

Ecology and Health

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KEYWORDS Ecology. Health. Cultural Factors. Biological Factors. Population

ABSTRACT In this paper an attempt is made to give an overview of the key elements and issues in the context of ecology and health that are increasingly causing concern. The vast population with multi-racial origin, diverse cultural, dietary and living habits, marriage laws and tradition, and the extreme variations in environment presents complexities in the study of diseases and faces a great challenge in seeking to improve their health status especially child population. The maintenance of ill-health across generations results from a complex interplay of social, economic, cultural and biological factors. This cycle can, in theory, be broken at any point. The complexity of the relationship provides many points at which the passage of ill health from generation to generation can be interrupted. Similarly, protection of the health of infants and young children also protects the health of the next generation of adult health.

1. INTRODUCTION

Ecology is the sub-discipline of biology that deals with interactions between organisms and their environment. Any population of organisms that multiplied as rapidly as the organisms' own reproductive biology permitted may cover the earth. This is prevented from occurring by deaths caused by such factors as predators, disease, scarcity of resources (such as food, water, breeding sites) and many others. The factor or combination of factors determining the size limit of a population varies from one species to another, from place to place and from time to time. The maximum size of a population that can be sustained at a given time under a given set of environmental conditions is referred to as the carrying capacity of the environment for that organism (Moran 1979). The importance of ecology has increased in contemporary time because of despoliation of the environment. Environmental degradation is not the sum of independent causes; it is the multiplication product of inter-connected ones—ranging from environmental to socio-economic to demographic to technological, all contributing to the overall aggravation.

According to a WHO definition "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (1946). "Health" in a broad sense is

"quality of life" rather than only the absence of disease; it is a universal goal even if cultural variations encrust in the way it is defined and achieved (Dubos 1965; Last 1988; Constanza et al. 1992; Waltner-Toews and Wall 1997). However, the health situation is often confined to the extent of registered deaths, diseases and available health resources. This leads to a narrow and sometimes misleading interpretation of the causal variables. Health situation is a complex dynamic equilibrium, which stems from the socio-economic conditions in addition to physical environmental, biological ones. Further, health is not a component but is an expression of development; so that the health of a community at a given moment is the very situation of the whole social, developmental systems.

Thus, the surrounding systems—the socio-economic, physical environment, structures and services, as well as nutritional intake, behavioural environment, attitudes, practices, and so on are important in the living context, particularly to sustain health well being. The systems do not work independently but influence one another. The interplay is critical to permit or prevent a change for the better.

Human ecology seeks to understand man and his problems by studying individuals and populations as biological entities profoundly modified by environment. This includes studying the effects of environment on man and those of man upon his environment (Salzman and Atwood 1996; Wolanski and Hennerberg 2001). The environment which man has is complex. It embraces physical, biological and socio-economic contexts (Bartuska 1975, 1989; Berg 1991; Pratt 1992; Boer 1993). Human ecology

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studies man in these contexts in term of his physiological and behavioural tolerance and the genetic and social mechanisms that provide continuities, feedback stabilities, and progressive adaptations of biological and cultural evolution. The man reached his present place in nature by virtue of his adaptability. This adaptability has been achieved by stabilizing selection. This adaptability stems largely from man's capacity to make homeostatic adjustments to environmental change. Thus man's adaptability has structural, functional, and behavioural bases. There in lies the particular complexity of human ecology. The uniqueness of man is not so much biological as it is cultural (Champbell 1967; Wolanski 2001).

Health ecology is also an emerging discipline that evaluates human health and wellness in regard of their total environment including social environment. Health ecology delves into the interaction between the human, the disease, and their home, work, or outside environment to which they are exposed, as well as into the psychological environment—perceptions, attitudes, practices and diet (Kay and Schneider 1994; Ewald 1994; Kay et al. 1999). Study of *health risk profiles* of populations in a comparative framework of known environmental factors is a main element in health ecology.

In this article, an attempt has been made to underscore the key ecological and health issues that are causes for concern, and delineate key variables that could be explored, manipulated for positive impact. The purpose is to provide an overview to the discerning researchers, academia, individuals, towards further catalyzing interest on this critical theme and supporting any endeavour for generating evidence.

MATERIALS AND METHODS

A desk review of published and gray literature related to ecology and health was undertaken in order to collate necessary information. Subsequently, a synthesis has been prepared, which is presented in this article.

RESULTS AND DISCUSSION

1. Key Ecological Issues

1.1 Carrying Capacity Concerns

1.1.1 Land, Energy and Mineral Resources

1.1.1.1 Land: Land area is a resource only in so far as *topography, climate, vegetation, quality*

of soil, availability of water and other characteristics enable the land to serve some human needs. For good reason, the human population is spread very unevenly over the earth's land surface. Although historically areas that are hospitable have supported human habitations, there is ample evidence that people have concentrated and continue to concentrate in areas that are not hospitable. In fact, with an increase in population size, people now even embark on colonizing the so-called inhospitable areas.

1.1.1.2 Energy: The use of energy, other than that derived from food, is disproportionate within and across societies/nations. In addition, the demand is threatening to outmatch supply in most areas. Demand of fuel—fossil fuels, hydroelectric energy and energy of the wind and tides, nuclear energy is increasing. The issue of over-utilization of fossil fuel is a serious concern today, whereas the pace of harnessing other potent energy sources is yet to be optimal.

1.1.1.3 Mineral Resources—Other than those for Energy Production: The resources of the earth's crust are very unevenly distributed—a result of the processes that led to their deposition and concentration. As a result of this uneven distribution, some areas of the earth (and thus some nations) are richly endowed with mineral wealth, while others have very little. Inequality at the level of the eco-resource base has implications for socio-economic stratification across society/nation.

1.1.2 Food and Other Renewable Resources

The most pressing factor limiting the capacity of the earth to support human being is the supply of food. Perhaps as much as one half of all the world's people are inadequately fed to some degree. The traditional diet of most Asians and inhabitants of other poor areas of the world, where under nutrition and malnutrition (not receiving enough calories per day) has been and still widespread, are much less varied than the diet of the typical European or inhabitants of the developed areas. This limited variety (seriously lacking in one or more essential nutrients, most commonly protein) could still be sufficient to meet nutritional needs. However, the nutritional deficiencies that exist today are mostly the result of either insufficient supplies of some or all of the traditional food or poverty and ignorance.

The serious malnutrition prevalent in the overpopulated world causes incalculable

suffering, waste of human life and loss of human productivity. Malnourishment, especially protein deficiency, inhibits the development of protective antibodies and lowers resistance to diseases. Even more alarming is the growing body of evidence that shows that protein malnutrition has permanent effect, especially on small children. Diseases that are ordinarily only minor nuisances for well-nourished individuals are devastating to the malnourished. The most commonly encountered deficiency diseases in under-developed countries are *marasmus* (protein-calorie deficiency in mostly babies less than a year old who are weaned early weaning or not breast fed) and *kwashiorkar* (protein starvation—most frequently follows weaning, when the child of one or two years is offered mainly starches or sugars for his diet and not protein rich diet). Vitamin and mineral deficiencies are also widespread in less developed countries.

Besides consuming and dispersing several irreplaceable fossil fuel resources, humanity is over-consuming resources that are ordinarily replenished by natural processes. Two renewable resources that are being consumed or destroyed faster than they can be restored are water and forests.

Water is, in the broad sense, a renewable resource. It circulates on the earth in a complex series of pathways known collectively as the hydrologic cycle. Even though it circulates, the finite supply of fresh water places limits on the numbers of people that can be supported, both in specific locations and on the earth as a whole.

Forests are another renewable resource, but the massive deforestation by man is changing their character impacting adversely all living beings.

1.2 Pollution

Pollution usually refers to harmful substances that are released into the environment as the result of human activities. There are different sorts of harm by many kinds of pollutants and these can be divided into following three major categories:

1. Direct assaults on human health (example lead poisoning or aggravation of lung disease by air pollution).
2. Damage of goods and services (example corrosive effects of air pollution on buildings and crops).
3. Other direct effects on what people perceive

as their “quality of life” (example, congestion and litter).

1.2.1 General Effects of Pollution on human health

1.2.1.1 Air Pollution: Carbon monoxide, sulphur dioxide, nitrogen oxides, hydrocarbon pollutants have terrible impact on health. If current trends are allowed to continue, death from air pollution will become obtrusive.

1.2.1.2 Water Pollution: Water pollution from sewage, industry (which pours into water supplies a vast array of contaminants—lead, detergents, sulphuric acid, hydrofluoric acid, phenols, ethers, benzenes, ammonia and so on), agricultural products (insecticides, pesticides, herbicides, and nitrates from fertilizers) is a growing concern. The infusion of the pollutants not just in streams, rivers, lakes and along seashores, but also (and most seriously) in groundwater, where purification is almost impossible, has increased the threat of epidemics of hepatitis, dysentery, other water borne diseases, and poisoning by exotic chemicals.

1.2.1.3 Solid Waste Pollution: A serious problem is the unsafe disposal and accumulation of solid wastes in open dumps. If the wastes are burned they contribute to air pollution; leaching, water filtering through them pollute groundwater supplies; and they serve as breeding grounds for such annoying and disease-bearing organisms as rats, cockroaches, flies and mosquitoes.

1.2.1.4 Pollution by Pesticides and Related Compounds: Various substances such as chlorinated hydrocarbons (DDT and similar organic chemical compounds), lead, mercury, and fluorides reach humans and many other living beings in so many ways and are considered as general pollutants. Another class of chlorinated hydrocarbon compounds, polychlorinated biphenyls (PCBs) has also been found to be serious pollutant. Alarming, many chlorinated hydrocarbon insecticides including aldrin, dieldrin, and benzene hexachloride have been traced in human milk.

1.2.1.5 Pollution by Heavy Metals: The metals, which are most toxic, persistent and abundant in the environment, are lead, mercury, cadmium, chromium, arsenic and nickel. Till the information on environmental effects and short and long-term human toxicity is available much more extensively about these metals, the

intelligent course is to limit as stringently as possible their release in the environment. Pollution by heavy metal causes lesions of the neuromuscular system, circulatory system, gastrointestinal tract, amongst other deleterious effects.

1.2.1.6 Radiation: Radioactive substances are those whose atoms undergo spontaneous nuclear disintegration, emitting both high speed particles and penetrating electromagnetic rays in the process. Both the particles and the rays are usually termed ionizing radiation. Release of radioactivity to the environment can result in a number of ways—from mining and processing the fuel, from the operation of power plant itself, from the transportation and reprocessing of spent fuel elements, and from storage of the long-lived radioactive wastes. Various genetic defects, cancers and stillbirths are associated with radiation exposure.

1.2.1.7 Chemical Mutagens: Chemical mutagens (substances known to cause mutations) such as caffeine and LSD, etc. have been alleged to be dangerously mutagenic in man. Increased interest in the causes of birth defects, combined with the progress being made toward an understanding of the chemical basis of heredity and development have led to an awareness that mankind is being exposed to many synthetic chemicals whose mutagenic potential is unknown.

1.2.1.8 Noise Pollution: Noise pollution has been brought into sharp focus by the discovery that many teenagers have suffered permanent hearing loss following long exposures to amplified rock music.

1.3 Urbanization—Urban Environment Deterioration

The deterioration of the environment both physically and aesthetically is most apparent in the cities/towns on account of rapid and unplanned urbanization, and socio-economic factors. Huge numbers live in slums—heavily populated urban areas characterized by substandard housing and squalor that are consequence of rural-to-urban migration, increasing urban poverty and inequality, insecure tenure, and globalization (UN-HABITAT 2007). In India, for example, 62% of the population of Mumbai live in slums, which cover only 6% of the city's land (Follath 2007). The dehumanizing

effects of life in the slums particularly where there is little hope for improving conditions have been often cited as causes contributing to urban rioting and disturbances. Crime rates are usually high in these neighbourhoods on account of such factors as unemployment, poverty and poor social environment. Such situation of general psychological maladjustment suggests that modern cities provide a less than ideal environment for human beings. Crime rate in the suburbs are also rising, surprisingly involving adolescent and youth from relatively affluent families, especially the new cash rich ones.

The environmental deterioration in cities is most obvious to the poor who live in them. For them environmental deterioration has nothing to do with the decimation of fish, natural forests, etc. or litter in camp grounds. Their concern is “*slum ecology*” including the wildlife in their homes—rats, mice and cockroaches. For them, all the problems and disadvantages of cities are greatly intensified—air is polluted due to crowding, use of fossil fuel (still common in many areas), unorganized economic activities that include use of various polluting materials; sewage and solid-waste disposal systems are inadequate; heat in winter is often insufficient as is coolness in summer; space is at a premium; crime rates and vandalism are high; food is often inadequate; medical care is poor; opportunities for recreation are virtually limited; schools, if exist are very basic; and public transportation is deficient, expensive and inconvenient. Such environment adversely affects the health of specifically the urban poor—and is reflected by higher death rates among the poor (especially infant and child mortalities) than among the general population.

1.4 Disruption of Ecological Systems

The direct effects of pollution on property, on human health and on the quality of life are varied and important, but they may ultimately prove to be less critical for society as a whole than the less obvious effect of pollution and other human activities on the ecological systems that sustain human life (McMichael 1993).

1.4.1 Biochemical Cycles

A biochemical cycle is the transport and transformation of chemicals in ecosystems. Energy from the sun is constantly entering and

passing through the earth's eco-systems. But our ecosystems have no similar extra-terrestrial source of the carbon, nitrogen, phosphorus, potassium and sulphur and many other substances that are required for life. These substances must be continually recycled through the ecosystem if it is to persist.

1.4.2 Modifying Ecosystems

Human beings have always had some effect on the ecological systems of which they are part, but the history of deliberate and significant modification of ecosystems began with the development of agriculture. Since, then human influence has reached to the remotest areas of the planet and has been intensified by increased numbers of people and the development of modern technology. The ecological results of human activities are as varied as the activities themselves. Some ecosystems are destroyed outright by such diverse activities as planting crops, logging of forests, starting fires, over-fishing, building dams, applying defoliant to jungle, constructing buildings, etc.

1.4.3 Abuse of Soil

Soil abuse is a serious problem that could be catastrophic as the world's population continues to expand and cultivable land increasingly shrinks. Severe logging of forests contributes to extreme changes that effectively destroy the forest ecosystem including land degradation leading to accelerated impoverishment & erosion of soil, greater contamination, decreased biomass production, and diminished wildlife diversity, amongst others.

1.4.4 Agriculture and Instabilities

Agriculture tries to manage ecosystems in such a way as to maximize productivity, nature "manages" ecosystems in such a way as to maximize stability, and the two goals are generally incompatible. In other words, productivity is mostly achieved at the expense of stability.

1.4.4.1 Insecticides: Besides being a direct threat to human health, synthetic insecticides are amongst the man's most potent tools for simplifying and maximizing productivity and thus destabilizing ecosystems. The increase in the concentration of the most persistent of these

compounds along each upward step in a food chain exposes the population to service poisoning to the highest concentrations.

1.4.4.2 Pesticides: Agriculture today is an ecologically disaster area. Through various ways and means, the plants are carefully bred out of their natural chemical defenses. In order to tackle the menace of pests, pesticides are used, often profusely.

1.4.4.3 Herbicides: In recent years, there have been an enormous upsurge in the rise of herbicides as substitute for farm machinery and labour in cultivating crops, for keeping roadsides, railroad rights of way and power line cuts free of shrubs.

1.4.4.4 Nitrogen and Phosphorous: As a result of heavy use of inorganic nitrogen and phosphorous fertilizers to maintain the soil fertility, the level of phosphate and nitrates has increased in surface water. All manners of organic and inorganic wastes—raw sewage, manure, paunch manure (the stomach contents of slaughtered animals), detergents, acids, pesticides, garbage etc. end up in the inland waters. All these substances affect the life in the water, all too often exterminating much of it and at the very least modifying the ecosystems in profound ways. The pollution problem is worldwide; many of the rivers on the earth are quickly approaching the "too thin to plough and too thick to drink" stage. In less developed countries rivers are increasingly becoming open sewers.

1.5 Ecological Breakdown and Need for Accounting

The biosphere supports human life by various ways and the loss/overuse/fast use of one or more of the vital means without a scope for regeneration would kill or seriously impair the health of a significant fraction of the human population. Such a loss could be result of any large scale ecological breakdown. As it has been seen, there is a great variety of possible causes of such a breakdown but there are relatively few forms that its human consequences can take. Probably the most likely of these would be a widespread shortage of food. The second most likely event would be a deterioration of public health resulting from an accumulation of toxic or disease harbouring substances at overloaded links in nutrient cycles (for instance, surface waters

overloaded with organic matter or accumulation of nitrates in ground water and soil, possibility of epidemic disease). A third might be a dramatic rise in the incidence of birth defects and cancers, brought about by the individual or combined effects of the array of persistent mutagens and carcinogens that society continues to disperse in the biosphere. Epidemic diseases can spread more readily through dense populations, especially, of course when malnourishment has made resistance low. Pressures related to the size of human population are already large and are growing rapidly. There is pressure on our physical resources—food, water, forests, and metals. There is pressure on the biological environment, whose ability to remove and recycle human wastes and to provide other vital services from pest control to fish production is being sorely taxed. There is pressure, on society's ability to dispense service-education on such important issues and values as equity and equality, privacy, freedom from restrictive regulations, and the opportunity to choose from a variety of life styles.

The focus of ecological accounting is on gauging environmental impacts. Without such accounting, the threat of ecological breakdown would go on unnoticed ultimately going beyond the threshold of recovery.

1.6. Population Growth and Need for Control

An exponential increase in population is particularly putting a lot of pressure on the carrying capacity. Demographic projections—rate of human population growth into the future, specific forecasts of trends in age-specific fertility, death rates, migration and so forth for the nations or regions of the world, all indicate the need to check population growth immediately to avoid its adverse consequences.

Only humane means of achieving control in the growth of the human population is by reducing the birth rate. Unquestionably the one of the most important factor in a country's reproductive rate is the motivation of the people toward the regulation of family size. A great many socio-economic factors affect the reproductive goals of individuals and of a society. Among these are the general educational levels, the degree of urbanization, the social status of women, the opportunities open to women for employment outside the home, and so on. The higher or greater each of these factors is, the lower fertility

generally will be. Other factors such as the average age at marriage (especially of women), the usual length of time of breast feeding also can directly affect the fertility rates. Family planning programmes in general have made little effort to influence these factors. Most of them try only to influence people by emphasizing the economic and health advantages of small families to themselves and their children.

A demographic transition would at best merely reduce growth rates in less developed countries to the level of those of the developed countries. Thus it cannot be expected to solve a country's population problem. At times, as a less developed country moves through the *demographic transition* of becoming developed, when the quality of health care has improved enough that death rates fall but birth rates still remain relatively high, there is a danger of demographic trap. That is, the country may become "trapped" in a self-perpetuating cycle. The country's *economic growth* from the transition stage ends up being used to support the needs of the exploding population instead of economic and social development. As a result, the country may not proceed to the final stage—the post-transition. In the least developed countries, an endemic shortage of resources and continued overpopulation may combine to prevent sufficient development for a demographic transition to occur. At worst then, the demographic transition might not be a solution at all to less developed countries' population problems impacting on overall development, betterment of health and well being. However, if and when the transition reaches its late phase, *fertility rate* falls and the youth dependency rate declines, there is a potential for rise in the rate of economic growth due to a rising share of working age people. This demographic dividend, which usually occurs late in the *demographic transition*, might be advantageous unless a country's economy is unable to absorb and productively employ the additional work force.

Among proposed general approaches to population control are family planning, the use of socio-economic pressures and compulsory fertility control. Maximum freedom of choice is provided by traditional family planning, which allows each couple to plan the number and spacing of their children. But family planning alone should not be regarded as "population control", because it includes no consideration of optimum

population size for the society, nor does it influence parental goals. The use of abortion and voluntary sterilization to supplement other forms of birth control can quite properly be included, wherever acceptable as part of family planning, and made available at free costs. Family planning programmes provide the means of contraception, and through their activities and educational campaigns, can spread awareness of the idea of birth control among the people. Given the family size aspiration of people everywhere, additional measures beyond family planning will unquestionably be required in order to halt the population explosion. The key measures could be:

Socio-economic Measures: Population control through the use of socio-economic pressures to encourage or discourage reproduction is an approach advocated by many demographers, with the objective to influence the attitude and motivation of individual couples.

Involuntary Fertility Control: Approach to population control by involuntary fertility control like vasectomy of all fathers of three or more children, compulsory sterilization of mothers after two or three children, compulsory control of family size. However, such coercion might not succeed in most areas unless complemented and supplemented with intensified behaviour change campaigns, introduction of incentives/conditional cash transfers on adoption of permanent methods, etc.

No form of population control, even the most coercive or repressive, will succeed for long unless individuals understand the need for it and accept the idea that humanity must limit its numbers. Therefore, the ultimate key to population control lies in changing human attitudes concerning reproductive behaviour and goals in all societies. But human survival seems certain to require population control programmes, at least in some places, even before the necessary changes in attitude can be brought about in the population. In fact, the establishment of such programmes might in itself help to convince people of the seriousness of the population problem (Ehrlich et al. 1973).

2. Key Variables

2.1 Human Settlements, Occupation, Activities and Amenities

The word nature means different things to different men. It could almost be said that there is

no such thing as “nature” for man; there are only homes. For a particular person, almost everything is “unnatural” outside the home environment to which he has become adapted. In other words, individuality thus becomes an important facet of human ecology. Among the findings that have emerged from the systematic study of individuality are insights with the nature and organization of human variation in representative populations (Dubos 1966).

Man was a predator in the food chains of the natural ecosystems. He had little or no impact on the metabolic and reproductive processes that regulated the planet’s life-support system. Gradually man’s unique attribute—the capability to produce culture began to emerge. Its evolutionary pace accelerated with each passing age. With each advance in cultural evolution man became more and more able to exploit environmental resources and rapidly rose to the position of dominance over the ecosystems. Dansereau (1957) describes the important anthroposers along a six point scale of “human interference” each of which represents a stage of cultural evolution.

2.1.1 Serial Stages of Human Interference

1. *Gathering:* Primitive groups engage in collective vegetable materials for subsistence, clothing and shelter. Gathering has only negligible impact on environment.

2. *Hunting and Fishing:* Man’s role is that of predator. Although he does not introduce environmental modification, the exploitation does not upset balances.

3. *Herding:* Human impact is significant. Fire and grazing lead to disclimaxes of the natural ecosystem. For example, grassland altered to desert by overgrazing.

4. *Agriculture:* As domesticated plants are introduced, there is relatively limited domestication of animals, for domesticated animals require stable human communities and cultivated fields. In Early Stage, an active and symbiotic partnership between man and plants were good for their continuing development. The village economy spread over the entire planet and it left everywhere the imprint of its essential features: variety, balance, controlled and limited growth as against the pressures of a mounting population, the strategy of management becoming one of preventing natural succession. Man began to create a “domesticated landscape” (Rostlund 1961), with a panorama of domesticated plants and animals,

cultivated fields and pastures and single species reforestation. Now this domesticated landscape comprises a series of artificial ecosystems, which assure man of plentiful food and raw materials to meet his domestic and industrial requirements.

5. *Industry*: Additional substitutions for natural ecosystems take place. For example, damming up streams creates artificial water ways and lakes, the water levels of which are out of phase with natural precipitation processes. Wide expanses of landscape are allocated to exploitation of resources by mining industry. This exploitation disrupts natural processes by changing soil profiles and introducing wastes into streams and rivers, amongst other adverse effects.

6. *Urbanization*: At this stage, all natural elements are replaced by man-made ones. There is an interlocking web of subsystems—each of which includes the city, its satellite towns and villages, a diversity of cultural traditions, a complex of communication links to areas of agricultural production, pools of wild plant and animal genes, natural resources, depots for wastes, and recreational sites. The city is a specialized consumer of resources and is wholly dependent for its existence upon a continuing inflow of natural resources, *e.g.* foodstuffs, fuels and a variety of raw materials (Savas 1971). Urbanization provokes an increasing exploitation of natural resources to provide energy and raw materials for the emerging human ecosystem.

2.2 Social Environment

The interrelationship between man, his culture and the ecosystems in which he lives are far more complex, however than are seen in technological innovation. The development of subsistence systems from hunting and gathering through farming to the economic complexities of modern industrial states carries with it profound cultural and social implications. In particular, the transition from hunting and gathering life ways to a settled farming existence was associated with so many changes that it is referred as a revolution. The increased energy produced by such societies, in terms of labour expanded, is associated with the more complex social stratification needed to direct and control the energy. The functional nature of social structure as an adaptive response to environmental pressures, whilst not a simple cause and affect one, may be seen to exist at various socio-economic levels. As an adaptive

mechanism, culture operation through both technological and structural channels, play a positive and a vital role. However, in addition to providing a set of alternate responses to the environment, culture, by so doing, creates new pressures requiring further adaptation and adjustment. Increases in fertility accompanying the development of agriculture and, in modern times, the industrialization of society causes new stresses upon the available nutrient sources. If the food supply cannot accommodate the increased size, the nutritional balance of the group may become undesirable and death rate itself goes up. The development of agriculture made possible the growth of towns and ultimately, of cities. With larger populations existing in a more restricted space, infectious disease became a major factor and endemic foci became established. Diseases which once spread through a community only to disappear as everyone contracted it became persistent forces as the population density increased to the point where a new, susceptible generation had appeared by the time the pathogen had run its course among the elder members. An epidemiological investigation must consider the effect of cultural variables upon the disease in question. Modern medicine has, of course, gone a long way in many countries toward the eradication of infectious diseases, although many emerging infectious diseases, *e.g.* HIV/AIDS, SARS, Avian Influenza, are becoming major public health threats. However, such has not been the case for the so-called chronic diseases (*e.g.* cardio-vascular disease, neoplasm, diabetes) whose incidence rates have remained essentially unchanged or have increased. It is suggested that social stresses play a major role in exacerbating such illnesses and have presented evidence indicating that their effects are separable from those due to increase efficiency of medical care.

2.3 Biological Environment

2.3.1 Biological Growth and Development

Human growth and development is a product of interaction between intragenic and extragenic factors. Studies on growth rates and adult body size and gross body composition represent valuable sources of information of nutritional status and important aspect of comprehensively defined health (WHO 1964; Malina et al. 1981).

2.3.2 Physiological Fitness

The denotation of characteristics as “adaptive” often implies selective advantage and its outcome as “fitness”. The term “fitness” generally refers to the individual’s ability to cope with stresses of various kinds, *i.e.*, environmental and biological stresses. In human and other populations, adaptation is nearly always evaluated by extrapolation from individual adaptation. The supposed ability and advantages of high-landers relative to plain dwellers or low-landers, such as increased work capacity, have formed the basis for assuming that high altitude populations are adapted to that environment.

A number of environmental factors [(*e.g.* *physical* - temperature, humidity, altitude, pollution; *socio-cultural* - social class, economic/educational characteristics, social change; *biological* - age and sex, body size/dimensions, genotypes (ethnic group); *other* - nutrition and health status)] can significantly influence work capacity. Among the least modifiable factor influencing work capacity is age, body size and ethnic group. Age changes in work capacity reflect a pattern of growth and senescence in body size and composition and in components of the cardiovascular system. Physical work capacity increases during childhood, exhibits an adolescent growth spurt, achieves a brief young adult plateau of maximal functional capacity and declines throughout adulthood. Physical work capacity during adulthood shows considerable variation for two principal reasons. First, the ageing process results in increased variation in the biological capacity to perform work due to increasing prevalence of ill-health. Second, socio-cultural norms generate variations in subsistence and leisure activity. A substantial proportion of the decline in physical work capacity during adulthood is attributable to decreased activity rather than biological age changes. Sex differences in physical work capacity vary with biological age. Boys and girls differ little in adolescence; however, afterwards females have lower physical work capacities than males.

Diet, disease, and activity patterns are variables that have an important influence on individual work capacity. Nutritional deficiencies leading to anaemia etc. decrease physical work capacity by decreasing the oxygen carrying capacity of the blood. Under-nutrition leading to reduced muscle mass is also accompanied by

decreased physical work capacity. Diseases may influence physical work capacity by reducing muscle mass, by producing pathological changes in the cardio respiratory system or by limiting physical activity. Severe parasitic disease and polyparasitism also decrease physical work capacity.

2.3.3. Nutritional Status

The nutritional fitness of human populations may be determined by a variety of methods (Jelliffe 1966). These include simple questionnaires and observations of food stuff utilization. A more quantitative approach involves “household surveys”. The surveys are based on retrospective or prospective measures of family food intake. Finally, the most accurate intake survey approach involves the measurement of individual intake. The results of such descriptive measurements have often been compared to various published minimum nutrient intake standards and the population’s nutritional status evaluated on this basis. These approaches have been frequently criticized, since other indicators of biological fitness such as nutritional disease prevalence, child growth and physiological work capacity frequently fail to agree with predictions derived by comparing intakes with minimum standards (WHO Expert Committee 1963). More difficult and laborious methods, which have been attempted include total balance studies (intake loss plus utilization), yet even in these studies, the results have often failed to fulfill predictions in some population segments (Durnin et al. 1973). With these problems inherent in descriptive nutritional research, overall quantitative population modeling efforts based on physiological processes have been mostly limited to calorie requirements in man (FAO 1957; Baker 1974).

2.3.4 Genetic Structure

Human populations are polymorphic for a large number of genetic loci. These polymorphic loci are useful for constructing linkage maps, genetic counseling, paternity testing, and studying the evolutionary relationship of human population and processes (WHO 1964, 1968). Human populations respond to ecological pressures, first of all, through evolutionary mechanisms.

Diet, disease, and activity patterns are variables that have an important influence on

individuals. Nutritional deficiencies leading to anaemia decrease physical work capacity by decreasing the oxygen carrying changes in their gene pools. Stresses which reduce the reproductive fitness of certain genotypes result in natural selection. Gene contained in the genotypes results in natural selection. Gene contained in the genotypes with reduced fitness will not be transmitted to the next generation as frequently as genes which have no associated reduction. The proportion of deleterious alleles in the gene pool will be systematically reduced from generation to generation and the population will become better adapted with time to those pressures through the operation of evolution. The haemoglobin locus provides some of the best evidence by virtue of sickle cell disease and other haemoglobinopathies in addition to the thalassemias and G6PD deficiency. The ABO locus also provides a number of examples of natural responses as demonstrated by a variety of research techniques, while strong selective pressures, perhaps leading to a balanced polymorphism, has been inferred for the Rh locus. At the level of evolutionary genetics, biological responses to environmental pressures have been noted in a number of instances among human populations.

The major histocompatibility (HC) antigens are: HLA-A, B, C, DR and DQ and minor antigens are: ABO and H-Y, which appear to be involved in the rejection of allo-antigenic grafts in tissue recipients. The ABO and HLA systems have been the subject of much study in investigating genetic relationship of selected populations and testing theories concerning human genetic adaptation and disease (Cavalli-Sforza and Bodmer 1971, 1990).

2.3.5 Demographic Structure

A number of standard approaches to the measurement of demographic structure exist. It should be noted, however, that the kinds of indices used must be partially modified to the problem. Fertility, mortality, migration and age-sex composition indicators have all proven highly useful in measuring the biological fitness of populations as well as providing an overview of social and 'immediate' physical environments.

2.3.6 Disease Types, Causes, Prevalence

According to May (1958), disease is "that alteration of living tissues that jeopardizes their

survival in their environment". In a framework *disease* as a general term are generally associated with *bad, harmful, malfunction* (including inability to work), *life shortening* (lower life expectancy), *fear, diagnosis, treatment with drugs, cure, death and doctor, clinic, hospital*. In a different framework, it is associated with the ideas of cause or process such as *inflammation* (local heat, pain, swelling), *fever* (general heat), *infection* (caused by invasion of an organism), *cancer, genetic inherited* - or sometimes, vaguely, *organic, functional*; or with ideas of time such as *acute, chronic, ailment* (mild and chronic, in one common usage). In yet another framework disease may be associated with *contact, contagion, infective, communicable, avoid fear* (again), *don't touch, flee, destroy* (i.e., burn, incinerate—the person or belongings). Some people associated some diseases with *retribution, punishment, penance*, and many other cultures believe in disease causation by *spirit, taboo, ancestors*. Ackerknecht's (1942, 1943) classical studies on ethno medicines and Sigerist's (1951) review of history of disease provide a framework for the study of patterns of disease. May (1959) contribute the first of three volumes along with studies in medical geography, which examine environment and cultural factors in the changing map of transmissible diseases? May (1960) examined the occurrence of disease in relation to three interrelated factors: the environment (physical, biological and emotional stimuli), the host (stress factors as well as genetic susceptibilities) and culture, which he defined as the sum total of the concept and techniques used to control the environment, cultural, ecological factors in the transmission of disease. Cultural influence on genetic variation and the interaction of genetic endowment and socio-cultural environment are stressed by Dunn (1960), while Levene (1960) warns against the danger of neglecting genetic factors in research. The concept of culture and of social class are being increasingly utilized in epidemiological studies and correlation made between socio-economic, ethnic, racial and medical findings (Young 1926; Marcial 1960; Quisenberry 1960). Berkson (1960) and Moser (1960) observed racial susceptibility while comparing epidemiological data of Negroes and Whites for elevated blood pressures and the increasing prevalence of blood pressure, whereas Scotch (1960) observed higher hypertension rates due to stress factor in urban as compared to rural society. Research is conducted to determine correlations between health status and changes

from rural agricultural to an industrial way of life. It has been observed that migration and social changes are characterised by cultural incongruity, which creates stresses leading to increased rates in individual and social ill health (Cassell et al. 1960). Nichter (1994) edited a volume on anthropological approaches to the study ethno medicine. This collection represents a broad range of research illustrating contemporary trends in the anthropological study of ethno-medicine, which span positivist, interpretive and critical theory as well as postmodern concerns and approaches.

2.3.6.1 Nutrition: Population growth, food supply, health, morbidity, mortality and nutrition are closely related with each other (Geissler and Geissler 2005, Shils et al. 2005). Malnutrition emerges as one of the important disabilities inherent in the culture of poverty. It has an adverse effect on physical growth, capacity to use intellectual endowment, emotional unfolding and personality development. Survivors of malnutrition start with a developmental path characterized by defective psychological functioning, scholastic backwardness and subsequent maladaptive behaviour. The resultant chain of events is a spiral effect.

A malnourished body is the victim of a number of deficiency diseases. Protein deficiency leads to kwashiorkor, retarded growth of the body, apathy and anorexia, edema, skin lesions, alterations in skin, hair pigmentation, fatty liver and diarrhoea. Deficiency of proteins, iron, folic acid and vitamin B12 gives rise to anemia, which is most common among children and expectant and nourishing mothers. Vitamin A deficiency produces night blindness and xerophthalmia and dermatosis. There are many other diseases associated with deficiencies of nutrients in human food. Beriberi, pellagra, scurvy, rickets, goiter, etc., are a few of them. Malnutrition itself is an all-pervading disability and constitutes important back-drop to tropical health. When it impinges at vulnerable points in the life cycle of an individual, its effect can be serious and far-reaching. Even during intrauterine life, in the unborn state as it were, maternal malnutrition can adversely effect the health of the embryo and the ultimate outcome of pregnancy. From the moment the child is born up to the school going age, again malnutrition seriously impairs growth and development and ability to cope with environment hazards such as infections and infestations. Severe malnutrition

in the early stages of infancy and childhood can produce long lasting results on the learning abilities of the individual. By its effect on body defences, malnutrition makes the individual susceptible to a variety of environmental hazards. Malnutrition in its entirety is also the cause for less perceivable disabilities. Growth retardation due to marginal malnutrition affects work capacity and mental efficiency. Thus, malnutrition coupled with a stress filled environment can place the population at a disadvantage. Undernutrition result in loss of weight and such disturbances as low basal metabolic rate; slow pulse; low blood pressure; suppression of menses in women; dry, coarse, cold skin; bloodshot eyes; insomnia and fractures from osteoporosis changes in the bones. Nutritional edema, burning sensations in the feet and hands and a sore mouth with increased salivation are common symptoms in chronic starvation.

2.3.6.2 Growth and Development: Growth is a complex phenomenon. By definition it means "progressive development of a living being or part of an organism from its earliest stage to maturity, including the attendant increases in size". The control of body size is certainly a complicated affair. Both genetic and environmental factors influence growth and the progress of any given child is the result of many different factors. Among the environmental factors, nutrition is the single most important determinant. In fact the growth status of children is generally accepted as a good index of nutritional status of a community. Growth alterations both during undernutrition and after nutritional rehabilitation have been studied (Eveleth and Tanner 1990).

2.3.6.3 Physiology-Biological Fitness: The biological response to any environmental condition is always physiological regardless of the age and it makes the study of physiological parameter of utmost importance. The crucial physiological parameters are related to cardio-respiratory system, particularly at higher elevations. Pulmonary volumes have assumed an important role in determination of habitual physical activity, level of physical fitness and hence level of adaptation (Baker 1977).

2.3.6.4 Population Genetics: The subject of Population Genetics deals on the one hand with exact genetic descriptions of human population, and on the other hand, tries to find out the reasons for genetic differences among them. To study the genetic differentiation processes in man, which

are obviously still ongoing, reliable population data are necessary. The existence of genetic variation in man is caused by many factors, among which selection, migration and gene flow, genetic drift and founder effect are the most important ones. By means of many examples, Cavalli-Sforza and Bodmer (1971) and Vogel and Motulsky (1986) have shown the importance of these factors for understanding of genetic variations in man. Mourant et al. (1978) have reviewed the associations between genetic markers of the blood and diseases, which are of considerable interest in this connection. As far as the various genetic markers of the human blood are concerned such comprehensive reviews have been given as, Mourant et al. (1976), Steinberg and Cook (1981), Tills et al. (1983), Roychoudhury and Nei (1988), Bhasin et al. (1992), Cavalli-Sforza et al. (1994), Cavalli-Sforza and Cavalli-Sforza (1998), Cavalli-Sforza (2000).

The newly discovered molecular techniques have provided a new direction and a whole battery of powerful polymorphic systems to study genetic diversity (Cavalli-Sforza and Feldman 2003; Jorde and Wooding 2004; Stone et al. 2007; Reddy 2008). The question, what happens to genes with degradation in biotic environment, acquires a primary place. With these newer interests, different kinds of techniques have been enunciated to understand nature-nurture relationship in a better fashion. Moreover, there has been a concomitant advancement in statistical methods that could be used to study many parameters (Collins et al. 2003; Bamshad et al. 2004; Tishkoff and Kidd 2004; Cavalli-Sforza 2005).

2.3.6.5 Genetic Epidemiology: Genetic epidemiology encompasses study of genetic factors, family resemblance, disease, risk factors, population aspects, cultural inheritance, random environment and contemporary health related problems. Genetic epidemiology can help in understanding the etiology of complex diseases, which may be guiding principles for their ultimate control. There is almost universal agreement that the occurrence of diseases is influenced by our living conditions and behaviour (Schull and Weiss 1980). According to Morton (1982) "Genetic epidemiology is a science that deals with etiology, distribution and control of diseases in groups of relatives and with inherited causes of disease in populations". Genetic epidemiology is an important tool for delineation of the genetic

and non-genetic factors in causation of disease. A critical appraisal of the available human population genetic studies has shown a high incidence of genetic and genetic-environmental disorders like abnormal haemoglobins S and E, glucose-6-phosphate red cell enzyme deficiency, etc (WHO 1966, 1967; Livingstone 1983; Yoshida and Beutler 1986; Honing and Adams 1986; Luzzatto and Mehta 1989; Beutler 1990; Bhasin et al. 1994; Mao 2007).

Birth defect or congenital anomaly is a term which is used to describe structural, metabolic, functional, behavioural and hereditary defects present at birth. A structural defect is commonly known as malformation. A functional defect of a normal structure is termed as deformation. A congenital malformation may be single or multiple, gross or microscopic, external or internal, major or minor. The word congenital implies a defect present at birth though not synonymous with heredity as sometimes believed. Congenital malformation may be due to genetic factors or due to external factors. There are numerous diseases that result from single-gene defects that are inherited in a simple Mendelian manner (McKusick 1986). Most diseases of unambiguous simple major gene etiology occur at a low frequency within the population. Another class of diseases consists of complex disorders such as coronary heart disease, diabetes and schizophrenia that affect substantial proportions of the population. These diseases do not result from a single genetic or environmental cause but rather from multiple factors such as one or more major genes (each with a large effect), polygenic and environmental influences. All genetic disorders are not seen at birth; a vast number of genetic defects are manifested only later in life. Chromosomal disorders (clinical cytogenetics) have gone a long way since the establishment of the exact chromosome number of man as 46 (Tjio and Levan 1956). The percentage of chromosome aberrations was reported to be 3-4 per 1000 live births in various surveys of newborns.

In the developing countries such as India, infectious and parasite diseases and malnutrition still contribute predominant causes of morbidity and mortality. This is in sharp contrast to the situation in developed countries where genetic disorders contribute significantly to human disease and death. After the Alma Ata Declaration of Health for all by 2000 A.D., there has been shift in health planning in the developing countries to

provide primary health care to all people that is meant to bring forth the emergence of genetic disorders as important causes of morbidity and mortality. In India, two factors namely: 1) high prevalence of haemoglobinopathies among many communities and 2) practice of consanguineous marriages by many population groups contribute significantly to the incidence of genetic disorders.

Numerous approaches have been developed as described to study the prevalence of given disease in human populations or settlements. Since many infectious diseases are of a cycling prevalence in nature, it is often difficult to describe the disease pattern in a population unless a time-depth dimension is included. Overall models of disease prevalence in populations are generally described by incidence and have often been disease-specific. Some attempts have been made to combine the findings into single indices such as morbidity classifications (Reid et al. 1966; May 1970). Since the concept of disease is often taken to be the opposite of health, disease prevalence descriptions often include some of the other biological fitness measures described in this section. Thus somatic disability related genetic structures may be termed genetic diseases, or the frequencies of specific ill health states caused by nutritional inadequacies are often termed nutritional diseases. Nevertheless, disease descriptions are usually developed on the basis of the frequencies of states classified as abnormal, thereby devising from the concept of biological fitness, which implies description of the total population unit.

2.4 Values, Attitudes, Beliefs, Knowledge, Practices

The problems of introducing modern medicine across cultural barriers and the practical implications of cultural receptivity to new health measures are pointed out in a number of studies. Foster (1957), Paul (1958) and Wellin (1958, 1960) indicate a pivotal role of local attitudes in the acceptance or rejection of improved health measures and the need for understanding cultural definitions of the situation in charting public health programmes in less developed areas. Cultural variations in definitions of disease syndromes, their etiology, prognoses and treatment have become apparent as a result of extensive research studies available. Firth (1959) reported the socio-cultural character of ideas of

health and disease, and the elaborate system of beliefs and practices that underlies primitive medicine. Contemporary studies in folk ethnography and peasant society frequently include data on disease, the role of curers and the ethnobotany of folk pharmacopoeia. Schulman (1960) observed that modern medicine is accepted when a pragmatic value has been established. A similar position was taken by Erasmus (1959), who stated that public health campaigns that lead to dramatic cures are accepted quickly than preventive programmes. Health measures may not result in any advantage where the group fails to perceive applicability of modern concepts of disease and methods of prevention. Foster (1957) stressed the need to utilize folk concepts in interpreting modern medical treatment to avoid failure in carrying out public health programmes and pointed out that pragmatic proofs are more educational in changing folk belief about medicine than didactic campaigns.

Overall, the importance of knowledge in getting a disease, seeking cure can not also be undermined. General poverty, low family income, illiteracy, and several socio-cultural factors, value system, etc. exacerbate the intensity of disease problems.

Diseases are caused by one or the multiplicative effect of the following factors:

1. Infections, water and/or air-borne;
2. Poor environmental sanitation, hygiene, and contact;
3. Genetic;
4. Ignorance about health; and
5. Unsatisfactory health care delivery system

People approach a number of medical systems and practices for disease cure. The term medical pluralism designates the state of combining different curative systems, which apparently may seem to be in conflict. The following are the main systems:

1. *Ayurvedic Medical System* (Sanskrit Classic Texts)
2. *Unani Medical System* (Arabic Classic Texts)
3. *Syncretic Medical System* (Traditional Culture)
4. *Professionalized Ayurvedic and Unani Medical System* (It has continued the syncretism of the past, transforming learned traditional culture medicine by assimilating modern knowledge and institutions)
5. *Allopathy or Modern Scientific Medical System*

6. *Homeopathic Medical System*: It originated in Germany and is a special form of popular culture medicine.
7. *Indigenous Medical System*: It refers to folk and learned dimensions of traditional medicine.
8. *Folk Medical System*: It encompasses traditional midwives, bone setters, supernatural curers and others. The concepts and practices in folk medicine draw upon the humeral theories, cosmological speculation and magical practices in learned medicine and religion, but systematic studies of the relationships between learned and folk medicine have not been made.
9. *Magico-religious Medical System*: Magical and religious therapy and practitioners range from illiterate villagers to sophisticated urban pundits.

A generic guide on collection of evidence related to ecology and health is presented as appendix 1.

3. Key Health Issues

Resource endowment of the "environment" affects the health status of the community. The relationships are extremely complex and may work through long causal chains, which are not immediately apparent. For instance, soil degradation may lead to a scarcity of fuel wood or safe water and thus compel a mother to spend several hours a day away from home, putting the small toddlers in the custody of older siblings/relatives. The repercussions in terms of morbidity, infant mortality or just sensorial retardation may never be singled out. In addition, greater maternal fatigue, superimposed on already low calorie-intake may lead to a low weight at birth of progeny and thereby to increased infant mortality.

In India, 30 to 50 per cent of the total energy use comes from traditional sources. In the vast rural areas, wood and charcoal are preferred because they give more heat and a higher temperature for a given weight. It has been estimated that in India in 1973-74, the per capita consumption of wood and charcoal for all energy purposes was 151.2 kg, of other solid fuels—it was 4.9 kg for coke and 25.2 kg for dung (Desai 1980). The use of wood for fuel has led to the degradation of forests impacting on overall physical environment; in addition the smoke is endangering the health of people.

The physical environment of a population is not just a provider of natural resources, but also source of constraints. It first affects the individual by influencing growth, sexual maturity, fecundity, then influences fertility and mortality and thereby the population as a whole. Spatial distribution of a population is a result of climate, rainfall, altitude, terrain and the carrying capacity of land. The stability between a population and the physical environment is reached after a prolonged exposure of a population to a particular environment and the stresses therein.

Safe water and sanitation are two other physical environmental components, which have a strong cultural determination and key influence on people's health, perhaps comparable only to food. While 74 per cent of households in India's urban area are served by piped water, only 31 per cent of households in the rural areas have easy access to such amenity. In case of sanitation, 47 per cent of urban area is served with installed sanitation facilities as compared to only 2 per cent of rural area. In addition to the overall resource constraints, the success of the water supply programme also depends on acceptance, maintenance and appropriate utilization. For instance, food, housing and fuel take precedence over water purity, and toilets are seen as a luxury, not a necessity (Chauhan 1983). Further the evaluation of the UNICEF/WHO assisted Rural Water Supply Programme in India in 1976, also noted that nearly 70 per cent of the pumps were not functioning at any given time. There is a necessity to design and introduce a water supply and sanitation technology suited to local conditions, which the local population themselves can operate and maintain without external assistance. This technology must be cheap enough so that the village communities particularly can afford it.

In India high costs and cultural barriers have blocked sanitation development. Villagers want water, but convenience is more important than quality. It is estimated that about 30 per cent of the rural population have access to potable water and 0.5 per cent basic sanitation facilities in India. The majority of the people are ignorant about the causation and prevention of disease being demonistic or deistic in outlook on health matters. People do not relate diseases to water supply and waste disposal.

The correlation between "educational level" and health status is now widely recognized. Health and education are inter-related. A child's ability

to take full advantage of schooling provided to him/her depends on the health, and later on, his/her ability to apply the acquired knowledge and skill depends on the mental, physical fitness.

Perhaps the most important factor in determining the health status of a population is food intake. Although affected by cultural patterns, seasonal variation, dietary knowledge of the mother or household food procurer, the intake is chiefly determined by food availability at household level. In turn, food availability is a function of food production, price mechanism and purchasing power—wages, etc.

Since health is the outcome of a complex set of socio-cultural and economic, as well as physical, or biological factors; health is realized in the context of overall development and specifically of a pattern of development that will give high priority to social goals in addition to economic ones. The health of a community depends on the health care system and related aspects. Improving access to primary health care in the rural areas is a priority. In India, the National Rural Health Mission launched in 2005 is oriented to ensure this, especially focusing on increasing access to the vulnerable sections in the society—the women, the children. Improved health, low death rates have been achieved in parts of India, where primary health care related to midwifery and maternal education on breast feeding and weaning, vaccinations, oral dehydration of patients of diarrhoea, and antibiotics against respiratory infection—have been implemented.

While medical practitioners and organizers have the main responsibility of promoting, administering and evaluating the delivery system, yet economic, social, political, cultural and moral dimensions of rural life cannot be ignored. The involvement of other disciplines for the success of primary health care programmes is also essential. Inter-sectoral convergence and community mobilisation and ownership are cornerstones for the success. One must take cognizance of the dual aspects of the problem and the multifarious responsibilities involved in the realisation of one's goal. The problem of health care has been tackled by two approaches—firstly, health care is seen as dependent on and derived from the wider social system and consequently, the problem of maintaining and improving the health of the members of a community is formulated as a problem of continuously restructuring the social system in a manner that

is conducive to the needs of maintenance and improvement of health. In the second approach, attention is mainly focused on the system of health care as an autonomous agency operating directly and exogenously on the health front. Ideally, it should have been an integrated approach, but in India the policy makers are concentrating on the second type of approach while not giving adequate attention to the first one. Sometimes, only a few socio-economic criteria are taken into account when there are some operational difficulties. A pragmatic approach is yet to be strategized and implemented.

There is no generally accepted classification of health indicators. The two most widely used measures, life expectancy at birth and the infant mortality rate, are not perfect. In fact, there is yet to be a consensus regarding a perfect health status indicator. As regards the use of mortality as an indicator of health, much of the criticism against the use of mortality (survival) measures is exaggerated and/or misguided. For instance, mortality data are frequently criticized because of their alleged insensitivity to the efforts of the health care system. From the various existing health indicators, survival, growth and development, morbidity and disability; mortality statistics still retain a central place in the evaluation of a health programme. "With respect to health indicators, problems arise, among other things, from the awareness that health is the continuum between death and complete health and also that health tends to become more and more a matter of social perception and behavioural patterns" (Hansluwka 1985). For comparisons among countries and the study of changes over time, mortality statistics simply cannot be replaced. In view of the difficulty in measuring health using a single indicator; studies have been carried out by taking an index variable—'Physical Quality of Life Index' (PQLI), which includes several individual variables. The index attempts to assess the development and well being in a population. Three variables—the literacy rate, the infant mortality rate and the life expectancy at birth—have been fused into a composite index, with a range of assigned values from zero to one hundred. The life expectancy, infant mortality, and literacy are used as indicators of development, describing progress in health, sanitation, education, and women's status. Thus, PQLI is a summation of complex social interrelationships on which no theoretical

explanation imposes any given weights/biases (Morris 1980). The PQLI informs about the changing distribution of social benefits among countries, between the sexes, among ethnic groups, and by region and sector; facilitates international and regional comparisons by minimizing developmental and cultural ethnocentricities. The PQLI was estimated 95 for the USA, 82 for Sri Lanka and 40 for India for 1975. The male-female PQLI differential is significant. In all states in India PQLI is higher for males than females (UNICEF 1980). Today, the *UN Human Development Index* (HDI) is a more widely used means of measuring well-being. The HDI is also an index combining normalized measures of *life expectancy, literacy, educational attainment, and GDP per capita* for countries worldwide. It is claimed as a standard means of *measuring human development*—a concept that, according to the *United Nations Development Program* (UNDP), refers to the process of widening the options of persons, giving them greater opportunities for education, health care, income, employment, etc. The basic use of HDI is to rank countries by level of “human development”, which usually also implies to determine whether a country is a *developed, developing, or underdeveloped country*.

A sensitive index of a community's health status is provided by the chances of survival and growth of its most vulnerable segment, the young children below five years of age. An analysis of the health and nutrition situation of children and women leads to the following broad inference on what happens to every 100 children born: *one* of them is likely to die before or at birth, some times along with the mother. Another *one* does not live to complete the first year. A further 6-7 die between one and five years. Of the remaining 92, some 60 to 70 survive against odds, their growth is sporadic, their development subdued. Only some 15-20 progress to anywhere close to their full potential. In addressing this situation, the primary health care approach is of direct relevance as referred above.

During infancy and childhood the major diseases, ranked by the extent of estimated mortality, are diarrhoea (acute, chronic), and dysentery of some 20 etiologies (1.5 million child deaths a year), acute respiratory diseases, mostly bacterial and viral pneumonias (0.6 million), measles (0.5 million) and tetanus (0.4 million), followed by infectious fevers such as malaria,

typhoid and hepatitis. In the majority of fatal cases the common underlying factor is malnutrition.

Diarrhoea is the single largest killer and as many as two thirds of the deaths are probably due to dehydration and underlying malnutrition. Current estimates of morbidity from acute diarrheal diseases (ADD) worldwide in under-5 children suggest 1.4 billion episodes per year, 3 episodes per child per year, and annual 123 million clinic visits and 9 million hospitalizations (Kosek et al. 2003; Levine and Santucci 2008), with loss of 62 million DALYs (Murray and Lopez 1997). This average masks the real morbidity rates of up to 10-12 episodes a year among children in some developing countries. The long-term effects of diarrhoeal illness on childhood health are extremely serious and include malnutrition and growth faltering (Brown 2003). Out of a little less than 2 million deaths worldwide from acute diarrhoea in under-5 children, 552 000 deaths are estimated to occur in the SEA Region. Little data are available on the diarrhoeal disease burden, diarrhoea morbidity and its contribution to mortality in the adult population. In India, the child under five years of age suffers three episodes of diarrhoea in a year on an average, 10 per cent develop dehydration and one per cent requires to be admitted in a hospital. During the monsoon, the incidence of diarrhoea increases further, before it declines during winter in most parts of the country except in the hilly northeastern region.

Acute respiratory infection pneumonia contributes about a fifth of the mortality in children less than five years of age. Morbidity on this account is extensive, children suffering 3 to 5 episodes a year, each lasting 7 to 14 days. Acute respiratory infection accounts for 30 to 60 per cent of out-patient hospital visits and 20 to 40 per cent of pediatric admissions. Some 20 to 30 per cent of all children suffer from pneumonia each year. In India up to 60 per cent of pneumonia is caused by bacteria (unlike in Europe and North America where pneumonia is caused mainly by virus). Globally, one-third of primary health care attendance by people above the age of 5 years is for respiratory symptoms, with non-tubercular respiratory infections accounting for the majority (Ottmani 2004). In high mortality countries in the SEA region, viz., Bangladesh, DPR Korea, India, Myanmar and Nepal, non-tubercular respiratory infections account for 10% or more of total deaths

across all age groups, leading all other causes of death (WHO 2004, 2009). Emerging and re-emerging acute respiratory infections such as Severe Acute Respiratory Syndrome and Avian Influenza have also on occasions presented as serious public health threats in the SEA region with their potential to cause a pandemic.

The poor with inadequate access to proper nutrition, essential health services, safe water and sanitation facility, and above all, deficient knowledge and awareness about effective interventions, are the most vulnerable and frequently suffering and succumbing to these above-referred diseases. While the efforts need to continue for strengthening and extending the reach of facility-based care, community based management of acute diarrhoea and respiratory infections with appropriate health systems' support for logistics, supervision and monitoring provides an effective approach for addressing leading causes of child mortality especially in resource-constrained settings (Dawson et al. 2008). In recent years, new developments that include: effective home management of severe but uncomplicated pneumonias with high dose oral amoxicillin (Hazir T et al. 2008); and of diarrhoeal diseases with low-osmolality oral rehydrating salt solutions and zinc supplements have emerged as effective tools for case management and prevention, but not intensely promoted so far. There is ample evidence how simple hygiene behaviour like hand washing (Global Water Supply and Sanitation Assessment 2000 Report; Val and Cairncross 2003; Luby et al. 2005; Ejemot et al. 2008); exclusive breastfeeding (Brown et al. 1989; Victora et al. 1989; Beasley and Amir 2007) starting complementary feeding at the appropriate time, etc. reduces the risk of diarrhoeal diseases and respiratory infections in children. Other factors influencing morbidity and mortality due to acute diarrhoea and respiratory infections are water quality at point of use and indoor air quality, outside the scope of health sector per se. During the last century in the United States and Great Britain, cholera and diarrhoea rates dropped sharply, mainly because of improvements in sanitary conditions. Studies in California and Kentucky have shown that compared to disease rates for children with both indoor water and toilets, diarrhoea occurred twice as often in children who had outside toilets, and four times as often in children who had neither. In twenty American cities, the average reduction in

typhoid fever following installation of water filtration was 65 per cent (Rosenberg 1962). A Chilean study concluded that, "The availability of drinking water supply cut the incidence of acute diarrhoea by about 74 per cent" (Department of Rural Water Supply, National Sanitary Work, Chile). The World Bank's privy construction in Costa Rica helped cut the death rate to half for diarrhoea and related diseases between 1941 and 1954. However, community and multi-sectoral participation, as well as good governance that are pre-requisites for improving hygiene and sanitation (Water Supply and Sanitation Collaborative Council and World Health Organization 2005) and also for improving indoor air quality at individual, household and societal levels need to be prioritized. Further, safe and cost-effective newer vaccines for cholera, rotavirus disease, haemophilus influenzae type b and pneumococcal and influenza infections also needs to be considered subsequent to cost-effectiveness evaluation assessment of disease burden.

Among the vaccine preventable diseases like poliomyelitis and tuberculosis seem to result more in debility and disability than in death. Tetanus and measles contribute significantly to infant and child deaths in less developed parts of the world. In India too, children still die of diseases usually not considered lethal in the developed world. Diarrhoea, complicated, brought on by malnutrition, causes about a third of all child and infant deaths. Pneumonia vies with diarrhoeal diseases as the leading taker of young lives. Measles, one of the most infectious diseases known, makes children more susceptible to pneumonia, though it is preventable by vaccination. Tetanus, whooping cough, diphtheria, and tuberculosis, also preventable by vaccinations, continue to take a heavy toll (Bhasin and Bhasin 1994).

The health situation among the children in India is yet to be satisfactory and has to be viewed against the background of their socio-economic status. The child health situation in India is both a consequence and cause of their less developed state. The rate of infant and child mortality is still high. Yet the child population constitutes the growing bulk of India's population. Parents in areas with high infant mortality rates typically produce more children than they desire because they want to ensure the survival of a minimum number as observed among cultivators. Subjected

to repeated pregnancies the women suffer from an almost continuous nutritional drain which exposes both mother and child to high mortality risks that shows a definite increase from one pregnancy to the next. The pressure of the population growth is felt more by the large families at low incomes. It has been shown by various studies that the larger the family size, the greater is the occurrence of common illnesses in the family. These conditions call for the diversion of increasing attention and resources to deal with the problem of child health.

The health of the family is affected by nutritional deficiencies. The health of a mother in a large family with limited income is affected by the low nutritional level and also by the physical and material pressures associated with child-bearing and child-rearing. The larger families moreover find it difficult to provide adequate medical facilities which result in the neglect of their members. Their ailments are noted only when they become serious. Women and children usually lack the most basic advantages. A United Nations' survey showed that pregnant or lactating women throughout the Third World consume an average of only 1750 calories per day, at least one-third fewer than the recommended and one-third fewer than men (Whitehead 1983).

Motherhood for the majority of poor Indian women has always been a period fraught with difficulties, given the low nutritional and health status and harsh living conditions. While women are being helped by improvements in health care, but factors like urban growth and congestion, increasing number of nuclear families, population increase and environmental degradation are not making life easier for them. An Indian woman, on an average, has 6-7 pregnancies, resulting in 5-6 live births, of which 4-5 survive. She is estimated to spend the greater part of her reproductive years in pregnancy and lactation. It is widely recognized that in all spheres of life women are discriminated against and their accessibility to various welfare services such as education, health and employment etc. is far less than their male counterparts. The situation is still worse in rural areas. Mortality and morbidity are perhaps much higher among females resulting in a continuous decline in the sex ratio. The discrimination against women starts right from her birth and continues till her last breath. Differences between the sexes frequently emerge in consideration of health and nutritional status. Infant mortality rates were 131 and 120,

respectively for females and males in 1978 with a greater disproportion in rural areas (Office of the Registrar General India 1980). In Northern India, the higher value placed on male infants is reflected in their higher overall rates during infancy and early childhood. Sons increase the family's status and wealth and are considered the mainstay of parent's old age. Though female infanticide has technically disappeared in the country, a large number of female deaths occur during the pre-school years due to neglect of female children (Miller 1981). Another demographic indicator of women's health status is the maternal mortality ratio. At around 300 per 1, 00,000 live births (UNICEF 2006), the Indian rate is yet relatively very high than that of developed countries. Besides anemia or general malnutrition, the commonest causes of maternal deaths are poor obstetric care of post-partum infections-a manifestation of inadequate services available to women in the ante-natal, intra-natal and post-natal periods.

Health factors include genetic constitution of individuals, their nutritional status, resistance to infections, and culturally determined health practices. Exposure to disease producing organism deficiency of certain micronutrients (such as iron, vitamin A, calcium and iodine) as well as the inadequate intake of calories and proteins, remain important reasons for ill-health.

Population growth, food supply, health, mortality and nutrition are closely related with each other. Population growth increases demand for basic needs of food and shelter. If the demand is met there may not be any effect on people's health and nutrition: otherwise it will affect health, nutrition and the mortality level of the community. Rapid increase in population, thereby decreasing total size of arable land and the cumulative effect of the deterioration of economic conditions of farmers, poses a serious threat.

The food that we eat is assimilated in the body and is used for the growth and good health. For sustaining healthy and vigorous life, diets should be planned with the knowledge of various nutritional constituents that are present in food-stuffs and their requirements for persons belonging to different age and sex groups. The formulation of nutrient requirements of Indians was being mainly based on the work carried out in other countries. In 1958, the Nutrition Advisory Committee of the Indian Council of Medical Research, revised the calories and protein

requirements on the basis of the data collected by National Institute of Nutrition, Hyderabad. Further, in the light of more research work, the Nutrition Advisory Committee made recommendations with regard to requirement of several other nutrients in 1968 and daily allowances of nutrients for various segments of Indians were drawn up.

Socio-economically, Indian society is heterogeneous. There is a small segment of the affluent population participating in high tech, consumerism with a throwaway attitude. There is a very large segment of the population suffering at the subsistence level that is destitution and low-earning. Malnutrition emerges as one of the important disabilities inherent in the culture of poverty. It has an adverse effect on physical growth, capacity to use intellectual endowment, emotional unfolding and personality development. Survivors of malnutrition start with a developmental path characterized by defective psychological functioning, scholastic backwardness and subsequent maladaptive behaviour. The resultant chain of events is a spiral effect.

Malnutrition itself is an all-pervading disability and constitutes an important backdrop to tropical health. When it impinges at vulnerable points in the life-cycle of an individual, its effect can be serious and far reaching. Even during intra-uterine life, in the unborn state as it were, maternal malnutrition can adversely affect the health of the embryo and the ultimate outcome of pregnancy. From the moment the child is born up to the school going age, again malnutrition impairs seriously growth and development and ability to cope with environmental hazards such as infections and infestations. Severe malnutrition in the early stages of infancy and childhood can produce long lasting results on the learning abilities of the individual. By its effect on body defenses, malnutrition makes the individual susceptible to a variety of environmental hazards.

A malnourished body is the victim of a number of deficiency diseases. Protein deficiency leads to Kwashiorkor, retarded growth of the body, apathy and anorexia, edema, skin lesions, acterations in skin, hair pigmentation, fatty liver and diarrhoea. Deficiency of proteins, iron, folic acid and vitamin B12 gives rise to anemia, which is most common among children and expectant and nourishing mothers. Vitamin A deficiency produces night-blindness and xerophthalmia and dermatosis. There are many other diseases

associated with deficiencies of nutrients in human food. Beriberi, pellagra, scurvy, rickets, goitre, etc. are a few of them.

Undernutrition results in loss of weight and such disturbances as low basal metabolic rate; slow pulse; lowered blood pressure; suppression of menses in women; dry, coarse, cold skin; blood shot eyes; insomnia and fractures from osteoporotic changes in the bones. Nutritional edema, burning sensations in the feet and hands and a sore mouth with increased salivation are common symptoms in chronic starvation.

Most of the people who are at a disadvantage due to nutritional handicaps are found in developing countries. India is no exception. In India, nutrition or rather lack of good food is the cause of a number of physical impairments like visual impairment particularly blindness arising out of vitamin A deficiency. Different types of deformities also arise due to nutritional causes for example lathyrism—a preventable paralysis due to eating a toxic legume (Khesri dhal - *Lathyrus sativus*, fluorosis—a crippling disease due to toxic nature of drinking water), deficiency of iodine causing endemic goiter. Malnutrition in its entirety is also the cause for less perceivable disabilities. Growth retardation due to marginal malnutrition affects work capacity and mental efficiency. Thus, malnutrition coupled with a stress filled environment can place the population at a disadvantage.

Growth is a complex phenomenon. By definition it means 'progressive development of a living being or part of an organism from its earliest stage to maturity, including the attendant increases in size.' The control of body size is certainly a complicated affair. Both genetic and environmental factors influence growth and the progress of any given child is the result of many different factors. Among the environmental factors, nutrition is the single most important determinant. In fact the growth status of children is generally accepted as a good index of the nutritional status of a community. Growth alterations both during undernutrition and after nutritional rehabilitation have been studied. The lag in the growth rate of children poor income group is mostly due to insufficiency of calories resulting from delayed and poor weaning practices. With weaning, diarrhoeal disease and impending malnutrition usually follow. Protein energy malnutrition, one of the most important nutritional disorders affecting children in India,

is widely prevalent in pre school children (1-5 years of age) belonging to poorer sections of the community. In addition these children suffer from anaemia, vitamin A deficiency, and vitamin B-complex deficiency. The low heights and weights in a great majority of school children are due to inadequate or suboptimal nutrition. As a consequence of unfavourable circumstances (mainly undernutrition and frequent infection throughout childhood and other stress filled environment) the child remains stunted in growth even when he or she reaches adulthood. In children with severe weight deficit, functional status as ability to fight infections can be affected. The adults of poorer income group are very much shorter and lighter than their counterparts of developed countries. While on the average a rural Indian adult is about 160 cm tall, well-to-do Indian measures 172 cm (National Institute of Nutrition, Indian Council of Medical Research 1981). Various studies indicate that work capacity and workout of underweight adult is considerably lower than that of normal adults. In addition those with low body weights have been shown to have higher heart rates from given work load. It is now recognized that environment factors are stronger determinants and nutrition is single most important determinant. However, the differences of about 3 to 4 cm between well to do adults of developing countries and of developed countries adult could still be attributable to genetic factors, particularly during adolescence. The growth of undernourished children can be improved by food supplements, which provide adequate calories and marginally more protein paving way for healthier future.

There is an interaction between malnutrition and the various confounding environmental factors which influence mental development. Some common diseases like mental disorders, skin disorders, anaemia, blindness, beriberi, pellagra, scurvy, rickets, eye abnormalities etc. are due to deficiency of nutrients like the magnitude of disabilities of the human mind resulting from various mental illnesses and emotional disturbances may be related to a relative insufficiency of one or more crucial nutrients like vitamins or minerals, coupled with a poor environment. The mental disorders may be due to *B-complex vitamin deficiency* (producing mental and neurological symptoms); *riboflavin deficiency* (significant elevation on personality measures of hypochondriasis, depression,

psychopathy, hysteria, hypomania and the like), *thiamine deficiency* (unsteadiness of gait with involvement of peripheral nerves), *niacin or nicotinic acid* (insufficient dietary supply of niacin or an amino acid, tryptophan) can cause pellagra. Endemic pellagra has been associated with maize consumption because of low availability of niacin, and whereas high leucine content present in *jowar* is known to influence the metabolism of niacin and thereby cause pellagra, *folic acid* (disorders in folic acid metabolism can produce mental illness among infants with inborn errors of foliate metabolism, as shown by abnormally high foliate activity in the serum, exhibit congenital deficiencies and mental retardation), *Vitamin deficiency* (mental symptoms such as subacute combined degeneration of the spinal cord), *ascorbic acid or vitamin C deficiency* (scurvy - a nutritional disability), *iron* (anaemia and mental and behavioural disabilities), *minerals* (sodium, potassium, magnesium, calcium, zinc, manganese, copper, deficiencies can lead to mental disorders and not normal pre-natal and post-natal development).

Key statistics related to basic indicators, nutrition, health, education, demographics, economics, women, child protection and rate of progress is presented as appendix 2.

Studies have been reported showing relationship between blood groups and major diseases such as infectious diseases; neoplasm (malignant growth); diabetes mellitus; mental disorders; diseases of circulatory systems; diseases of the blood; diseases of the digestive system; diseases of genito-urinary diseases, diseases of the skin and the congenital anomalies, in Indian population (For review see Bhasin and Khanna 1991). It was proved that the blood groups were inherited and their allele/haplotype frequency varied widely which were involved in the process of natural selection (Mourant et al. 1976a, 1978). Wiener (1970) is the strongest critic of the studies of association of diseases with blood groups.

The term 'haemoglobinopathies' covers the group of hereditary abnormalities in which the structure (e.g. HB S, HB C, HB D, HB E) or the rate of synthesis (thalassaemia) of normal haemoglobin is altered. A close concordance between the geographic distribution of endemic malaria and that of high frequency haemoglobin variants, thalassaemias and other red cell defects

have been observed which represents one of the principal factors leading to the general acceptance of the malaria hypothesis *i.e.*, in a malarial environment, selective forces have acted to preserve heterozygotes of haemoglobin variants because of their advantage against malarial infection (Allison 1954 a,b, 1964; Livingstone 1957, 1967, 1971, 1983; Rucknagel and Neel 1961; Motulsky 1964; Durham 1983; Bain 2006). The selective resistance of the heterozygote illustrates the concept of balanced polymorphism and may be contributory to the maintenance of high allele frequency in a particular area. It is possible that there are still other factors that maintain this genetic equilibrium.

Glucose-6-phosphate dehydrogenase (G-6-PD) enzyme deficiency disease was discovered when a number of Americans of African and Asian descent were treated with certain antimalarial drugs particularly primaquine, which produced a mild haemolysis in these individuals (Carson et al. 1956). G-6-PD deficiency was mainly found in populations originating from tropical and subtropical areas of the world. The geographic distribution was similar to that of falciparum malaria and suggested that G-6-PD deficiency similar to the sickling trait owed its distribution to selection by this malarial organism. Evidence related to a correlation of the frequencies of the sickling gene and that of A-type of G-6-PD deficiency exists in African countries and that between b-Thalassemia and the Mediterranean type of G-6-PD deficiency in Sardinia. The deficiency of G-6-PD is found in a belt extending from Mediterranean area through Southwest Asia and India to Southeast Asia (Parker 2007).

CONCLUSION

The vast population with multi-racial origin, diverse cultural, dietary and living habits, marriage laws and tradition, and the extreme variations in environment presents complexities and challenges in the attempt to improve the health status. The maintenance of ill-health across generations results from a complex interplay of social, economic, cultural and biological factors. This cycle can, in theory, be broken at any point. The complexity of the relationship provides many points at which the passage of ill health from generation to generation can be interrupted.

In the heterogeneous society, to bridge the gap between different socio-economic levels, there is a need of holistic approach to environ-

ment, economy, energy, equity and development. The whole range of transitions, which is needed, include among other things, population stabilization; intergradations; land use planning; sustainable agriculture, forestry, animal husbandry and fisheries; conservation of biodiversity; control of air and water pollution; non-polluting energy systems especially renewable ones with high energy efficiencies; recycling of wastes and residues; ecologically compatible housing and slum improvement; environment friendly technologies; poverty alleviation; blending economics with ecology; improving health care service delivery and other infrastructure in addition to community sensitization and mobilization for increasing knowledge and awareness, informed decision making and responsive behaviour.

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APPENDIX 1

GUIDE ON COLLECTION OF EVIDENCE RELATED TO ECOLOGY AND HEALTH

1. Data Collection

The data may be collected under the following broad headings: (1) Physical Environment (2) Human Settlement, Amenities, Activities and Socio-cultural Variables, (3) Biological Variables (Bhasin and Bhasin 1997).

1.1 Physical Environment

1. *Climate*: (a) Collection of area maps and contour maps of various regions; (b) Collection of recorded data from Meteorology Department regarding photo period solar radiation, diurnal variation in temperature, rainfall etc.

2. *Forest*: Collection of data and/or literature on forest types and the relative importance of various forest trees in the contribution of major and minor forest produce.

3. *Flora and Fauna*: (a) Collection of data and/or literature on the flora and fauna of the region; (b) Collection of data and/or literature and information on plant and animal resources in relation to their ethnobotanical and ethno-zoological interests.

4. *Soil*: Collection of data and/or literature on soil analysis including micro-nutrients contributing to the fertility of the soil and the correction measures in case of defective soils.

5. *Water Resources*: (a) Collection of data and or literature on limnological survey of the different water resources; (b) Physico-chemical data on seasonal basis on selected water bodies; (c) Phyto-and zoo-plankton analysis on seasonal basis; (d) Study on various pollutants on physical, chemical and biological features of water.

1.2 Human Settlement, Amenities, Activities and Socio-cultural Variables

1. *Structure and Population Distribution*: This would help to understand the relation

between population pressure and source problem, estimation of population trends.

2. *Social Structure, Social Stratification, Ethnicity, Social Networks and Degree of Communication with Others*: This would help to understand the regulation of resource practices, a socio-economic stability, receptiveness to innovation, stability of present patterns distribution of existing income, availability and stability of labour force, channels for innovation, change deviation, disease, commerce, alternative life changes etc. Factors if any for the decrease in the population group(s) under study.

3. *Study of Power Structure (Internal and External)*: This would helps to understand the decision making processes as effects existing and changing planning processes.

4. *Social Disorganization and Conflict*: This would help to understand effects of disruptive social processes and social problems.

5. *Impact of Various Development Programmes and Facilities on Life way of the People*: (a) Communication and Transport (b) Medical Facilities (c) Educational Facilities (d) Drinking Water (e) Market (f) Postal Facilities (g) Electricity Supply (h) Agriculture (i) Horticulture (j) Animal Husbandry (k) Industry (l) Tourism

6. *Making a Living*: (a) Land Utilization (b) Agriculture (c) Animal Husbandry (d) Horticulture (e) Industry

1.3. Biological Variables

Biological fitness refers to the “*health*” or “*absence of disease*” in the human organism. However, biological fitness is not independent of health in the psychological and social sense. There are a number of recognized characteristics of biological fitness.

1. *Demographic Structure*: Fertility, mortality, infant mortality, migration and sex-age composition, are useful in measuring the biological fitness of population.

2. *Genetic Structure*: Survey of genetic structure through “marker genes” would provide

an indication of a population's somatic fitness in a given environment.

3. *Biological Growth and Development*: This would help to measure physical growth, especially among children, are generally used, particularly in relation to nutritional stress.

4. *Physiological Fitness*: This would help to estimate work capacity, which can serve as an important measure of biological fitness.

5. *Nutritional Status*: Household surveys of individual intake may be linked to calorie requirements.

6. *Disease Incidence*: Diseases in populations may be generally described in term of incidence of specific diseases, based on frequencies of states classified as abnormal.

2. Methodology

The primary method of the study should be participant observation and interviews with the help of schedules (Bhasin and Bhasin 1997).

2.1 Schedule

The following schedules could be used to gather information regarding different aspects of life as well as the extent to which different development activities have affected the life of people.

Schedule No. 1 - General Schedule: This schedule is filled up at head-quarter on the basis of block records available and discussions with authorities. The schedule will give information regarding land utilization, irrigation facilities, average yield per acre of principal crops with local seeds, improved seeds, fertilizers, manures and use of pesticides etc. details of loans, insect pests and plant diseases, information regarding forest administration and control measures, soil conservation, land development, livestock data, diseases from which cattle, sheep, goat etc. suffer, number of veterinary institutions and centers, information regarding education, number of schools, primary, middle/lower, high, number of boys and girls attending the school in summer and winter and the facilities available in the schools, information regarding Public Health Care and medical facilities; Number of patients availing these facilities, information regarding cooperative societies, loan advanced, types of societies functioning and number of their member, and information regarding the industries, source of raw materials and market facilities, industrial loan, production-cum-training centers and other

activities under Community Development Programme.

Schedule No. 2 - Village Schedule: This schedule is filled at village level for information regarding the village concerned. This schedule is for collecting the village statistics relating to land utilization, irrigated area, cropping pattern, wages paid to agricultural labour, holding or ownership, livestock, industries, transport and communication facilities available, food habits, housing and culture etc. In respect of each selected village a house list is prepared for the village. This provides a listing of all houses in the selected villages along with the purpose for which used. In case of occupied houses, however, further information in respect of occupying household in regard to their occupations, nature of household industry, if any, number of members engaged in each occupation etc. is collected to serve as a basis for the selection of household for a detailed study. Data are collected regarding educational and medical facilities etc. in the village. The information for the village schedule will be obtained from the knowledgeable persons e.g. village elders, headmen etc. in consultation with the Incharge, Revenue Block concerned.

Schedule No. 3 - Household Schedule: This schedule is filled at personal level. The selection of the household is made at random on the basis of probability proportional to population. The household is taken as a group of persons normally residing together i.e. living under the same roof and taking their meals from a common kitchen unless exigencies such as work prevent them from doing so. In each of the sample village, a house-hold is selected at random from religious and ethnic groups and from each category of the households in proportion to the number of household in the village having any of the following categories of occupation, (i) Engaged in cultivation alone (ii) Engaged in cultivation-cum-industry (iii) Engaged in cultivation-cum sheep and goat rearing (iv) Engaged in cultivation-cum-industry-cum-sheep and goat rearing (v) Engaged in other occupations

This schedule provides full information about the people concerned, their views on changes and Community Development Programmes, their social and cultural life patterns, economic structure, diseases/morbidity and different health practices prevalent.

The schedule is designed, and questions are worded in such a way as to elicit the required information (of both 'current' and retrospective

kinds) completely and accurately. Cross questions are also included for this purpose.

I. General Information (a) Name of informant (b) Name of head of the household (c) Caste, Sub-caste, Schedule Caste, Scheduled Tribe (d) Income (e) Type of family etc.

II. Living Standard (a) Type of residence (b) Sanitation (c) Facilities available and utilized etc.

III. Composition of the Household (a) Members of the household (b) Their relation to the head of the household (c) Their respective ages (along with date of Birth) (d) Their respective education levels (e) Occupation (f) Separate income, if any.

IV. Information on Ages at Various Stages in Life (a) Present age (of both husband and wife) (b) Ages at menarche, menopause (c) Age at marriage (of both husband and wife).

V. Marriage and Offspring (a) Age at marriage, widowhood, separation, marriage etc. (b) Number of children, born alive, dead; Number of still-births, abortions, miscarriages etc.

VI. Performance at Each Conception (a) Age at conception (b) Result of the pregnancy (c) Duration of breast feeding (d) Postpartum amenorrhea

VII. Infant Mortality and Still Birth (a) Order of birth of the infant (b) Age, Sex (c) Symptoms observed, Cause suspected/diagnosed, Treatment given.

VIII. Any Death in the Family in the Past Five Years (a) Name of the individual (b) Age, Sex (c)

Relation to the head of the household (c) Year of death (d) Cause of death.

IX. Family Planning Practices (a) Understanding of family planning (b) Knowledge of family planning methods (c) Type of method used/not used (d) Reasons for using/not using (e) Ideal number of children preferred.

X. Health and Disease Prevalence (a) The concept of disease, health and traditional health practices (b) Diseases incidence (c) Medical facilities available and frequency of its utilization (d) Methods relating to preventive health care, sanitation and personal hygiene, food habits (e) Disease and its curative which are being used by people or indigenous health practices prevalent (f) Names of herbs and plants used for cure (g) Diseases for which any modern medical facilities are availed and for which only traditional practices are used (h) Clean water supply. Apart from this, any additional information that could be gathered during the course of the interview will also be noted. This schedule is made to assess the nutritional status of the people. This will be filled at personal level and it will provide us with information regarding (1) Hygienic condition (2) Nutrition

2.2 Laboratory Techniques

For Biological (Schedule No. 4) and Genetic (Schedule No. 5) variables standard techniques are to be used.

APPENDIX 2

Key statistics related to basic indicators, nutrition, health, education, demographics, economics, women, child protection, and rate of progress is presented as appendix 2.

Basic Indicators

Under-5 mortality rank	49
Under-5 mortality rate, 1990	115
Under-5 mortality rate, 2006	76
Infant mortality rate (under 1), 1990	82
Infant mortality rate (under 1), 2006	57
Neonatal mortality rate, 2000	43
Total population (thousands), 2006	1151751
Annual no. of births (thousands), 2006	27195
Annual no. of under-5 deaths (thousands), 2006	2067
GNI per capita (US\$), 2006	820
Life expectancy at birth (years), 2006	64
Total adult literacy rate, 2000-2005*	61
Primary school net enrolment/ attendance (%), 2000-2006*	84

Nutrition

% of infants with low birth weight, 1999-2006*	30
% of children (2000-2006*) who are: exclusively breastfed (<6 months)	46
% of children (2000-2006*) who are: breastfed with complementary food (6-9 months)	56
% of under-fives (2000-2006*) suffering from: underweight, moderate & severe	43
% of under-fives (2000-2006*) suffering from: underweight, severe	16
% of under-fives (2000-2006*) suffering from: wasting, moderate & severe	20
% of under-fives (2000-2006*) suffering from: stunting, moderate & severe	48

<i>Health</i>	<i>to the top</i>
% of population using improved drinking-water sources, 2004, total	86
% of population using improved drinking-water sources, 2004, urban	95
% of population using improved drinking-water sources, 2004, rural	83
% of population using adequate sanitation facilities, 2004, total	33
% of population using adequate sanitation facilities, 2004, urban	59
% of population using adequate sanitation facilities, 2004, rural	22
Immunization 2006, 1-year-old children immunized against:, TB, corresponding vaccines: BCG	78
Immunization 2006, 1-year-old children immunized against:, DPT, corresponding vaccines: DPT1&	78
Immunization 2006, 1-year-old children immunized against:, Polio, corresponding vaccines: DPT3&	55
Immunization 2006, 1-year-old children immunized against:, Polio, corresponding vaccines: polio3	58
Immunization 2006, 1-year-old children immunized against:, Measles, corresponding vaccines: measles	59
Immunization 2006, 1-year-old children immunized against:, HepB, corresponding vaccines: HepB3	6
Immunization 2006, 1-year-old children immunized against:, Hib, corresponding vaccines:Hib3	-
Immunization 2006, % newborns protected against tetanus	82.9
% under-fives with suspected pneumonia taken to an appropriate health-care provider±, 2000-2006*	69
% under-fives with diarrhoea receiving oral rehydration and continued feeding, 2000-2006*	32
<i>Education</i>	
Youth (15-24 years) literacy rate, 2000-2006*, male	84
Youth (15-24 years) literacy rate, 2000-2006*, female	68
Primary school enrolment ratio 2000-2006*, gross, male	123
Primary school enrolment ratio 2000-2006*, gross, female	116
Primary school enrolment ratio 2000-2006*, net, male	92
Primary school enrolment ratio 2000-2006*, net, female	86
Secondary school enrolment ratio 2000-2006*, gross, male	63
Secondary school enrolment ratio 2000-2006*, gross, female	50
Secondary school attendance ratio (2000-2006*), net, male	64
Secondary school attendance ratio (2000-2006*), net, female	58
<i>Demographics</i>	
Population (thousands), 2006, under 5	126843
Population annual growth rate (%), 1970-1990	2.2
Population annual growth rate (%), 1990-2006	1.8
Crude death rate, 1970	16
Crude death rate, 1990	10
Crude death rate, 2006	8
Crude birth rate, 1970	38
Crude birth rate, 1990	32
Crude birth rate, 2006	24
Life expectancy, 1970	49
Life expectancy, 1990	59
Life expectancy, 2006	64
Total fertility rate, 2006	2.9
% of population urbanized, 2006	29
Average annual growth rate of urban population (%), 1970-1990	3.5
Average annual growth rate of urban population (%), 1990-2006	2.6
<i>Economics</i>	
GNI per capita (US\$), 2006	820
GDP per capita average annual growth rate (%), 1970-1990	2.2
GDP per capita average annual growth rate (%), 1990-2006	4.4
Average annual rate of inflation (%), 1990-2006	6
% of population below US\$1 a day, 1995-2005*	34
% of central government expenditure (1995-2005*) allocated to:, health	2
% of central government expenditure (1995-2005*) allocated to:, education	2
% of innermost government expenditure (1995-2005*) allocated to:, defence	13
ODA inflow in millions US\$, 2005	1724
ODA inflow as a % of recipient GNI, 2005	0
Debt service as a % of exports of goods and services, 1990	25
Debt service as a % of exports of goods and services, 2005	18

<i>Women</i>	
Life expectancy: females as a % of males, 2006	105
Adult literacy rate: females as a % of males, 2000-2006*	66
Enrolment and attendance ratios: females as a % of males, net primary school 2000-2006*, enrolled	93
Enrolment and attendance ratios: females as a % of males, net primary school 2000-2006*, attending	101
Enrolment and attendance ratios: females as a % of males, net secondary school 2000-2006*, enrolled	-
Enrolment and attendance ratios: females as a % of males, net secondary school 2000-2006*, attending	91
Contraceptive prevalence (%), 2000-2006*	56
Antenatal care coverage (%), 2000-2006*	74
Skilled attendant at delivery (%), 2000-2006*	47
Institutional deliveries (%), 2000-2006*	41
Maternal mortality ratio†, 2000-2006*, reported	300
Maternal mortality ratio†, 2005, adjusted	450
Maternal mortality ratio†, 2005, Lifetime risk of maternal death. 1 in:	70
<i>Rate of Progress</i>	
Under-5 mortality rank	49
Under-5 mortality rate, 1970	192
Under-5 mortality rate, 1990	115
Under-5 mortality rate, 2006	76
Average annual rate of reduction (%)T, 1970-1990	2.6
Average annual rate of reduction (%)T, 1990-2006	2.6
Reduction since 1990 (%)T	34
GDP per capita average annual growth rate (%), 1970-1990	2.2
GDP per capita average annual growth rate (%), 1990-2006	4.4
Total fertility rate, 1970	5.4
Total fertility rate, 1990	4
Total fertility rate, 2006	2.9
Average annual rate of reduction (%), 1970-1990	1.5
Average annual rate of reduction (%), 1990-2006	2

*: Data refer to the most recent year available during the period specified in the column heading.

+: The maternal mortality data in the column headed 'reported' are those reported by national authorities. Periodically, UNICEF, WHO and UNFPA evaluate these data and make adjustments to account for the well-documented problems of underreporting and misclassification of maternal deaths and to develop estimates for countries with no data. The column with 'adjusted' estimates for the year 2000 reflects the most recent of these reviews.

Sourced from: http://www.unicef.org/infobycountry/stats_popup10.html