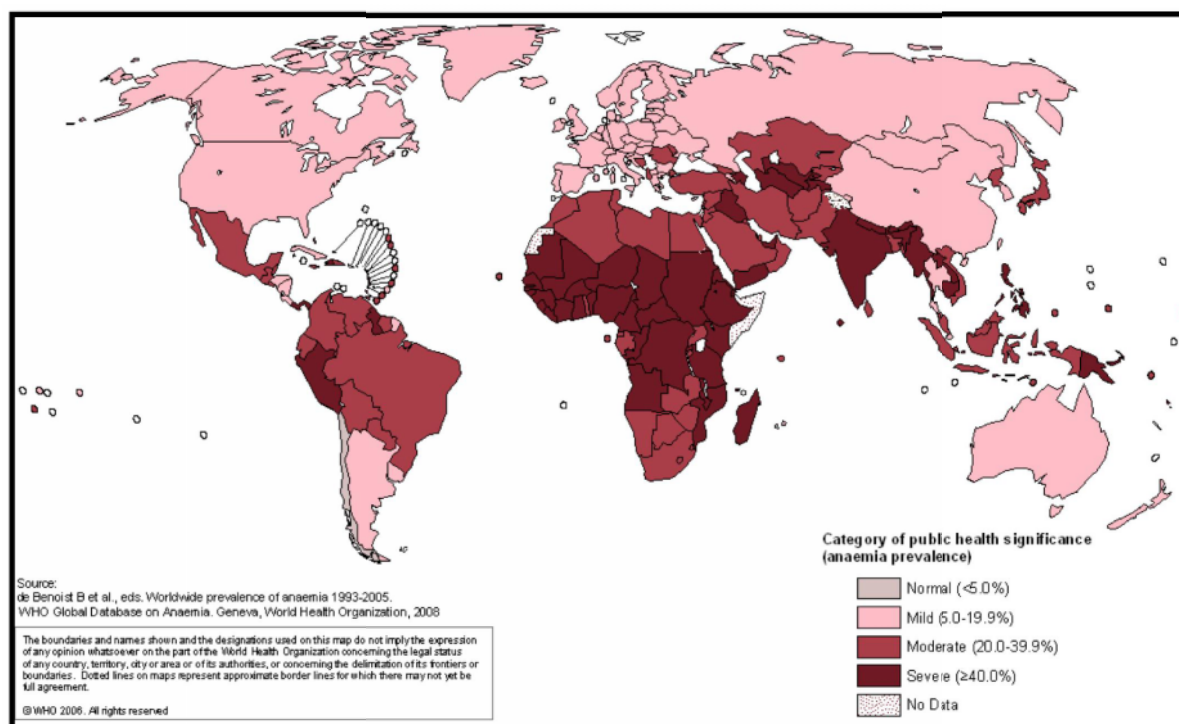


Figure 3

Global Prevalence of Iron Deficiency Anemia

Severe Iron Deficiency Anemia is in countries like India, some parts of Africa, Yemen, Iraq, Peru, Moderate form of Iron Deficiency Anemia is in countries like Egypt, Libia, Algeria, Pakistan, Afganistan, Eran, Brazil, Mexico, Kazhakistan, mild form of Iron Deficiency Anemia is in Argentina, United States of America, Canada, Alaska, Russia, Australia etc.

In India, study by Balgir *et al.*, (1998) on tribal children of Sundargarh and Mayurbhanj districts of Orissa represented moderate to severe anemia of 68-75 per cent, lower mean heights and weights in comparison to ICMR standards (ICMR Report, 1984). However, a cross-sectional evaluation of physical growth and development among the tribal children aged 6-14 years of Mayurbhanj and Sundargarh districts who were staying in Ashram School Boarding and growing their own fruits and vegetables for consumption revealed the better health and nutritional status of Ashram school children than the ICMR average for Orissa (Balgir *et al.*, 1999). Deficiency of essential dietary components leads to malnutrition, protein calorie deficiency and micronutrient deficiencies like vitamin A, iron and iodine deficiency.

D. Methods of Assessing Nutritional Status among Tribal Children

Understanding measures of nutritional status is critical for the interpretation of nutrition-related development outcomes. Standards, reference values and indicators have been constructed for nutrition outcomes against which the nutritional status of individuals and populations can be compared.

Nutritional assessment is often viewed according to the ABCD scheme:

- A. Anthropometry, i.e. physical growth and body size
- B. Biochemistry, used mostly for micronutrients
- C. Clinical evaluation
- D. Dietary intake assessment

"A child's growth rate reflects, perhaps better than any other single index, his state of health and nutrition. Similarly, the average values of children's heights and weight reflect accurately the state of a nation's public health and the average nutritional status of its citizens. Thus a well-designed growth study is a powerful tool with which to monitor the health of a population or to pinpoint subgroups of a population whose share in economic and social benefits is less than it might be".

Growth has been described as "a mirror of society" and takes a leading position in the available measures of nutritional status. Measures of growth in childhood are among the best general proxy measures for constraints to human welfare and are also a highly practical way of describing complex problems. The measurement of growth is widely used to demonstrate the success or failure of interventions. Poor growth performance (resulting in stunting or wasting) is a strong and feasible predictor of subsequent ill-health, functional impairment and mortality. Among developing countries, differences in

average height are not very well explained by differences in income. In particular, children in India are shorter, on average, than children in Sub-Saharan Africa, even though Indians are richer on average. Because addressing widespread stunting is a health and economic policy priority, understanding determinants of children's height is important. There is increasing evidence for one possible explanation- open defecation.

According to Sati and Dahiya (2012) nutritional status of children (7-9 years) were assessed in terms of dietary assessment, anthropometric measurement and clinical assessment of signs and symptoms of various nutrient deficiency diseases. Dietary assessment was done by 24 hour dietary recall method for three consecutive days. Anthropometric measurements were used to construct indices for malnutrition that were compared to reference values. The results of the study revealed that food and nutrient intake was inadequate and anthropometric measurements (mean height and weight) were significantly ($P < 0.05$) lower than reference value, 54.11 percent of the children were stunted and 55.5 per cent were underweight.

The low nutritional status of tribal population in general and that of children in particular is much lower as compared to that of the rest of the population. The Institute for Research in Medical Statistics (IRMS) Delhi, undertook a cross sectional study to assess the nutritional status of children in the tribal districts of Bihar, to assess the dietary intake and nutritional status among the children. The study covered 396 villages from seven tribal districts of Bihar. 1847 preschool children (0-6 years) were studied. 24 hours recall method was used to assess the nutrition intake and anthropometric measurements included height and weight. Information was collected on household characteristics, demographic profile and anthropometry. Anthropometric rods used for measuring the height were Seka while Infantometer was used for recording recumbent length. Both had an accuracy level of 1 mm. Spring balances were used for measuring the weight with accuracy level of 100 g. Health status and measurement on height and weight were carried out for the members of these 20 households per village/town. Further, for 10 households detailed information on the dietary intake (5 households for family and 5 households for individual diet) was collected. Recall diet survey schedule, food frequency, socio-cultural aspects of food consumption and nutritional assessment schedule were used. All individuals covered for anthropometry were also examined for presence of clinical signs of nutritional deficiency. Dietary intake was assessed by actual weighing for 24 hour recall method. Care was taken to avoid fasting and festival days

while noting the intake. Calories and other nutritive intake were calculated by using the table of nutritive value of Indian food (ICMR, 1993). To further validate the 24 hour nutritive intake data, the consumption of major food items was assessed using food frequency table. Nutritional intake was compared with ICMR, RDA and nutritional status assessed by SD classification. The intake of protein was broadly in line with the RDA in all age groups among children. However, the average intake of energy and other nutrients was lower in all age groups as compared to RDA. Calorie deficiency was 38 per cent whereas protein deficiency was about 19 per cent. More than half of the children were calorie deficient in Katihar, Bokaro, Godda and Singhbhum (east and west). The overall prevalence of stunting was about 60 per cent and underweight about 55 per cent and was comparable in boys and girls. However, wasting was more frequent in girls (urban - 34.5 per cent vs. 16.3 per cent and rural - 34.9 per cent vs 18 per cent). The level of malnutrition was not very different in rural and urban areas. The nutritional status and dietary intakes of tribal children in Bihar is very poor. Urgent remedial measures are required in this context, particularly on a war footing in especially vulnerable districts identified by this survey (Singh, 1999).

E. Strategies to Combat Malnutrition among PTG Children

There are three main types of intervention to prevent and combat vitamin and mineral deficiencies, which can be deployed individually or in combination: short-term supplementation; medium-term food fortification; and a long-term focus on balanced nutrition (dietary diversification). These approaches to reducing malnutrition are complementary rather than mutually exclusive. A coherent and multi-sectoral approach including health, food security and agriculture is, therefore, of prime importance.

1. Supplementation

Nutrient supplements, like other dietary supplements, are regulated as a subcategory of food by the FDA's Center for Food Safety and Applied Nutrition. The DSHEA of 1994, which amended the Federal Food, Drug and Cosmetic Act of 1938, defines and sets safety and labeling requirements for dietary supplements. The DSHEA defines a dietary supplement, in part, as a product intended to supplement the diet that contains any of the following dietary ingredients: a vitamin; a mineral; an herb or other botanical; an amino acid; a dietary substance for use by humans to supplement the diet by increasing the total dietary intake; or a concentrate, metabolite, a constituent, extract,

or combination of any ingredient mentioned above. Dietary supplements are intended to be taken by mouth and can be in many forms, including pills, capsules, tablets, liquids, powders, or other forms as long as they are not represented for use as a conventional food or as a sole item of a meal or diet. They must also be identified on the label as a dietary supplement (DSHEA, 1994). Supplements may be useful when they fill a specific identified nutrient gap that cannot or is not otherwise being met by the individual's intake of food. Nutrient supplements cannot replace a healthful diet. Individuals who are already consuming the recommended amount of a nutrient in food will not achieve any additional health benefit if they also take the nutrient as a supplement. In fact, in some cases, supplements and fortified foods may cause intakes to exceed the safe levels of nutrients (Dietary Guidelines for Americans, 2005).

Food supplements are highly concentrated vitamins and minerals in the form of capsules, tablets or injections and administered as part of health care or specific nutrition campaigns (Horton *et al.*, 2009). The World Bank (WHO-FAO, 2006) estimates that the per capital cost per unit is low: a dose of vitamin A, for example, is estimated to cost between USD 1.00 and USD 2.5 per capita. The cost of iron is put at between USD 0.5 and USD 3.17 per capita. The greatest cost-benefit effect comes from giving supplementary vitamin A to children under the age of two, because the damage caused by micronutrient deficiency in the early years of life is irreversible.

Nutritional Supplementation with Spirulina

Spirulina has been used for years. In his memoirs, Cortès the Spanish colonizer relates the utilization of the algae by the Aztec. It was consumed in dried palets. Later, the benefits of the algae were rediscovered by Europeans in Tchad, Africa where Spirulina has always been used as food complement by the Kanembous tribes. Today, spirulina is consumed in Africa as a cure (at less than 10g per day). It is taken pure or with another product to mask the strong taste of the algae. In the 80s, seeing the multiple benefits of the alga, scientific research began to determine the beneficial health effects of spirulina.

Spirulina is a cyanobacter, Gram + microbe. Like the other blue algae, spirulina is able to photosynthesise and so to produce its own organic matter. There are more than 39 species but for its composition stability and balance of nutrients, *Spirulina platensis* is the specie most used in developing countries cultures.

The rate of protein in Spirulina is high and represents between 60 and 70 per cent of the dry matter (Clément, 1975; Fox, 1999) which is more than fish (25%) or than soya (35%) (Henrikson, 1994). With this rate of protein, 10g of spirulina provide between 6g and 7g of protein which represent almost 50 per cent of the 10g needs of a child. However, for the adults, the interest of spirulina as a hyperprotein ingredient is limited. The composition of protein is balanced in amino acids and contains more than 40 per cent of essential amino acids (Borowitzka, 1988) like isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. However, composition of spirulina is too low in sulphured amino acids (cystéine and methionines) which are essential for malnourished people and especially children. Even if it contains a large part of essential amino acids, spirulina must be associated with other protein sources rich in amino acids, to maximize benefits.

Beta-carotene accounts for 80 per cent of the carotenoids present in spirulina, the remainder consisting mainly of physoxanthin and cryptoxanthin (Palla and Busson, 1969). Each kilogram of dry spirulina contains between 700 and 1700mg of beta-carotene and about 100mg of cryptoxanthin; these two carotenoids are convertible into Vitamin A by mammals. For adults Vitamin A requirements are estimated at less than 1mg per day (Evets *et al.*, 1994), one to two grams of spirulina are easily sufficient to cover them. Moreover, the absence of retinol rules out a possible risk of overdose, as beta-carotene, unlike Vitamin A, is not cumulatively toxic. The beta-carotene values were obtained from samples of spirulina dried by spraying, and thus without heating; when hot-drum drying processes are used, the values should be reduced by nearly a third (Bujard *et al.*, 1970). Clinical studies have also shown excellent utilisation of spirulina carotenoids in humans. A study on 5000 Indian pre-school children showed that a single daily dose of one gram of spirulina was surprisingly effective against chronic VAD. After five months, the proportion of children with serious VAD, i.e. with Bitot's spots on the conjunctiva of the eye fell from 80 to 10 per cent (Seshadri, 1993). This study seems to demonstrate that even very low doses of spirulina are sufficient to achieve a considerable reduction in the risks of blindness and neurological damage caused by Vitamin A deficiency in children. Because of the growing number of indications that carotenoids have a range of effects against cancer, various extracts of spirulina have been tested from this viewpoint on HIV, VAD and cancer (Seshadri; 1993; Sembe *et al*, 1994).

Dry spirulina contains 50-190mg/kg of Vitamin E (Challem *et al.*, 1981), (Eartrise Farms Spirulina, 1986), (Nippon Ink and Chemicals, 1977) a level comparable to that of wheat germ. Daily requirements of E are estimated at 15 IU (Guyton, 1986), or 12mg of free tocopherols. The antioxidant properties of tocopherol for unsaturated fatty acids could explain the good conservation of these substances in dried spirulina.

While spirulina is less rich than yeast in the group B Vitamins (except for Vitamin B12), it is nevertheless a good source of these co-factors:

The Vitamin Content of Spirulina

Vitamin	Content (mg)
Thiamine (B1)	34-50
Riboflavin (B2)	30-46
Pyridoxine (B6)	5-8
Cyanocobalamin (B12)	1.5-2.0
Niacin	130.00
Folate	0.50
Pantothenate	4.6-25
Biotin	0.05
Vitamin C	traces

It is worth stressing the exceptionally high Vitamin B12 (Cyanocobalamin) content, since this vitamin is by far the most difficult to obtain in a meatless diet because no common food plant contains it. Spirulina is four times as rich in B12 compounds as raw liver, long put forward as the best source. However, it should be noted that a controversy surrounds the real bioavailability to humans of the B12 complex in spirulina. Some radiochemical tests concerning intrinsic factors would appear to contradict the presence of active Vitamin B12 in spirulina (Carmichael, 1994). The results are apparently variable depending on the strain of spirulina, for the same analytical method is stated to show high levels of active B12 in certain strains. Vitamin B12 deficiency (pernicious anaemia) derives either from a shortfall in intake (as happens in strict vegetarian diets) or from defective absorption. Moreover, it seems that certain pathological conditions systematically give rise to Vitamin B12 deficiency, as in the case of HIV infections leading to AIDS (Harriman *et al.*, 1989), Rule *et al.*, 1994).

The minerals of particular interest in spirulina are iron, calcium, phosphorus and potassium. The very high iron content should be doubly stressed because iron deficiencies (anaemia) are very widespread, particularly in pregnant women and children, and good sources in food are rare. As a comparison, whole cereals, which are ranked as one of the best sources of iron, contain only 150-250 mg/kg. In addition, iron supplements given in the form of ferrous sulfate can pose a toxicity problem and often cause diarrhoea. Cereals, meanwhile, are rich in phytic acids and phosphatic polymers, which sharply limits the bioavailability of the iron they contain. In the case of spirulina, iron bioavailability has been demonstrated both in rats and in humans (Johnson and Shubert, 1986). Calcium, phosphorus and magnesium occur in spirulina in quantities comparable to those found in milk. The relative amounts of these elements are balanced which rules out the risk of decalcification through an excess of phosphorus. It may be noted that regions with soils poor in magnesium are common and cause deficiency syndromes, including cardiovascular and nervous disorders, in the local populations. The high potassium content is also worth underlining, because many nutritionists attack the very low potassium/sodium ratio available in the majority of food sources. There is unfortunately very little iodine in spirulina. However, there are data that indicate that it is possible by selection or adaptation to obtain spirulina strains capable of fixing iodine (Singh and Kumar, 1994).

There are other compounds in spirulina with antioxidative, anti-inflammatory, anticancer antiviral, neuro protective, hepato protective and immuno enhancing properties. These are associated with substances like selenium, carotenoid, phenolics, essential fatty acids and phycocyanins. Essential fatty acids constitute more than $\frac{3}{4}$ of spirulina fatty acids and are mainly constituted by linoleic (C18:2) and linolenic (C18:3) acids. The phycocyanine is the blue pigment of the algae and its concentration is determined by the light intensity.

Carotenoids are rapidly becoming known as the superstars of nutrition as more people realize that antioxidants play a vital role in human health. "The consumption of a diet rich in carotenoids has been epidemiologically correlated with a lower risk for several diseases". (Stahl and Sies, 2005) Scientists in Australia recently found that prostate cancer risk declined with increasing consumption of carotenoids including lycopene, lutein, α -carotene, β -carotene, β -crypto xanthin and zeaxanthin (the latter three out of the six listed are present in Spirulina). They concluded that diets containing carotenoid-rich

fruits and vegetables may be protective against prostate cancer. Many earlier studies have found similar relationships between carotenoid intake and other forms of cancer (Jian *et al.*, 2005).

Polysaccharides are another constituent of spirulina that show promise of having great benefits in human nutrition. Calcium spirulan is one such polysaccharide, which is separated out from a hot water extract of spirulina. Japanese researchers have found excellent potential for calcium spirulan in different applications. In one experiment, calcium spirulan was found to inhibit the replication of several different viruses including HIV-1, herpes simplex 1, measles, mumps, influenza, and human cytomegalovirus. "It was found that calcium spirulan selectively inhibited the penetration of virus into host cells." (Hayashi *et al.*, 1996) The same group of researchers from Toyama Medical and Pharmaceutical University performed another experiment in which calcium spirulan again showed excellent antiviral properties against HIV-1 and Herpes simplex 1. The study said "calcium spirulan can be a candidate agent for an anti- HIV therapeutic drug that might overcome the disadvantages observed in many sulfated polysaccharides." (Hayashi *et al.*, 1996)

Spirulina is also found to be a good source of Vitamins K1 and K2. No other Spirulina in the world to our knowledge has been shown to include K2. Vitamin K1, also known as phylloquinone, has long been linked to blood health because about half of the 16 known proteins that depend on the vitamin are necessary for blood coagulation. Vitamin K1 has also been widely researched for its benefits for bone health, and to a lesser extent for Alzheimer's patients. Vitamin K2 on the other hand has become one of the hottest nutrients researched over the last ten years. Vitamin K2 is known as menaquinone. K2 is important for the proper metabolism of calcium, and thus, like Vitamin K1, it also plays an important role in bone health. In bone, Vitamin K2 activates a critical protein required to bind calcium, thus strengthening the skeleton. Recent studies have revealed that K2 can have positive effects in alleviating osteoporosis. Vitamin K2 also can play a role in preventing cardiovascular diseases. In circulation, K2 participates in the activation of the most potent inhibitor of arterial calcification, thus lowering the risk of vascular damage. This is just one of many potential benefits from K2 for cardiovascular health. In addition, Vitamin K2 has been extensively researched for its ability to prevent a variety of cancers and for its beneficial effects on the liver.

2. Food fortification

Food fortification is to fortify food with essential nutrients. The United Nations' FAO recommends that governments in countries with high malnutrition rates consider fortifying food with iodine, iron and vitamin A in particular and that they regulate fortification (FAO, 2005 & United Nations Standing Committee on Nutrition, 2010). The UN's Codex Alimentarius Commission lays down international food standards, which list the basic conditions for national fortification programmes: (1) (in) direct evidence of an appropriate rate of malnutrition; (2) identification of a food carrier (such as flour or edible oil) that is consumed by the whole of the malnourished population and whose consumption is recorded; and (3) an evidence base for minimum and maximum fortification rates (FAO, 1991 & United Nations Standing Committee on Nutrition, 2011).

Food fortification is attractive because it does not require the target groups to change their diet but can be implemented by the food industry and because it reaches large numbers of consumers through retail. It is a particularly effective way of tackling deficiencies in densely populated urban areas. World Bank studies suggest that the annual per capita cost of fortifying a food with vitamin A is between USD 0.69 USD and USD 0.98, while the cost of fortification with iron is just USD 0.12 to USD 0.22 per capita per year (World Bank, 2006 & DFID, 2009). Fortification is, therefore, seen as particularly cost-efficient and cost-effective. Fortified food is also important in crisis situations. In situations of fragility triggered by economic crises, natural disasters or long-term violent conflict, diet is often inadequate and unbalanced, so food fortified with vitamins or minerals is distributed to prevent malnutrition. This distribution of fortified foods in crisis situations is in line with the objectives of the United Nations. Where local markets can supply an adequate variety of food, dietary diversification can also be promoted by means of cash transfers of vouchers (Bailey and Hedlund, 2012).

3. Dietary diversification

Linking cultivation of a variety of staple foods with a high vitamin and mineral content to nutritional education can produce better consumer behaviour, as has been demonstrated by multi-sector approaches to food security. Success relies on combining diversified crops, nutritional advice and targeted short-term nutrition intervention. The use of mass media, including nutrition information in radio and television programmes, has also proved effective. SAFO has, for example, supported the NGO partner KFI in Indonesia to produce content for media outlets. In some countries, this content has had

positive effects in supporting the population to be more aware of nutritional issues when choosing food and preparing meals. Having a balanced diet involves a number of factors and is a long-term objective, especially by contrast with dietary supplementation (Lancet, 2008).

These strategies represent complementary approaches and may form part of bilateral rural development projects. BMZ's new 10-point programme for rural development and food security makes explicit reference to measures to reduce undernutrition and malnutrition (point 3) and to integrate food security in bilateral development cooperation. These are particularly effective among children and mothers as an investment in the future (BMZ, 2012).

Diversification can take the form of improved agricultural production, development of vegetable plots, a good variety of foodstuffs and sound preparation methods within families, or multi-sector nutritional advice and training in schools. It can also be delivered through health services, along with food supplementation and fortification and can play a major part in helping to reduce malnutrition.

4. Nutrition Education

Education sector is the core area of mankind and human resource development. Health Education is the first prerequisite of overall development. Vasantha Kumari *et al.*, (2005) opined that, 850 million people in the world are illiterate and of them about 50 percent are in India alone. High morbidity and high mortality particularly among infants and children are an index not only of a community's low health level but also of inadequate health education of women. Illiterate mothers lacked knowledge about nutrition and the effect of surroundings on the child's health. Most important determinants of the women's nutrition knowledge were educational level, age and their kind of occupation. Women who had better knowledge of nutrition also exhibited better dietary behavior, thus underlying the importance of nutrition education for improving dietary behavior. Thus, nutrition education offers a great opportunity to individuals to learn about the essentials of nutrition and health and to take steps to improve the quality of their diets, and their well being to lead a healthy life (Robinson, 2003).

The term nutrition education applies to any communication system that teaches people to make better use of available food resources with ultimate goal of improving nutritional status and essentially involves communication for behavioral change of all the individuals with in a family or community. It reinforces knowledge and corrects faulty

concepts about nutrition, commonly nutrition education acts as a conserving force maintaining the validity of the culture and as an innovative force facilitating adjustment to contemporary problems and conditions. Channels are the pathways to deliver the developed material for nutrition education a single channel of communication may lead to monotony and may not grab the attention of the target group; hence multiple channels were used to diffuse the information. Though mass media easily influence attitude and reinforce behavior, but use of community or interpersonal interventions to teach and encourage adoption of behavior are more influential where feedback is instantly available (Anangamathi and Varalakshmi, 2014).

According to Vasanthamani and Julie (2011) nutrition education and individual dietary counseling can help in maintaining good nutritional status. Nutrition Education programs of shorter duration using a 'communication mix' of channels with repeated reinforcement can bring about improvement not only in awareness but also in IFP (Sethi *et al.*, 2003).

Using data from Cambodia's 2005 DHS survey, Miller and Rodgers (2009) analyzed how nutritional status of under-five children varied with maternal education, using birth size, low height-for-age (stunting), and low weight-for-height (wasting) as measures of children's nutritional status. After controlling for socioeconomic status, the study found that maternal education was strongly inversely associated with stunting, but not with small birth size or wasting. The inverse relationship between maternal education and child malnutrition has also been reported in other studies, such as Mukuria *et al.*, (2005) and Frost *et al.*, (2005). A series of studies have argued that maternal education affects child nutrition through health knowledge and attitudes, and in particular that maternal education improves the mother's knowledge about child health, including causes, prevention, and treatment of diseases (Frost *et al.*, 2005). Emina *et al.*, (2009) observed that children whose mothers are educated tend to live in more hygienic environments and are more likely to be vaccinated and have better nutritional outcomes. Kabubo-Mariara *et al.*, (2009) analyzed the determinants of children's nutritional status in Kenya using a pooled sample of 1998 and 2003 Kenya DHS data sets. The study analyzed the impact of child, parental, household, and community characteristics on children's height and on the likelihood of suffering from stunting. The study also found maternal education to be a more important determinant of children's nutritional status than the educational attainment of the father.

The infant's most frequent caretaker in his earliest months is his own mother, and it is his mother who, whether directly through her behavior towards him or indirectly through other aspects of the environment she provides for him, plays a large part in determining the nature and extent of his experience during his first year. If mothers are given proper knowledge and scientific education of child care practices such as nursing, neonatal and infant care, nutrition, health, child's growth and behavior, it is imperative they would exercise their knowledge on children thereby reducing the incidences of faulty fads and beliefs and rearing their children in an environment that promotes growth and positive development (Sharma and Nagar, 2006).

According to Sharma and Nagar (2006) after providing education for one and a half years, the mean scores of mothers in educated groups had shown an increase but as compared to the control group, the experimental group mothers had better knowledge on different aspects of childcare. When we look upon the categories of child care knowledge and nutrition highly significant differences were obtained in case of knowledge regarding neonatal and infant care, nutrition, health aspects, child's growth and child's behavior. Compared to the control group, increased scores were seen between two groups in these aspects also. In a study done by van den Boom (1994) on the influence of temperament and mothering, it was found that after giving intervention, mothers were significantly more responsive, stimulating and controlling of their infants behavior than control group mothers.

Smith *et al.*, (1983) reported that mothers' nutrition-knowledge scores were associated with the long-term well-being of children represented by height for age. The relationship between the nutrition knowledge of the mothers and the nutritional status of their children was much stronger. Their findings shows that the mothers' nutrition knowledge did not affect the weight for age and height for age of the children 37-72 months old, whereas acute malnutrition as indicated by weight for height was significantly related to the mothers' knowledge in children of all age groups. It is likely that for older children, other factors have a stronger influence on nutritional status than mothers' nutrition knowledge. Also, by the time children are three or four years old, they may have younger siblings who require maternal care and attention, in which case the older children are likely to be ignored.

5. PD Hearth

Positive Deviance/Hearth Nutrition Program is a home-based and neighborhood-based nutrition program for children who are at risk for protein-energy malnutrition in developing countries. The program uses the “positive deviance” approach to identify those behaviors practiced by the mothers or caretakers of well-nourished children from poor families and to transfer such positive practices to others in the community with malnourished children. The “Hearth” or home is the location for the nutrition education and rehabilitation sessions (Child Survival Collaborations and Resources Group, Nutrition Working Group, 2003).

The “positive deviance” approach is used to find uncommon, beneficial practices by mothers or caretakers of well-nourished children from impoverished families. Once identified, the goal is to spread these practices and behaviors to others in the community with malnourished children.

A “Hearth” is the setting of the nutrition education and rehabilitation part of the program. Suggesting a family around a fireplace or kitchen, Hearths are carried out in home settings where caretakers and volunteers prepare “positive deviant foods”. They practice beneficial child care behaviors and feed malnourished children with extra energy rich/ calorie-dense supplemental meals (CORE PD Hearth Essential Elements, 2005).

Positive Deviance is based on the premise that some solutions to community problems already exist within the community and just need to be discovered. Because behaviors change slowly, most public health practitioners agree that the solutions discovered within a community are more sustainable than those brought into the community from the outside. The PD/Hearth process taps into local wisdom for successfully treating and preventing malnutrition and spreads that wisdom throughout the community. Positive Deviance is a “strength-based” or “asset-based” approach based on the belief that in every community there are certain individuals (“Positive Deviants”) whose special, or uncommon, practices and behaviors enable them to find better ways to prevent malnutrition than their neighbors who share the same resources and face the same risks. Through a dynamic process called the Positive Deviance Inquiry (PDI), program staff invites community members to discover the unique practices that contribute to a better nutritional outcome in the child. The program staff and community members then design an intervention to enable families with malnourished children to learn and

practice these and other beneficial behaviors (Positive Deviance/Hearth: A Resource Guide for Sustainably Rehabilitating Malnourished Children, 2003).

Positive Deviance/Hearth is a community-based approach to address malnutrition with three inextricably linked goals: 1. Rehabilitate malnourished children. 2. Enable families to sustain the rehabilitation of these children at home on their own. 3. Prevent malnutrition among the community's other children, current and future. The Positive Deviance (PD) process identifies affordable, acceptable, effective and sustainable practices that are already used by at-risk people and that do not conflict with local culture. Through learning what their neighbors with equally limited resources are doing to prevent malnutrition, families are empowered to adopt better practices even with very limited access to health services. The Hearth part of PD/Hearth is an intensive behavior change intervention targeting families of children with moderate to severe malnutrition to introduce the locally-discovered positive deviant practices as well as promote other practices essential to child health. Hearth sessions incorporate a number of approaches for behavior change including mother-to-mother support, counseling, negotiation, 6 CORE PD Hearth Essential Elements 2005 adult learning principles, skills building, motivation through visible results, and community mobilization. PD/Hearth can be an entry point to mobilize communities to address malnutrition or an intervention for rehabilitating large numbers of malnourished children identified through routine growth monitoring promotion (GMP) programs. PD/Hearth targets the families with malnourished children, knowing that these families may be those least likely to participate in regular community nutrition education or to access health services. It is, in essence, a "mop-up" program to eliminate the pool of ever-malnourished children not usually affected by more generalized programs, not only through rehabilitation but also by permanent behavior changes in their families which prevent malnutrition in future siblings. It is the second and third goals that make PD/Hearth unlike other nutrition rehabilitation programs.

PD/Hearth will be most successful in contributing to overall reductions in child malnutrition and improvements in child health if the program is linked to other health and nutrition interventions for all families within the target communities. Complementary programs include breastfeeding promotion and support, maternal nutrition, growth monitoring and promotion, immunizations, micronutrient supplementation and de-worming, general health and nutrition education, water and sanitation, and income generation or food security interventions such as promotion of home gardens and small

animal production. PD/Hearth, with its strong community focus, can be included as part of the Essential Nutrition Actions strategy, and be a logical companion project within a Community IMCI1 strategy. Before entering the Hearth, families are required to take children to the health facility for de-worming, micronutrient supplementation, and needed immunizations. PD/Hearth volunteers reinforce continued use of health services through referrals and counseling. If a growth monitoring program did not exist previously in the community, the PD/Hearth program must work with the health facility to establish one. PD/Hearth does require careful implementation including selection of sites where families live in relatively close proximity, where there are a significant number of moderately and severely malnourished children (30 percent or 100 children), and where community leaders can be mobilized to take an active role. PD/Hearth is not appropriate for emergency settings, but can be implemented in the post-crisis, relief-to-development phase. (CORE PD Hearth Essential Elements, 2005).

6. Kitchen Garden

The tribal farm women cannot have enough wealth to purchase costly vegetables for their family. Majority of tribal farm women have lack of knowledge about health and nutrition, dietetic blueprint of pregnant and lactating women and complementary feeding for children. Due to poor economic condition, they are unable to purchase fruits and vegetables from market for their daily dietary need. This is resulted in poor health and imbalance nutritional status of farmers, farm women and children (Chauhan, 2012).

Home gardens are found in many humid and sub-humid parts of the world. They are sometimes called backyard or kitchen gardens. These gardens have an established tradition and offer great potential for improving household food security and alleviating micronutrient deficiencies. Gardening can enhance food security in several ways, most importantly through: 1) direct access to a diversity of nutritionally-rich foods, 2) increased purchasing power from savings on food bills and income from sales of garden products, and 3) fall-back food provision during seasonal lean periods.

One of the easiest ways of ensuring access to a healthy diet that contains adequate macro- and micronutrients is to produce many different kinds of foods in the home garden. This is especially important in rural areas where people have limited income-earning opportunities and poor access to markets. Home gardens are also becoming an increasingly important source of food and income for poor households in peri-urban and urban.

A well-developed home garden has the potential, when access to land and water is not a major limitation, to supply most of the non-staple foods that a family needs every day of the year, including roots and tubers, vegetables and fruits, legumes, herbs and spices, animals and fish. Roots and tubers are rich in energy and legumes are important sources of protein, fat, iron and vitamins. Green leafy vegetables and yellow- or orange-coloured fruits provide essential vitamins and minerals; particularly folate, and vitamins A, E and C. Vegetables and fruits are a vital component of a healthy diet and should be eaten as part of every meal. Meat, chicken and fish are good sources of protein, fat and micronutrients, particularly iron and zinc. They are especially important in small children's diets to ensure normal growth and intellectual development.

Strategies and technologies for successful home gardening and nutrition education are contained in FAO's popular training material *Improving Nutrition through Home Gardening*. Separate training packages, specially designed to take account of regional food production and eating patterns and respond to the needs of diverse population groups, have been prepared for Southeast Asia, Africa and Latin America and are widely disseminated.

FAO's Nutrition and Consumer Protection Division (2013) in conjunction with the Plant Production and Protection Division, actively collaborate with national agricultural extension, research, and training institutes, as well as with NGOs to train field staff, farmers' and women's groups, and schools teachers in gardening techniques and practical nutrition. Successful field projects have been implemented in Bangladesh, Bhutan, India, Indonesia, Niger, Somalia and Vietnam (FNA) and training activities are implemented in Ghana and Kenya in Africa; Bolivia, Ecuador, El Salvador, Honduras, Nicaragua, and Peru in Latin and Central America; and in Grenada in the Caribbean.

As a part of nutrition education component in a community nutrition education intervention trial in south India, seeds of amaranth and saplings of drumstick and papaya were distributed in 12 intervention villages to mothers of Preschool children. The positive outcome was found to be an increase in the awareness of the significance of vitamin-A rich foods in the children's diet. Mothers reported the home gardening as the second most valued benefit among the services they received. (George *et al.*, 1994). A food based approach to nutrition improvement and household food security in Vietnam was studied with an emphasis on two components nutrition education of pregnant women and women with children under 5 years and promotion of home gardening. After two years of

intervention the mothers knowledge score increased by 26 percent with an associated 32 percent of mothers who used vegetable weaning foods. The prevalence of xerophthalmia decreased from 1.01 -0.09 percent and Bitots spots from 0.04- 0.09 percent (Tungu *et al.*, 1994).

The proposed interventions in agriculture, horticulture, poultry, animal husbandry and value addition programmes have enhanced the knowledge, abilities, skills and income level of the tribal families by improving their living standards. A desirable change was brought in economic, social, health aspects of tribal farmers. Such types of inventions are required to improve the primitive groups and hence can be replicated in the similar situations. The project can be replicated by adopting same type of interventions through introduction of farming system in rural and tribal India (Kalyani *et al.*, 2013). A community gardening program can reduce food insecurity, improve dietary intake and strengthen family relationships (Carney *et al.*, 2012).

According to Huang *et al.*, (2014) perceptions of the value of the kitchen garden initiative in Kolli hills largely increased kitchen gardens in an area where kitchen gardens were on the decline due to lack of access to quality seeds and other agricultural resources to support them. A special emphasis on the inclusion of local vegetables and greens was important to ensure sustainability. Participants reported increased access to and consumption of vegetables as a result of the intervention. Participation in kitchen gardens also encouraged the enactment of traditional values such as sharing in the community. Furthermore, in a culture where men predominantly went to the market due to the long distance to purchase the produce, and the labour required to transport them home, a kitchen garden allowed women to have increased control over the types of foods consumed in the household due to the close proximity of the kitchen gardens to their homes. Further research is required to examine the role of kitchen garden interventions in increasing women's autonomy and control over foods consumed in the household and the potential implications of this.

In tribal villages of Tangi-Choudwar and Badachana Block the people were solely dependent on forest for their livelihood. There are small pieces of upland under their possession and huge community land remained unutilized. Woodcutting and selling was their daily business that resulted depletion of forest squeezing their livelihood sources. To change this situation, it was planned with the community in five villages to promote sustainable agricultural practices among tribal women utilizing the available land and

water resources. Women groups, farmers groups and Joint forest management committees were formed at the community level. Land development, pond renovation and water management, kitchen gardening, vegetable cultivation, demonstration of organic farming practices was carried out to convert the forest dependent economy of the tribal people into a agriculture based economy by utilizing available natural resources. The programme has substantially reduced the dependency of tribal women on forest and settled them in a sustainable Agricultural livelihood sources. This program has now been scaled up to 24 neighboring villages. 300 families engaged in paddy, vegetable and other cash crop cultivation and settled them in a sustainable source of livelihood. Vegetable consumption and production has been increased in the area. An income of ₹ 250/- per family in an average has been generated from sale of surplus vegetable products. A model kitchen garden plan has been developed and used by tribal farmwomen to carry out vegetable cultivation throughout the year in their courtyard. 50 hectares of wasteland developed into cultivable standard. Through the demo farm the farmers in five project villages and neighboring villages were exposed to soil and water management, model kitchen garden, intensive vegetable cultivation, and organic farming practices. 5 small Agro Service centers formed catering to the growing farm demands of 300 farmers. 5 Grain and seed banks formed. 25 Quintals of raw paddy saved ensuring food security during crises. Lending from neighboring Jaminidars and lenders are stopped by 95 per cent. 300 days of forest dependence has been reduced to 120 days. Because of local employment the seasonal migration rate also reduced by 80 per cent in last two years. 2,500 hectares of natural forest protected to reduce the soil erosion, meet the fuel wood and other requirements. The community initiative for forest protection has been linked with Government department through formation of joint forest management committee. The increased women leadership in the community is taking active steps in stopping atrocities on women and promote women's education, reduce corruption, increase saving, stop alcoholism (Samaj, 2000).