CHAPTER XII

POPULATION AND ENVIRONMENT IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT IN NEPAL

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1. Population and Environment in the Context of Sustainable Development

Environment is an essential component of development and that environmental realm does not exist separate from human actions, needs, and aspirations. In fact environment and population are two sides of the same coin. The interpretation of their existence in isolation only suggests the naivety and the lack of understanding of the complexity of human-environment interrelationships. They are inexorably interlinked and that these problems cannot be treated separately. According to WCED (1987:37)

> "Development cannot subsist upon a deteriorating environmental resource base; the environment cannot be protected when growth [population] leaves out of account the costs of environmental destruction."

Development customarily refers to economic progress that aims to meet the needs of people. However, a focus on meeting the needs of growing population is rather simplistic or incomplete view. A more precise conceptualization should incorporate economic and ecological parameters within the framework of development. While this conceptualization is commonly known as sustainable development (Redclift, 1991), some authors have referred to this as co-evolutionary development as well (Norgaard, 1984). Thus, over the years, whereas the focus of development has been on fulfilling human needs and aspirations, there has been increasing realization that efforts to meet the needs of current population should not compromise the ability of future generations (WCED, 1987).

Meeting human needs and enhancing the quality of life i.e.. development, requires important demands on the environment. It is people who make the demand and in terms of sustainable development people should recognize that the limits of sustainability have structural as well as natural origins (Redclift, 1991). Chambers (1986) pointed out that environment and development are means not end in themselves and that environment and development are for people, and not people for environment and development. Thus, there is a clear link between population, environment, and sustainable development. Growth of population brings a challenge to development

and that additional demand on environment is imperative. Sustainable development in this regard aims at economic planning and management that does minimum damage to ecological processes without hurting human aspirations for economic and social improvement.

Keeping a balance between productive potential of ecosystem with a minimal or no damage of its environment and increase in human welfare which can cope with increasing numbers is a very critical issue of contemporary society. A focus on production increase to cope with increasing population should ensure that production itself does not degrade resources beyond a certain point. Population should be considered with ecological sustainability with a view that in a particular resource base and technological context sustainable development presupposes an upper limit of demand beyond which the resource system shows signs of stress and looses its regenerative capacity.

2. Population and Environment: The Interrelationships

The relationship between population and environment is complex and this complexity is further reinforced by the numerous dimensions of each factor. It is obvious that people modify their environment, the population in turn is also affected by changes in the environmental conditions. The interdependence between them is so critical that human beings cannot exist without environment and environment does not have any meaning without people. While the interrelationships unfold over space through time, the socioeconomic factors play an important role in mediating the relationships.

2.1 Theoretical Nexus

Misunderstandings surround, our knowledge of the interrelationships between population and environment. Attempts to understand the interrelationships have just begun (UNEP, 1993; ESCAP, 1993). The overall impression is such that over time population increases and its increased size puts pressure on the environment and its resources beyond their regenerative capacity. There has been a presumption that the impact of population growth is always negative. These notions are too simplistic and that they are distortions of reality.

The issue of population is not only about its size but also about its structure, quality, and pattern of distribution. Population size alone is not the sole factor for environmental changes, it is the consumption level, pattern, and the technology that play a vital role in the overall environmental changes of an area. This in turn is related to the socio-economic structure of the society. In a

similar manner, the institutions primarily political, social, and economic have important say in the overall changes of the environment.

The literature suggests two major viewpoints about the exact relationships of population growth and environmental changes. Ehrlich and Ehrlich (1990) take a view that environmental deterioration is the direct consequence of population growth. They argue that population growth causes a disproportionate negative impact on the environment and that redistributing population would be a dangerous pseudo solution to the population problem. In their original formulation, Ehrlich and Holdren (1971) suggested that the total impact of a society on the eco-system can be expressed as:

$$\mathbf{I = P.* F.}$$

where I stands for total impact; P means population size; and F stands for impact per capita.

Commoner et al (1971), view that population plays a role in the environmental deterioration, however it is not the major detriment of the environmental crisis. For them other variables such as technology play a much more significant role in the ecological crisis. Accordingly, technological changes are more important than mere population size and the impact per capita. In a simple term the interrelationship of population and environment can be expressed as:

$$\mathbf{I} = P * A * T$$

where I is a measure of environmental impact, P stands for an index of population, A is per capita consumption, and T is a measure of environmental damage done by technology used in supplying each unit of consumption.

2.2 Schematic Presentation

Figure 1 attempts to summarize the interrelationships between population and environment. The left panel shows population and its various dimensions whereas the right panel shows selected dimensions of environment. The issue of population is not only related to its quantity i.e., size, structure, growth, and distribution, but also with the quality. The indicators of quality of population include level of education, health, technical skills and tastes (values) some of which citizens may have developed through their culture. In addition, the behavioral aspect of population including fertility, mortality, nuptiality and migration have direct ramification on the utilization of environment.

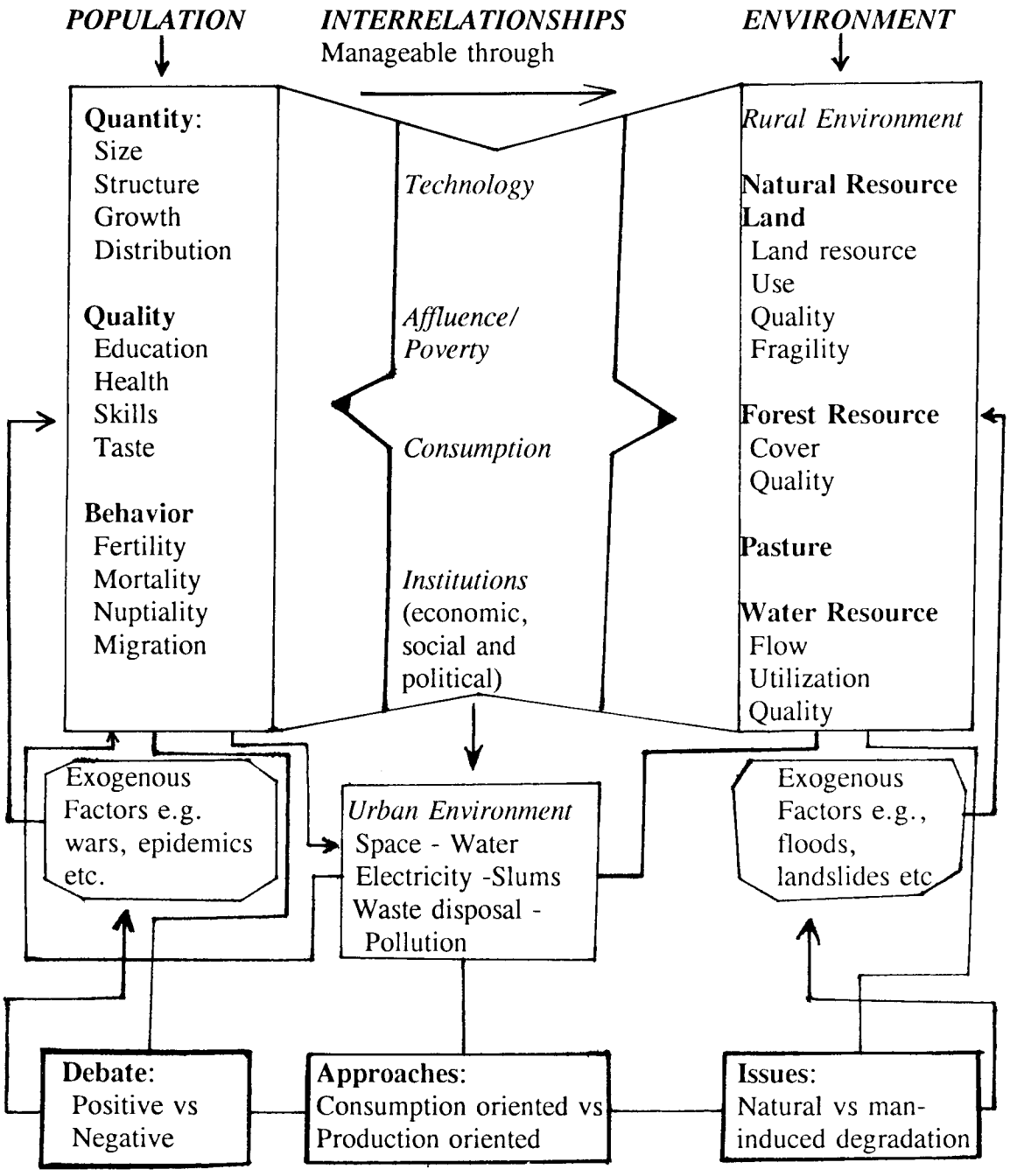
Likewise, environment in general is translated as the natural resource base. In the context of developing countries such as Nepal the most commonly used environmental resources include land, forest, water, and pasture and that their quality, coverage and level of utilization are equally important as that of their magnitude. The middle panel specifies the critical variables from which the impact and the interactive relationship between population and environment materializes. This signifies that the use/misuse, utilization and assessment of carrying capacity is manifested through existing technology, affluence/poverty, consumption level and efficiency (or misconduct) of existing social, economic and political institutions.

The lower middle panel specifies the attributes of urban environment. Commonly observed urban environmental issues in the countries such as Nepal include space, slums/squatters, water supply, electricity, waste disposal, and various kinds of pollution. Whereas the quality of urban environment is influenced by the intermediate variables of the middle panel i.e., technology, consumption, affluence, and institutions, this (urban environment) is also a manifestation of size and distribution pattern of population of the country. The level of urbanization, in turn, help modify fertility behavior and social quality of population. Whereas the interrelationship between population and environment is interactive, it is also dynamic and that any change in the components of each of these variables will have corresponding impact on the other variables. Similarly, an introduction of a new technology, a change in consumption level and institutional commitment will bring significant changes in the existing relationships between population and environment.

Further complexity arises when exogenous factors enter into this realm. Disease epidemics, wars, and political turmoil bring instability in the existing structure of population component, thereby the nature of relationship with the environment. Likewise, natural disasters such as flood, landslides, earthquakes, volcanoes function as the exogenous factors for environmental component. These exogenous impacts severely constrain the existing status of environmental resource base and in turn limit its carrying capacity of population. This upsets the existing population-environment relationships and thus inhabitants are compelled to readjust as well as react.

Figure 1

Population and Environment Relationships: A Schematic Diagram



The bottom panel identifies issues, approaches and debates commonly found in the literature about population, its behavior and the nature of environmental problems. Scholars such as Simon (1981) argue that because people are the ultimate resource, there is little or no reason to be pessimistic about population growth. On the other hand, there are those who take the pessimistic perspective and relating population with world food situation, argue that food situation has reached a precarious state and in the long run substantial further growth is considered simply unsustainable (Ehrlich and Ehrlich, 1990; Bongaarts, 1993)).

While some scholars such as Malthus, take consumption oriented approach to population and warn that any additional number is burdensome, others take a production-oriented approach and argue that population growth is not necessarily a bad idea (Boserup, 1968) simply because the new generation also brings talent and earning hands with them. Even concerns about whether humans are the sole agents of environmental degradation or nature itself has some bearing on it has remained an issue in the study of human - environment relations. Thus, the list in the bottom panel (Figure 1) shows the complexity and unsettled issues of population and environment as well as their roles. Moreover, this also helps to further our understanding of the complexity of population and environmental problems.

In the context of a poor country such as Nepal it is doubtful that we can make a real assessment of population and environmental relations through this scheme and equation. Firstly, data required are complex and that our data base is poor and not always reliable. Secondly, apart from the variables mentioned in the equation above, other factors such as poverty and the existing institutions may have played a more important role in the environmental changes that have taken place so far. Ananalysis of time period for massive destruction of forest in the recent history clearly justifies this. Moreover, existing regional disparity suggests that a single framework for the whole nation is not practical and thus adds a further complexity in the already complex problem of comprehensive assessment of population and environment in Nepal.

2.3 The Case of Nepal

Nepal is a special case where population has been increasing rapidly and even at low level of consumption and technology, the overall impact on environment looms more negative than otherwise. Most of the existing studies dealing with overall national scenario of population and environment in Nepal have portrayed a grim picture and bleak prospect for future (Shrestha, 1993;

Pudasaini, 1993; Pant, 1992). Overpopulation is blamed for the increased pressure on resources such as land and that the poor and the landless have been seriously affected by overpopulation at the local level (Shrestha, 1982). It is true that the environmental situation is not encouraging, however, it should be recognized that contrary to these observations, some local level studies especially from the eastern Hills have shown positive effects of population growth as well (Subedi, 1993; Dahal, 1983).

2.3.1 National Scenario: The Rural Environment

The national scenario of the main issues of population and environment can be summarized into several components, the main of which is the dynamics of land use.

With the growth of population, significant changes in land use have taken place over the years. The most notable change has taken place in agriculture, pasture land, and forest. Sixth Plan (1980-1985) reports that in 1974 the total land under agriculture was 16.5 per cent. The same document also reports that in 1979 the total land under agriculture reached 22.2 per cent, an increase by 5.7 per cent. Similarly, according to the Eighth Plan (1992-1997), total agriculture land accounts for 26.5 per cent of the total area of the country. This is indicative of significant change in bringing other land uses under agriculture. Increase in total agriculture land cannot be considered either positive or negative in itself. However, the fact that most recent increase in agriculture land are slope and marginal lands which are less productive plus environmentally sensitive means that the direction of change is incongruous to keep a better harmony between environment and population. This is because these slope and marginal land are among those which are most vulnerable to natural hazards such as landslide and soil erosion.

Change in area under agriculture is reflective of population growth and their ever increasing needs. Whereas bringing other land uses under cultivation has remained the main coping strategy with population growth thus far, the future prospect of land expansion for agriculture is minimal primarily in the Hills and Mountains. Reports suggest that it has already reached limits (Banskota, 1992). It is to be noted that even the better lands in Terai, the only frontier left, has been brought under cultivation. This insinuates too negative a picture and this is not the whole story. Some positive changes such as inter-cropping, multiple cropping, intensification, and an increase in cropping intensity, have also taken place. However, these positive changes have become muted in the face of huge negative impacts of population growth. Similarly, contrary to what has been advocated by

the extreme environmentalists not only areas cultivated for the food grains have increased production of food grains has increased at rates higher than the rate of population growth (Acharya, 1993). In terms of productivity however, there are mixed outcomes. Reports suggest that while productivity of some crops has declined it has increased or remained stable for others (Acharya, 1993, Banskota, 1992).

Whereas agriculture land has increased, the proportional share of pasture land has decreased. A cursory examination of government's plan documents clearly justifies this. Of the total land resource 12.7 per cent was used as pasture land in 1974. Data for 1979 report that same proportion of total land resource was devoted for pasture land. A decline in the total percentage of pasture land is evident after 1979. By the Eighth Plan the total pasture land comprised of only 1 1.8 per cent of the total land of the country showing a decline by 0.9 per cent (NPC, 1992). This decrease is primarily attributed to its conversion into agriculture land over the years.

Structurally, the landscape of the country is composed of young mountains. Thus, the terrain is naturally fragile, erodible and inaccessible. More importantly, human factors have further accelerated this process and a report indicated that approximately 53 per cent of landslides in Nepal were man-made (NPC, 1985). Human misuse such as cultivation in slopes greater than 30 degrees, and terracing without proper drainage consideration has further accelerated the process of erosion and landslide. Frequent floods in the Terai, change in the course of river such as Koshi, substantial loss of top soil from the farm lands as well as loss of human lives have become common features of Nepalese life over the years.

Areas under forest have undergone similar changes. However, available data are often in conflict about the direction of change in areas under forest. Earlier studies have reported heavy deforestation in the Terai during 1960s and 1970s and that this process has not stopped even though the extent has decreased. From 1950 to 1985, 103,968 hectares of forest land was cleared for settlements (Bhatta, 1992). Master Plan for Forestry Sector (FSMP) estimated that the average annual loss of forest area from 1978/79 to 1984/85 was 7,566 ha. or 0.14 per cent of the natural forest (HMG/ADB/FINNIDA,1988). If we consider the figures documented in the various periodic plans, the picture is complex. Eighth Plan documents that of the total land (14,855,0042 ha.), 42.4 per cent (i.e., 96, 306, 460 ha.) is forest land while the Sixth Plan (1980-1985) recorded that only 29.1 per cent of the total land of the country was covered by forest.

In a poor country such as Nepal, the extent and pace of forest depletion is more critical than the proportion of forest cover in the total area of the country. Degradation and change in crown cover of forest is a fact of Nepalese natural landscape and that such a degradation is more serious in the Hills. FSMP (1988) demonstrates that from 1979 to 1985, approximately 219,300 ha of forest land was degraded due to over cutting to meet the increasing demands of people and livestock. Studies have further reported that between 1964 and 1985 area under forest cover was reduced by 22,800 ha. per year (LRMP, 1986) and that effective reforestation was hardly 8.7 per cent of the reduced forest area (Bhatta, 1992). The loss of forest land is normally attributed to conversion into cultivated land, cutting for fodder and fuel wood (Bajracharya, 1983), and occasional fire by the herders.

2.3.2 **The Urban Environment**

The level of urbanization in Nepal is very low by any standard but the percentage of total population living in urban areas is increasing over the decades. The proportion of urban population has increased from 2.9 per cent in 1952/54 to 9.2 per cent in 1991 and that the absolute number has increased from 238,275 in 1952/54 to 1,695,719 in 1991. During the same period the number of urban localities has increased from 10 in 1952/54 to 33 in 1991 (currently 36 in total). While the country's total population has grown by 2.1 per cent per annum between 1981 and 1991, the urban population has grown by 4.47 per cent per annum for the same period. Several factors are responsible for such a rapid growth of urban population. Whereas the role of rural-urban migration and reclassification (incorporation) is substantial, the contribution of natural growth is considerable.

While urban population has grown rapidly over the years, considerable changes have taken place in the urban landscape. These changes are more articulate over the last two decades and a careful observation of Kathmandu clearly justifies this. Land use competition is stiff. Over the years hundreds of hectares of prime agriculture land has been encroached for urban uses. Likewise a significant portion of public lands are also brought under urban uses. A study reported that between 1971 and 1981, about 40 per cent of agriculture land of Kathmandu and 27 per cent of Lalitpur were converted into urban complex (PADCO, 1984).

Solid waste collection and its disposal has become a major problem in the urban areas primarily in Kathmandu city. Waste left to decompose at open space, streets corners, and river banks has become a normal feature of urban landscape in Kathmandu. At least 42 per cent of the households

are recorded to disposing their waste in the open space and street (EMA, 1992). The total solid waste generated from three municipalities of Kathmandu valley is estimated to be 284 tons per day. Of the total waste generated, 16.5 per cent (47 ton/day) is industrial, commercial, and institutional waste and the rest is domestic waste (ICIMOD, 1993). While 213 ton is collected, 71 ton is left to decompose in the street corners, open spaces, and river banks resulting into repugnant odor and unpleasant sight of the cities.

Households' access to piped sewerage system is limited. The existing pipes are very old and that leakage is not uncommon. Of the total households only 17 per cent have an access to piped sewerage in Kathmandu and this proportion is 34 and 64 per cent for Lalitpur and Bhaktapur respectively (EMA, 1992). Very limited sewerage treatment facilities exist and most of them are largely non-functional.

Rapid population growth, poverty, and absence of off-farm employment in the rural areas have collectively contributed to the increased rural-urban migration in recent years. The growth of informal sector in urban areas has reinforced the migration process by providing employment, though limited to the new comers. Because cities, primarily Kathmandu and Lalitpur, are faced with limited living spaces, one consequence of increased rural-urban migration is the growth of slums and squatters. In Kathmandu, squatters have surfaced as a common vista of urban landscape from 1970s and that by 1988, 39 such localities of considerable size were already developed (Gajabasiddi, 1988). Majority of these settlements are located along the river banks and solid waste dumping areas. The problem of squatter settlement is not limited to Kathmandu city, the cities of Biratnagar, Pokhara are also faced with this problem. At least 7 such settlements in Biratnagar mainly around mill areas (MSTP, 1987) and 13 in Pokhara have been recorded (Kansakar, 1988). These squatters are devoid of essential services except electricity. The result is a further deterioration of already filthy urban environment.

Haphazard establishment of industries in urban areas primarily in Kathmandu has further aggravated the problem of urban environment. Unregulated and mushroomed garment and carpet industries and their untreated effluent discharged directly into rivers have not only polluted the river water of Kathmandu valley, they are equally responsible for air pollution and filthy environment. Untreated sewage from Kathmandu and Patan together with industrial effluent has not only exceeded the selfpurification capacity, but also Bagmati has turned into an open sewerage especially between Thapathali and Chobhar (ICIMOD, 1993).

While the water supply situation in Kathmandu is already in a crisis point, the level of fecal bacteria is alarming. This bacterial contamination gradually increases as the piped water passes through densely populated areas. A comparison of water quality in Kathmandu valley with that of WHO's acceptable level demonstrates that the quality of our drinking water is beyond imagination. While WHO's permissible level of total coliform bacteria is 3 cell number per 100 ml, sample taken from various parts of Kathmandu exceed 4800/100m1 (CEDA, 1990). Similarly, an examination of physical, chemical, bio-chemical and micro-biological components of ground and surface water found that water in Kathmandu is bacteriological unfit for drinking in both summer and winter (ICIMOD, 1993).

The above summary indicates that while existing studies attempted to describe the population and environment situation at the national level, there is a dearth of studies so far to examine the population-environment situation at the district level and with the indicators that proximately summarize the situation and existing regional diversity. In a country with vast physical diversity, ecological dimension should be the important consideration. The extent of problem of population and environment vary greatly by ecological zones and an examination of selected indicators at the district level is imperative for the objective assessment of the status of population and environment. Before doing this a review of government policies and programs on population and environment is essential.

3. Review of Government Policies and Programs

Issues of population and environment have become an important concern of the government over the years and efforts have been to incorporate population and environmental concerns into the nation's development process. A detailed review of these policies is beyond the scope of this paper. Thus, a very brief impression of these policies as reflected in government documents is presented here.

3.1 Policies on Environment

Policies and programs of HMG on environment are stated in a number of documents of which The Eighth Plan (1992-97), Nepal Environment Policy and Action Plan (HMG, 1993), and National Conservation Strategy (HMG/IUCN, 1988) are notable. The seriousness of environmental problems was first recognized in the 1980s and the inclusion of `environment and land use policy' in the Sixth

Plan (1980-85) is one indication of this. Onwards environment has continuously obtained an important place in the government plans and programs. The focus of environment policies as documented in the Eighth Plan is on the incorporation of preventive and mitigating measures at different levels. Some specific focuses include disseminating awareness and information about environment, incentives for industries which provide continuity in environmental protection, identification of critical regions, proper attention on traditional preservation technology, extensive legal provision, and a special concern in designing and incorporating programs that minimize negative impact of environment.

The Eighth Plan including recent environmental policy document of the government (HMG, 1993) recognizes that people are both the means and end of environment. However, at the program level the fact that man is the principal actor for environmental changes is not reflected explicitly. Thus, programs reflect isolated sectoral focus and very little attention is given to integrate population and its critical role in the environmental programs.

3.2 Policies on Population

On population, although resettlement programs were in operation as early as during the late 1950s, the Third Plan (1965-70) recognized the need to slow down the growth of population and initiated the program of Nepal Family Planning and Maternal and Child Health Project in 1968. Later on, the government adopted a National population Strategy (1983), the first comprehensive population policy of the nation which took a multi-sectoral, integrated approach to population control. As Sharma (1992) points out the intent was to initiate a process whereby population policies are integrated with social and economic development programs. The Eighth Plan aims to establish adequate balance between population growth, socio-economic development and environment and thereby help citizens fulfil their basic human needs. The specific targets include reducing TFR to 4.5, IMR to 80, and CMR to 130. While it targets to reduce maternal mortality rate to 720/100,000, it aims to increase life expectancy to 61 years. In addition, regulating internal migration is also one of its targets.

The policies focus on creation of atmosphere conducive to small families, women's development and literacy, integrate family planning with primary health care, mobilize NGOs for family planning, and the development of skilled manpower. Integration of population programs in forestry, agriculture, rural development, and environment related projects has remained one of the major

elements of policy since the adoption of National Population Strategy (1983). However, at the implementation level, neither the integration process is clearly defined nor the programs have been developed yet. Further more, the institutional and management capability to translate policies into programs and actions is woefully weak. Even the sporadic programs on formal / informal education and training for women have not been able to elevate the status of women. Even after decades of heavy investment and emphasis on family planning, the achievement is not encouraging and that the contraceptive prevalence rate is still very low (24 per cent).

3.3 Critique

A review of government policies and programs related to environment and population suggests that both these issues are treated separately and in isolation. The multi-sectoral approach has not been materialized. There is a clear gap between policies and translating policies into action oriented programs. The documents indicate that both the issues are critical and planners and policy makers know this. At the program level however, there is a lack of integrated programs to bring a better harmony between population and environment. In practice, while the environmentalists are too busy disseminating the issue of "eco-crisis" and blaming on human actions perhaps at the cost of people, the actor, the demographers are too much after fertility and the prescription of technical fix such as family planning. It appears as if they consider pregnancy as a disease and contraception is the prescription. There is a need to interpret both these issues in totality of social landscape of the Community.

While the implementation mechanism is extremely weak on both sides, there is a clear need of coordination. For example, on both sectors, one of the policies is to incorporate respective issues in school curricula and dissemination of awareness in both the issues. These policies can be translated into programs in a coordinated way and attempt to this end is yet to materialize. Thus, issues have been raised, policies are set but they are lost somewhere between programs and implementation.

4. A Framework for Assessing Population-Environment Status and Its Relationships

We have already noted that our data base is poor and that assessing status of population and environmental status and relationships is very difficult. However, on the basis of available data, a simple framework has been applied which includes several elements (indicators) of population and

environment. These indicators are selected in such a way that they can be understood very easily and that they provide a proximate summary of the general status of each of the two major components, i.e.., population and environment. The indicators utilized are selective and not exhaustive. The main purpose here is to propose an assessment scheme so that future refinements can be made and discussion followed. It is to be noted that depending upon the availability and reliability of data, this framework can be extended to include other indicators as they become available and critical.

For population, most recent intercensal growth rate (1981-1991) and density (1991) are taken as the main indicators of population dynamics. These are basic and for which data are available, accessible and most importantly reliable. Similarly, for the assessment of environmental status seven indicators have been selected. These include: a) relief ratio, b) percentage of area with $>30^0$ slope i.e.., environmentally sensitive area, c) percentage of non-forested and degraded forest, d) cropping intensity, e) fodder situation, f) fuel wood condition and g) food balance. District level details for all these indicators have been collected. The districts have been categorized into four groups depending upon the value of each of the indicators. These four groups have been identified in such a way that while the first two refer to positive values, the last two groups refer to negative values.

4.1 The Status of Population

4.1.1 Growth Rate

Intercensal growth rate and crude density of population are the two indicators taken to assess the population status at the district level. On the basis of ecological zones, while most of the Mountain districts show either low or medium growth rate, all the Terai districts (except Mahottari) show a very high growth of population (Table 1). Among 21 districts with a gro-wth rate of less than 1.0 per cent one-third is from the Mountains and the rest from the Hills. Data suggests that even though most of the Mountain districts have low growth, for some reasons, Bajura, and Humla, are an exception where the growth rate exceeds 2.0 per cent. At least three districts namely, Mugu, Manang, and Taplejung have a negative growth rate.

The situation in the Hills is complex and that Hill districts are spread over all the four categories of growth rates. Even the distribution does not show a clear pattern in terms of east west direction.

While 14 out of 39 show a low growth rate, there are seven districts that are critical. These include Ilam, Udayapur, Lalitpur, Kathmandu, Makwanpur, Kaski, and Surkhet. These are the ones that have growth rate of more than 2.0 per cent.

Table 1: Distribution of Districts by Population Growth Rates, 1981-1991

Ecological Zone	Low (upto 1.0 per cent) (A)	Medium (1.0-LS per cent) (B)	High (1.5-2.0 per cent) (C)	Very High (> 2.0 per cent) (D)
Mountain	Taplejung, Sankhuwasabha, Solukhumbu, Jumla, Mugu, Kalikot, Manang (7)	Dolakha, Sindhupalchok, Mustang, Dolpa, Bajhang, Darchula (6)	Rasuwa (1)	Humla, Bajura (2)
Hill	Bhojpur, Khotang, Okhaldhunga, Kavre, Bhaktapur, Gorkha, Lamjung, Syangja, Mygdi, Baglung, Palpa, Rolpa, Achham, Doti (14)	Panchthar, Terhathum, Dhankuta, Dhading, Parbat, Gulmi, Arghakhanchi, Pyuthan, Dailekh, Jajarkot, Baitadi (11)	Ramechhap, Sindhuli, Nuwakot, Tanahun, Dadeldhura, Rukum, Sallyan (7)	Ilam, Udayapur, Lalitpur, Kathmandu, Makwanpur, Kaski, Surkhet (7)
Terai			Mahottari (1)	Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusa, Sarlahi, Rautahat, Bara, Parsa, Chitawan, Nawalparasi, Rupandehi, Kapilvastu, Dang, Banke, Bardiya, Kailali, Kanchanpur(19)

Source: Based on Population Census, 1991.

Note: The symbols i.e.., A, B, C, and D, in the parenthesis indicate rankings where A = Relatively Better, B = Good, C = Poor, and D = Very Poor.

4.1.2 Density

Another indicator of population status is its density. Among the Mountain districts 13 have a crude density of 50 persons per sq.km. Only three mountain districts namely, Kalikot, Sindhupalchok, and Dolakha have a density of more than 50 persons per sq. km. and that none of these districts exceed a density of 103 persons per sq. k.m. The Hill districts have a complex picture. Fifteen out of thirty-nine have a density of 125 persons or less whereas twenty-four exceed 126 persons per sq. k.m. (Table 2).

Table 2 : Population Density by District, 1991 (persons/ Sq. km.)

Ecological Zone	< 50 (A)	51 - 125 (B)	126 - 200 (C)	> 200 (D)
Mountain	Taplejung, Sankhuwasabha, Solukhumbu, Rasuwa, Manang, Mustang, Dolpa, Jumla, Humla, Mugu, Bajhang, Bajura, Darchula (13)	Dolakha, Sindhupalchok, Kalikot (3)		
Hill	Myagdi (1)	Udayapur, Ramechhap, Sindhuli, Gorkha, Lamjung, Rolpa, Rukum, Sallyan, Dailekh, Surkhet, Jajarkot, Achham, Doti, Dadeldhura (14)	Panchthar, Ham, Terhathum, Bhojpur, Dhankuta, Khotang, Okhaldhunga, Makwanpur, Dhading, Tanahun, Kaski, Baglung, Arghakhanchi, Palpa, Pyuthan, Baitadi (16)	Kavre, Bhaktapur, Lalitpur, Kathmandu, Nuwakot, Syangja, Parbat, Gulmi (8)
Terai		Dang, Banke, Bardiya (3)	Chitawan, Kailali, Kanchanpur (3)	Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusa, Mahottari, Sarlahi, Bara, Parsa, Rauthat, Rupendehi, Nawalparasi, Kapilvastu. (14)

Source: Population Census, 1991.
Note: The symbols i.e.., A, B, C, and D, in tire parenthesis indicate rankings where A = Relatively Better, B= Good, C = Poor, and 1) - Very Poor.

Critical 11111 districts in terms of density are from central and western Hills. Eight of them belong to very poor category and they have a density of more than 200 persons per sq. km. These Include Kavre, Bhaktapur, Lalitpur, Kathmandu, Nuwakot, Syangja, Parbat, and Gulmi. As normally expected 70 per cent of the Terai districts have a density of more than 200 persons. Among the remaining 30 per cent i.e.., six districts, three namely Chitawan, Kailali, and Kanchanpur have a density between 126 to 200 persons. Similarly, Dang, Banke, and Bardiya are the only districts which have a density of less than 125 persons. Clearly, while the Mountains have low density, the Terai has high density. Owing to the differential physical quality of ecological zones this high/low density should be interpreted carefully. This means that the low density in the Mountains does not necessarily mean that there is a prospect for future population growth.

4.2 The Status of Environment

Based on the available data the district level environmental status has been assessed with regard to seven indicators. Before developing a single index, each indicator will be discussed briefly and the status of the districts assessed. Relief ratio is one indication of the physical quality of an area and a higher value suggests its unsustainablity for further expansion of cultivation and other economic activities.

4.2.1 Relief Ratio

Relief ratio is an expression of landscape configuration based on elevation and that higher the ratio is indicative of poor situation in terms of agricultural expansion'. The regional analysis of relief ratio in Nepal suggests that all the Mountain districts have a value greater than 30. Among them the situation of 8 districts i.e.., 50 per cent, is very poor where the slope ratio is greater than 45. These include Dolpa, Humla, Kalikot, Mugu, Mustang, Manang, Rasuwa, and Solukhumbu.

Table 3: Distribution of District by Relief Ratio

Ecological Zone	< 15 (A)	15 - 30 (B)	30 - 45 (C)	> 45 (D)
Mountain			Darchula, Bajhang, Bajura, Jumla, Sindhupalchok, Dolakha, Sankhuwasabha, Taplejung (8)	Kalikot, Humla, Mugu, Dolpa, Manang, Mustang, Rasuwa, Solukhumbu (8)
Hill		Achham, Doti, Dailekh, Kaski, Lamjung, Tanahun, Dhading, Nuwakot Makwanpur, Ramechhap Sindhuli, Udayapur, Ilam (13)	Baitadi, Dadeldhura, Jajarkot, Pyuthan, Rolpa, Rukum, Sallyan, Surkhet, Arghakhanchi, Gulmi, Baglung, Parbat, Myagdi, Gorkha, Syangja, Kavre, Bhaktapur, Kathmandu, Lalitpur, Bhojpur, Khotang, Okhaldhunga, Dhankuta, Terhathum, Panchthar (25)	Palpa (1)
Terai	Kailali, Kanchanpur, Kapilvastu, Nawalparasi, Rupandehi, Parsa, Bara, Rautahat, Sarlahi, Siraha, Saptari, Morang, Sunsari, Jhapa (14)	Banke, Bardiya, Dang, Chitawan, Dhanusa, Mahottari (6)		

Source: Calculated from LRMP Data, 1986.
Note: A = Relatively Better, B = Good, C = Poor, and D = Very Poor.

Most of the Hill districts fall under poor category. Only 13 out of 39 districts are categorized as those with good relief ratio (Table 3). Under the existing condition, 70 per cent of the Terai districts i.e.., 14 districts, fall under relatively better condition. However, of the Terai districts, the relief ratio for 6 districts (i.e.., 30 per cent) is described as good only. Overall, Terai districts have better condition and this is followed by the Hill districts. The situation in the Mountain districts is considered rather worse.

4.2.2 Proportion of Area > 30^0 Slope

Area with greater than 30° slope are generally considered unsuitable for agriculture and thus environmentally sensitive. A higher percentage of such area in a district means higher sensitivity of that district in terms of land expansion for cultivation. This also means that chances of landslides and soil erosion are higher if such an area is brought under cultivation. Fifty per cent or more area of all the Mountain districts have a slope greater than 30° and that 75 per cent of these districts have more than 75 per cent of their area under this category (Table 4).

Table 4:Distribution of Districts by Percentage of Area with > 30° Slope

Ecological Zone	< 25 Per cent (A)	25 - 50 Per cent (B)	50 -75 Per cent (C)	> 75 Per cent (D)
Mountain			Jumla, Dolakha, Sankhuwasabha, Sindhupalchok (4)	Darchula, Bajhang, Bajura, Dolpa, Humla, Mugu, Kalikot, Manang, Mustang, Rasuwa, Solukhumbu, Taplejung (12)
Hill	Bhaktapur, Kathmandu (2)	Sallyan, Syangja, Lalitpur, Nuwakot, Bhojpur, Dhankuta, Terhathum, Panchthar, Ilam (9)	Baitadi, Dadeldhura, Achham, Doti, Dailekh, Jajarkot, Pyuthan, Rolpa, Surkhet, Arghakhanchi, Baglung, Parbat, Palpa, Gulmi, Lamjung, Tanahun, Dhading, Kavre, Makwanpur, Ramechhap, Sindhuli, Khotang, Okhaldhunga, Udayapur (24)	Rukum, Gorkha, Kaski, Myagdi (4)
Terai	Kanchanpur, Bardiya, Kapilvastu, Rupandehi, Bara, Parsa, Rautahat, Dhanusa, Mahottari, Sarlahi, Siraha, Saptari, Sunsari, Morang, Jhapa (15)	Kailali, Banke, Nawalparasi, Chitawan (4)	Dang (1)	

Source: Based on LRMP, 1986.
Note: A = Relatively Better, B = Good, C = Poor, and D = Very Poor.

Among the Hill districts 24 districts are considered poor in terms of sensitivity of area. The situation is categorized as critical for four of them and these include Myagdi, Rukum, Kaski, and Gorkha. Most of the Terai districts fall under "relatively better" category. Only four districts namely Kailali, Banke, Nawalparasi, and Chitawan are categorized as those with good condition. In general, while the environmental status of spatial sensitivity can be described as poor or very poor for the Mountains, Terai as a whole can be noted as having good or relatively better condition. Hills fall under intermediate category.

4.2.3 Ratio of Non-forested and Degraded Forest

The ratio of non-forested and degraded forest is indicative of the state of forest degradation. While the lower value means better situation the higher value is suggestive of bad or worse situation. The environmental status based on this ratio suggests that most of the Mountain and Hill districts display a discouraging situation. Eight out of sixteen Mountain districts are poor. More importantly, the situation is worse for 5 Mountain districts namely Dolpa, Manang, Mustang, Solukhumbu, and Taplejung.

Table 5: Classification of Districts by Ratio of Non-forested and Degraded Forest (Average)

Ecological Zone	< 30 Per cent (A)	30 - 45 Per cent (B)	45 - 60 Per cent (C)	> 60 Per cent (D)
Mountain	Kalikot (1)	Bajura, Jumla (2)	Bajhang, Darchula, Humla, Mugu, Dolakha, Rasuwa, Sindhupalchok, Sankhuwasabha (R)	Dolpa, Manang, Mustang, Solukhumbu, Taplejung (5)
Hill	Dadeldhura, Doti, Surkhet, Makwanpur, Sindhuli, Udayapur (6)	Achham, Dailekh, Jajarkot, Rolpa, Rukum, Arghakhanchi, Baglung, Kaski, Ham (9)	Baitadi, Pyuthan, Sallyan, Lamjung, Tanahun, Palpa, Myagdi, Dhading, Bhojpur, Khotang, Panchthar (12)	Gorkha, Gulmi, Syangja, Bhaktapur, Kavre, Kathmandu, Lalitpur, Nuwakot, Ramechhap, Dhankuta, Okhaldhunga, Terhathum (12)
Terai	Kailali, Kanchanpur, Banke, Bardiya, Chitawan, (5)	Dang, Kapilvastu, Nawalparasi, Rupandehi, Bara, Dhanusa, Mahottari, Rautahat, Saptari (9)	Sarlahi, Parsa, Siraha, Sunsari, Morang, Jhapa (6)	

Source: LRMP, 1986.

Note: A = Relatively Better, B = Good, C = Poor, and D = Very Poor.

Similarly, nearly one-third of the Hill districts are critical in terms of forest degradation notwithstanding the fact that situation for six districts is promising (Table 5). Terai districts demonstrate rather better situation and that among all the status of forest is encouraging in Kailali, Kanchanpur, Banke, Bardiya and Chitawan.

4.2.4 Cropping Intensity

Cropping intensity is increasing over the years. An analysis of Agriculture Sample Census Survey between 1981 and 1991 justifies this. An increase in cropping intensity is indicative of at least three points: a) that the physical environment is conducive to grow multiple crops and there is a potential

for crop diversification; b) the population has grown and households are utilizing their resources more intensively; and c) that innovation and new technologies are introduced in our agriculture. This includes introduction of various cash crops and modern technology including various agricultural inputs. The most recent figures (CBS, 1993) suggest that 20 per cent (15) of the total districts exceed the cropping intensity of 190. Among them, twelve are from the Hills and three from the Terai. Majority of the districts (56) show their cropping intensity between 150 to 190. Thirty four districts show a cropping intensity between 170 and 190 whereas twenty-two fall within a range of 150 to 170. Only four districts namely, Manang, Dolpa, Mugu, and Humla have the cropping intensity value of less than 150. The pattern suggests that the Hills have a higher cropping intensity, followed by the Terai and the Mountains have the least value of cropping intensity'. This is one indication of the changing relationship between population and the utilization of available resources.

Table 6: Distribution of Districts by Cropping Intensity, 1991

Ecological Zone	> 190 (A)	170 - 190 (B)	150 - 170 (C)	< 150 (D)
Mountain		Darchula, Bajhang, Bajura, Kalikot, Sindhupalchok (5)	Jumla, Mustang, Rasuwa, Dolakha, Solukhumbu, Sankhuwasabha, Taplejung (7)	Humla, Mugu, Dolpa, Manang (4)
Hill	Baitadi, Dadeldhura, Doti, Sallyan, Myagdi, Baglung, Arghakhanchi, Syangja, Kathmandu, Makwanpur, Ramechhap, Sindhuli (12)	Achham, Pyuthan, Rolpa, Rukum, Jajarkot, Surkhet, Gulmi, Parbat, Kaski, Gorkha, Dhading, Nuwakot, Lalitpur, Bhaktapur, Okhaldhunga, Udayapur, Khotang, Dhankuta (18)	Panchthar, Ham, Terhathum, Bhojpur, Kavre, Lamjung, Tanahun, Palpa, Dailekh (9)	
Terai	Rautahat, Chitawan, Kanchanpur (3)	Kailali, Bardiya, Dang, Bara, Parsa, Dhanusa, Mahottari, Sarlahi, Siraha, Morang, Sunsari (I1)	Jhapa, Saptari, Nawalparasi, Rupandehi, Kapilvastu, Banke (6)	

Source: Agriculture Sample Census Survey, 1991.

Note: A = Relatively Better, B- Good, C = Poor, and D = Very Poor.

4.2.5 Food Situation

Analysis of food situation is based on total crop production of the district, calorific value of the crops produced and the total population in 1991. The total population per district is converted into adult conversion factor (ACF) for calculating the load of population. The carrying capacity of agriculture land is derived from converting total crops produced into calorie value and dividing this by demand of an adult in kilogram per day (CDG, 1994). The surplus or deficit is calculated by subtracting the existing load i.e.., total population converted into ACF' from the existing carrying capacity.

An analysis based on above mentioned criteria suggests that the food situation is positive for 30 districts. Among them four are from the Mountains, thirteen from the Hills and ten from the Terai. Those from the Mountains include Sankhuwasabha, Rasuwa, Manang, and Mustang. Among these Manang leads all the food surplus districts in the Mountain. The Hill districts with food surplus are Panchthar, Terhathum, Dhankuta, Bhojpur, Sindhuli, Kavre, Nuwakot, Tanahun, Gorkha, Syangja, Lamjung, Parbat, Sallyan and Rukum. Among them food situation of Dhankuta is reported to be better off than the rest.

Table 7: Classification of Districts by Food Situation (surplus or deficit in persons / hectare)

Ecological Zone	1.5 or More (A)	0.0 - 1.5 (B)	- 0.1 -(-)1.5 (C)	- 1.5 or Less (D)
Mountain	Manang, (1)	Sankhuwasabha, Rasuwa, Mustang (3)	Taplejung, Dolpa, Mugu, Darchula (4)	Solukhumbu, Dolakha, Sindhupalchok, Jumla, Kalikot, Humla, Bajura, Bajhang (8)
Hill	Dhankuta (1)	Panchthar, Terhathum, Bhojpur, Sindhuli, Kavre, Nuwakot, Tanahun, Syangja, Terhathum, Lamjung, Parbat, Sallyan, Rukum (13)	Ilam, Khotang, Makwanpur, Dhading, Palpa, Arghakhanchi, Kaski, Myagdi, Surkhet, Jajarkot, Achham, Dadeldhura (12)	Udayapur, Okhaldhunga, Ramechhap, Lalitpur, Bhaktapur, Kathmandu, Gulmi, Baglung, Pyuthan, Rolpa, Dailekh, Doti, Baitadi (13)
Terai	Bara, Kanchanpur	Jhapa, Morang, Sunsari, Saptari, Siraha, Parsa, Chitawan, Dang, Bardiya, Kailali (10)	Mahottari, Sarlahi, Rautahat, Nawalparasi, Kapilvastu (5)	Dhanusa, Rupandehi, Banke (3)

Source: Agriculture Sample Census Survey, 1991.

Note: A = Relatively Better, B = Good, C = Poor, and D = Very Poor.

Forty-five districts are recorded to have a shortage of food. Among them twelve are from the Mountains, twenty-five from the Hills and eight from the Terai. Among the Mountain districts with food shortage Solukhumbu, Dolakha, Sindhupalchok, Jumla, Kalikot, Humla, Bajura, and Bajhang have a critical shortage whereas the situation is not too bad in Taplejung, Dolpa, Mugu, and Darchula. Similarly, food deficit in the Hills is more pronounced in the thirteen Hill districts namely, Udayapur, Okhaldhunga, Ramechhap, Lalitpur, Bhaktapur, Kathmandu, Gulmi, Baglung, Pyuthan, Rolpa, Dailekh, Doti and Baitadi.

In the Terai, Mahottari, Sarlahi, Rautahat, Nawalparasi, and Kapilvastu are recorded to have food deficit while the deficit is critical in Dhanusha, Rupandehi, and Banke. In general, the food situation is not favorable for most of the Mountain and Hill districts albeit most of the Terai districts have a positive food balance. Even with all the favorable physical configuration in the Terai, the food situation cannot be considered satisfactory at present, a reflection of increased population pressure.

4.2.6 Fodder Situation

The estimation of fodder demand at the district level is based on livestock data available from DFAMS, 1991/92. The same source has been used to estimate the share of crop residue in total supply of fodder. The LRMP data and Master Plan for Forestry Sector are used for calculating area of accessible forest and grazing land, and accessibility factor (LRMP, 1986, FSMP, 1988). Crop residue has also been calculated and used to derive the supportive capacity of the district. The total livestock are converted into livestock unit (LSU) using conversion factor of 0.8 for cattle, 0.9 for buffalo and 0.2 for sheep and goats.

Table 8: Classification of Districts by Fodder Situation surplus or deficit in LSU/hectare)

Ecological Zone	> 0.5 (A)	0.0 - 0.5 (B)	-0.01 - 0.5 (C)	- 0.5 or Lower (D)
Mountain		Sankhuwasabha, Solukhumbu, Manang, Mustang, Jumla, Mugu Humla (7)	Taplejung, Dolakha, Sindhupalchok, Rasuwa, Kalikot, Bajura, Bajhang, Darchula (8)	Dolpa (1)
Hill	Terhathum, Bhaktapur (2)	Panchthar, Ilam, Khotang, Makwanpur, Kathmandu, Kaski, Doti, Dadeldhura (8)	Dhankuta, Bhojpur, Udayapur, Okhaldhunga, Sindhuli, Ramechhap, Kavre, Lalitpur, Nuwakot, Dhading, Palpa, Arghakhanchi, Tanahun, Gorkha, Lamjung, Parbat, Baglung, Myagdi, Pyuthan, Rolpa, Sallyan, Rukum, Surkhet, Jajarkot, Dailekh, Achham, Baitadi, (27)	Gulmi Syangja (2)
Terai	Bara, Parsa (2)	Morang, Sunsari, Siraha, Sarlahi, Rautahat, Chitawan, Nawalparasi, Kailali, Kanchanpur (9)	Jhapa, Saptari, Dhanusa, Mahottari, Rupandehi, Kapilvastu, Dang, Banke, Bardiya (9)	

Source: Calculated from DFAMS, 1991/92; FSMP, 1988; and LRMP, 1986. Note: A = Relatively Better, B = Good, C= Poor, and D = Very Poor,

An analysis of demand and supply situation of fodder suggests that most districts (63 per cent) have a shortage (Table 8). Only 28 districts have a surplus and this surplus is more explicit in Bara, Parsa, Terhathum and Bhaktapur. Of the total mountain districts 44 per cent have a surplus. These include Sankhuwasabha, Solukhumbu, Manang, Mustang, Mugu, Jumla, and Humla. The remaining Mountain districts record a shortage of fodder. While this group includes Taplejung, Dolakha, Sindhupalchok, Rasuwa, Dolpa, Kalikot, Bajura, Bajhang, and Darchula, the shortage is very critical for Dolpa.

Of the total Hill districts a surplus is reported for only 10 districts. These includes Ilam, Panchthar, Terhathum, Khotang, Makwanpur, Bhaktapur, Kathmandu, Kaski, Doti, and Dadeldhura. Among them the surplus is more pronounced in Terhathum and Bhaktapur. The remaining 29 Hill districts have a shortage and this shortage is critical for Gulmi and Syangja. In the Terai while Bara and Parsa have a clear surplus, Jhapa, Saptari, Dhanusha, Mahottari, Rupandehi, Kapilvastu, Dang, Banke, and Bardiya have a deficit. The remaining districts are reported to have been self sufficient. Overall, in terms of fodder supply, the most of the Hill districts are rather critical than either the Terai or the Mountain districts.

4.2.7 Fuel-wood Situation

Using data from LRMP (1986), WECS (1987) has calculated the volume of fuel wood supply and demand at the district level. The calculation is based on the assumption that the supply of fuel wood is reducing at the rate of 2 per cent per annum. The demand estimate is based on the assumption that per capita consumption for the Hills is 640 kg while for the Terai the figure is 424 kg.

The 1991 estimate based on the above assumptions suggests that of the 75 districts only seven show that their supply exceeds their demand. While two of them are from the Mountain (e.g., Dolpa and Mugu), the rest are from the Terai. The Terai districts where supply exceeds demand include Kanchanpur, Kailali, Bardiya, Banke and Chitawan.

All the Hill districts show a shortage of fuel wood. Among them seven districts namely, Kavre, Lalitpur, Bhaktapur, Kathmandu, Syangja, Kaski and Parbat show a critical shortage where the deficit is more than two persons/hectare (Table 9). Fourteen out of 16 Mountain districts show a shortage but among them 12 districts (86 per cent) are within an acceptable range of one person per hectare. Nonetheless, the situation of Dolakha and Sindhupalchok is poor.

Table 9: Classification of Districts by Fuel Wood Situation (surplus or deficit in persons/hectare)

Ecological Zone	Surplus (0.0 or more (A)	Deficit (upto - 1) (B)	Deficit (-1 to - 2) (C)	Deficit (> - 2) (D)
Mountain	Dolpa, Mugu (2)	Taplejung, Sankhuwasabha, Solukhumbu, Rasuwa, Manang, Mustang, Jumla. Kalikot, Humla, Bajura, Bajhang, Darchula (12)	Dolakha, Sindhupalchok (2)	
Hill		Ham, Panchthar, Terhathum, Dhankuta, Bhojpur, Khotang, Okhaldhunga, Sindhuli, Tanahun, Lamjung, Baglung, Myagdi, Pyuthan, Rolpa, Sallyan, Rukum, Jajarkot, Dailekh, Achham, Doti, Dadeldhura, Baitadi (22)	Udayapur, Ramechhap, Makwanpur, Nuwakot, Dhading, Palpa, Arghakhanchi, Gulmi, Gorkha, Surkhet (10)	Kavre, Lalitpur, Bhaktapur, Kathmandu, Syangja, Kaski, Parbat (7)
Terai	Chitawan, Banke, Bardiya, Kailali, Kanchanpur,(5)		Parsa, Dang (2)	Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusa, Mahottari, Sarlahi, Bara, Rautahat, Nawalparasi, Rupendehi, Kapilvastu

Source: Calculations based on WECS, 1987.
Note: A = Relatively Better, B = Good, C = Poor, and D = Very Poor.

Among the Terai districts 75 per cent of them have a negative fuel wood balance. More importantly, fuel wood situation is very poor for 13 districts of the Terai region of which critical shortage is observed in Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Rautahat, and Rupandehi.

4.3 The Crude Index of Population (CIP) and Crude Index of Physical Quality of Environment (CIPQuE)

Based on the indicators of population and environment and their individual values the districts were ranked into four ranks and those ranks were identified by symbols A, B, C, and D in the above discussion. In this section, those rankings have been assigned values in a scale of I to 4 where rank A with a value of 4 and B, C, D, the values of 3, 2, and I respectively. While a value 01' ' I' indicates the worse situation, `4' indicates a better condition. Cut-off points for these rankings have been based on general understanding of the issues of the indicators. This is a preliminary exercise and that this approach can be refined as more reliable data become available.

The categorization of districts and their respective values are given in Table 10. The ranking of all the individual parameters is summed up and from the total value of ranking, the mean values for both population and environment are derived for each individual districts. The resulting index of population is referred as crude index of Population (CIP) and that of environment as Crude Index of Physical Quality of Environment (CIPQuE). These indices for national average are also computed. This is also done for the individual ecological zones (Mountain, 11111, and Terai).

Several points have been taken into account for the ranking of districts and developing index Values. First, in countries such as Nepal where data base is poor, a worthwhile conclusion can be derived if we rank the values into meaningful ranks and use them as a proxy for numerical values. This is based on the fact that given poor data quality, conclusions based on absolute numerical values may be misleading. It is argued that if data are properly ranked a more realistic understanding (based on data) emerges than either mere descriptive studies or studies based on absolute numerical values.

Secondly, this is an attempt to bring together and use whatever can be obtained from data that are available at several places and see if any meaningful conclusions can be drawn from them and that complaining about the data quality is no solution. Thirdly, as has been noted earlier this is a preliminary exercise, and it is done with a hope that this initial exercise will lead scholars to critique this and come up with better indices in future as data quality improves over time.

Table 10: Index Values of Population and Environment by Districts

Mountain

District	Population				Environment								
	a	b	Total	CIP	A	B	C	D	E	F	G	Total	CIPQuE
Taplejung	4	4	8	4	1	2	2	1	2	2	3	13	1.85
Sankhuwasabha	4	4	8	4	2	2	2	2	3	3	3	20	2.85
Solukhumbu	4	4	8	4	1	2	1	1	1	3	3	12	1.71
Dolakha	3	3	6	3	2	2	2	2	1	2	2	13	1.85
Sindhupalchok	3	3	6	3	2	3	2	2	1	2	2	14	2.00
Rasuwa	4	2	6	3	2	2	1	1	3	2	3	14	2.00
Manang	4	4	8	4	1	1	1	1	4	3	3	14	2.00
Mustang	4	3	7	3.5	1	2	1	1	3	3	3	14	2.00
Dolpa	4	3	7	3.5	1	1	1	1	2	1	4	11	1.57
Jumla	4	4	8	4	3	2	2	2	1	3	3	16	2.14
Mugu	4	4	8	4	2	1	1	1	2	3	4	14	2.00
Humla	4	1	5	2.5	2	1	1	1	1	3	3	12	1.71
Kalikot	3	4	7	3 5	4	3	1	1	1	2	1	15	2.14
Bajura	4	1	5	2 5	3	3	2	1	1	2	3	15	2.14
Bajhang	4	3	7	3.5	2	3	2	1	1	2	3	14	2.00
Darchula	4	3	7	3.5	2	3	2	1	2	2	3	15	2.14

Table 10 cont..

Hill

District	Population				Environment								
	a	b	Total	CIP	A	B	C	D	E	F	G	Total	CIPQuE
Panchthar	2	3	5	2.5	2	2	2	3	3	3	3	18	2.57
llam	2	1	3	*1.5*	3	2	3	3	2	3	3	19	2.71
Terhathum	2	3	5	2.5	1	2	2	3	3	4	3	18	2.57
Bhojpur	2	4	6	3	2	2	2	3	3	2	3	17	2.43
Dhankuta	2	3	5	2 5	1	3	2	3	4	2	3	18	2.57
Khotang	2	4	6	3	2	3	2	2	2	3	1	17	2.43
Udayapur	3	1	4	2	4	3	3	2	1	2	2	17	2.43
Okhaldhung a		4	0	3	1	3	2	2	1	2	3	14	2.*00*
Ramechhap	3	2	6	3	1	4	3	2	1	2	2	15	2.14
Sindhuli	1	2	S	2 5	4	4	3	2	3	2	3	21	3.00
Kavre	1	4	5	2 5	1	2	2	2	3	2	1	13	1.86
Bhaktapur	1	4	5	2.5	1	3	2	4	1	4	1	16	2.29
Lalitpur	1	1	2	1	1	3	2	3	1	2	1	13	1.86
Kathmandu	1	1	2	1	1	4	2	4	1	3	1	16	2.29
Makwanpur	2	1	3	1 5	4	4	3	2	2	3	2	20	2.86
Dhading	2	3	5	2.5	2	3	3	2	2	2	2	16	2.29
Nuwakot	1	2	3	1 5	1	3	3	3	3	2	2	17	2.43
Gorkha	3	4	7	3 5	1	3	2	1	3	2	2	14	2.00
Lamjung	3	4	7	3 5	2	2	3	2	3	2	3	17	2.43
Tanahun	2	2	4	2	2	2	3	2	3	2	3	17	2.43

Table 10 Contd...

Hill

District	Population				Environment								
	(a)	(b)	Total	CIP	(A)	(B)	(C)	(D)	(E)	(F)	(G)	Total	CIP QuE
Kaski	2	1	3	1.5	3	3	3	1	2	3	1	16	2.29
Syangja	1	4	5	2.5	1	4	2	3	3	1	1	15	2 14
Parbat	1	3	4	2	2	3	2	2	3	2	1	15	2.14
Myagdi	4	4	8	4	2	4	2	1	2	2	3	16	2.29
Baglung	2	4	6	3	3	4	2	2	1	2	3	17	2 43
Gulmi	1	3	4	2	1	3	2	2	1	1	2	12	1.71
Arghakhanchi	2	3	5	2.5	3	4	2	2	2	2	2	17	2 43
Palpa	2	4	6	3	2	2	1	2	2	2	2	13	1.86
Pyuthan	2	3	5	2.5	2	3	2	2	1	2	3	15	2 14
Rolpa	3	4	7	3.5	3	3	2	2	1	2	3	16	2.29
Rukum	3	2	5	2.5	3	3	2	1	3	2	3	17	2 43
Sallyan	3	2	5	2.5	2	4	2	3	3	2	3	19	2 71
Dailekh	3	3	6	3	3	2	3	2	1	2	3	16	2.29
Jajarkot	3	3	6	3	3	3	2	2	2	2	3	17	2.43
Surkhet	3	1	4	2	4	3	2	2	2	2	2	17	2 43
Achham	3	4	7	3.5	3	3	3	2	2	2	3	18	2.57
Doti	3	4	7	3.5	4	4	3	2	1	3	3	20	2 86
Baitadi	2	3	5	2.5	2	4	2	2	1	2	3	16	2.29
Dadeldhura	3	2	5	2 5	4	4	2	2	2	3	3	20	2 86

Table 10 Contd...

Terai

District	Population				Environment								
	(a)	(b)	Total	CIP	(A)	(B)	(C)	(D)	(E)	(F)	(G)	Total	CIP QuE
Jhapa	1	1	2	1	2	2	4	4	3	2	1	18	2.57
Morang	1	1	2	1	2	3	4	4	3	3	1	20	2.86
Sunsari	1	1	2	1	2	3	4	4	3	3	1	20	2.86
Saptari	1	1	2	1	3	2	4	4	3	2	1	19	2.71
Siraha	1	1	2	1	2	3	4	4	3	3	1	20	2.86
Dhanusa	1	1	2	1	3	3	3	4	1	2	1	17	2.43
Mahottari	1	2	3	1.5	3	3	3	4	2	2	1	18	2.57
Sarlahi	1	1	2	1	2	3	4	4	2	3	1	19	2.71
Rautahat	1	1	2	1	3	4	4	4	2	3	1	21	3.00
Bara	1	1	2	1	3	3	4	4	4	4	1	23	3.29
Parsa	1	1	2	1	2	3	4	4	3	4	2	22	3 14
Chitawan	2	1	3	1.5	4	4	3	3	3	3	4	1	3.43
Nawal parasi	1	1	2	1	3	2	4	3	2	3	1	18	2.57
Rupandehi	1	1	2	1	3	2	4	4	1	2	1	17	2.43
Kapilvastu	1	1	2	1	3	2	4		2	2	1	18	2.57
Dang	3	1	4	2	3	3	3	2	3	2	2	18	257
Banke	3	1	4	2	4	2	3	3	1	2	4	19	2.71
Bardiya	3	1	4	2	4	3	3	4	3	2	4	23	3.29
Kailali	2	1	3	1.5	4	3	4	3	3	3	4	24	3.43
Kanchanpur	2	1	3	1.5	4	4	4	4	4	3	4	27	3.86

Note: Population:
(a) = Population Density
(b) = Growth Rate of Population

Environment:
(A) = Percentage Ratio of Non-forested and Degraded Forest (Average) (B) = Cropping Intensity
(C) = Relief Ratio
(D) = Percentage of Area with > 30° Slope (E) = Food Balance
(F) = Fodder Situation
(G) = Fuel Wood Balance

Considering the prevailing condition of the country, the ecological regions and districts with values below the national average have been taken as areas with environmental and population stress, whereas those with values above the national average have been treated as areas with relatively low stress. The crude index of population *(CIP)* for the nation came up to be 2.39. The values for the ecological belts are 3.47, 2.52, and 1.25 for the Mountains, the Hills, and the Terai respectively (Table 1 1). This indicates that the demographic situation in the Mountains is not serious whereas the Terai in general is critical. While all the Mountain districts have *CIP* value consistently above national average, all the Terai districts have this value below national average. Although *CIP* for the Hills in general is above the national average, given its long history of settlement where environmental resources are utilized to a high extent, this cannot be considered as something to be content.

Table 11: Crude Index of Population *(CIP)* by Regions

Ecological Regions	Index
Mountain	3.47
Hill	2.52
Terai	1.25
Nepal	2.39

The environmental index computed for the nation is 2.43 whereas for the ecological belts the values are 2.01, 2.36, and 2.91 for the Mountains, the Hills and the Terai respectively (Table 12). The environmental status measured in terms of the parameters used in this framework appears to be negative in the Mountains and the Hills, whereas it appears positive in the Terai.

Table 12: Crude Index of Physical Quality of Environment *(CIPQuE)* by Regions

Ecological Regions	Index value
Mountain	2.01
Hill	2.36
Terai	2.91
Nepal	2.43

Note: Values above national average indicate positive status and those below national average indicate negative status.

Environmental stress in general increases successively from south to north with most critical situation in the Mountains. On the other hand, the demographic situation measured in terms of the density and the growth rate shows a reverse trend, demonstrating a gloomy situation in the Hills and the Mountains.

4.4 Assessment of Districts with National Values of CIP and CIPQuE

To assess the population and environment situation of the districts in terms of average national situation all the districts have been categorized into two groups on the basis of the index values below and above the national average (Table 13 and 14). The districts with negative values in both environment and population have been identified as critical districts.

Demographic Index shows that none of the Mountain district have negative values whereas none of the Terai districts have positive values. In the Hills eleven districts show negative values. The rest twenty-eight districts appear above the national average, showing relatively low population pressure on the local environment (Table 13). Moreover, the index value of several districts such as Kathmandu, Lalitpur, Ilam, Makwanpur, Nuwakot, and Tanahun, suggests that demographic situation there is something to be concerned.

Table 13: Classification of Districts by Status of Population

Mountain		Hills		Terai	
Above National Average	Below National Average	Above National Average	Below National Average	Above National Average	Below National Average
Taplejung, Sankhuwasabha, Solukhumbu, Dolakha, Rasuwa, Manang, Mustang, Dolpa, Sindhupalchok, Humla, Jumla, Mugu, Kalikot, Bajhang, Bajura, Darchula,		Panchthar, Terhathum, Bhojpur, Dhankuta, Khotang, Okhaldhunga, Ramechhap, Sindhuli, Kavre, Bhaktapur, Dhading, Gorkha, Lamjung, Syangja, Myagdi, Bajhang, Palpa, Arghakhanchi, Pyuthan, Rolpa, Rukum, Sallyan, Dailekh, Jajarkot, Achham, Doti, Baitadi, Dadeldhura,	Ilam, Udayapur, Lalitpur, Kathmandu, Makwanpur, Nuwakot, Tanahun, Kaski, Parbat, Gulmi, Surkhet,		Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusa, Mahottari, Sarlahi, Parsa, Bara, Rautahat, Chitawan, Nawalparasi, Rupendehi, Kapilvastu, Dang, Banke, Bardiya, Kailali, Kanchanpur,
16		28	11		20

Of the three ecological regions, Mountains have the most critical environmental condition. This is followed by the Hills. On the other hand, environmental situation can be considered satisfying in the Terai. At the district level all the Mountain districts with an exception of Sankhuwasabha appeared to be negative. In the Hills twenty districts have negative values and nineteen districts show a positive value. No clear trend in east - west direction is discernible (Table 14). In the Terai only two districts, Dhanusha and Rupandehi show negative values. Therefore, most of the Terai districts do not seem to be under environmental stress.

The interpretation of index values to identify critical areas depends upon nature of the geographical attributes. For instance, Terai has high population but because of the relief ratio and the cropping intensity, most of the Terai region is non critical. On the other hand Mountain region with low population index does not indicate its sound environmental status. The region is still critical because of the fragility of the slope, relief ratio and low cropping intensity.

Table 14:Classification of Districts by Environmental Status

Mountain		Hills		Terai	
Above National Average	Below National Average	Above National Average	Below National Average	Above National Average	Below National Average
Sankhuwasabha	Taplejung, Solukhumbu, Dolakha, Sindhupalchok, Rasuwa, Manang, Mustang, Dolpa, Humla, Jumla, Mugu, Kalikot, Bajhang, Bajura, Darchula,	Ilam Panchthar Terhathum Bhojpur Dhankuta Sindhuli Makwanpur Lamjung Tanahun Baglung Gulmi Arghakhanchi Rukum Sallyan Jajarkot Surkhet Achham Doti Dadeldhura	Okhaldhunga Ramechhap Kavre Bhaktapur Lalitpur Kathmandu Dhading Gorkha Kaski Syangja Parbat Myagdi Palpa Pyuthan Rolpa Dailekh Baitadi Khotang Udayapur Nuwakot	Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusha, Mahottari, Sarlahi, Parsa, Bara, Rautahat, Chitawan, Nawalparasi, Rupandehi, Kapilvastu, Dang, Banke, Bardiya, Kailali, Kanchanpur,	Dhanusha Rupandehi
1	15	19	20	18	2

In order to identify the critical districts in terms of relationship between population and environment, the district with index values below the national average in both the indices have been identified. These districts include Udayapur in the east, Lalitpur, Kathmandu, Nuwakot and Dhanusha in the center; and Kaski, Parbat and Rupandehi in the West. In terms of ecological regions, two Terai

districts i.e.., Dhanusha and Rupandehi, and six Hill districts namely, Udayapur, Lalitpur, Kathmandu, Nuwakot, Kaski, and Parbat seem to have acute problem of population and environment. None of the Mountain districts apparently appears to be critical due to low population size.

5. Conclusion

The interrelationship between population and environment is complex. This complex relationship is further complicated by a country's level of technology, affluence or poverty, consumption level, and the existing institutions (political, economic, social) most of which change over time and over space. Even our understanding of this interrelationship is still at the embryonic stage and the theoretical base is not yet adequately developed. While the relationship is dynamic, it is interactive as well. In a poor country such as Nepal a realistic assessment of the status of population and environment is very difficult owing to both the absence and the poor quality of data.

The rate of population growth is high and that corresponding changes in the environment are more towards negative than positive. There is a consensus on this essence. The in-built momentum of young population suggests that the growth will continue for some decades to come and that it will exert more pressure on the existing resources. Over all consumption level may increase over time which means additional pressure to the environment. More migration towards urban areas is imperative and unless a prudent policy is developed it will further deteriorate the already deteriorated urban environment.

It is important to understand that any policy instruments meant for keeping a balance between population, environment, and development in a mountainous nation such as Nepal must be able to deal with mountain specificities, their attributes and implications. Banskota and Jodha (1992) have pointed out five such specificities including inaccessibility, fragility, diversity, `niche' and marginality (Sharma, 1994). In these circumstances, population growth becomes imperative as an adaptation strategy to cope with adversities out of these specificities. It seems that our policies and programs in both environment and population have failed to address this. There is no denial that population is the key element. However, one must realize that it is not the population *per se* but "population within the spatial context" that should be the vital element in any developmental efforts of the country.

There is a need to reconsider our strategies of population control and measures and make sure that measures that are not in direct conflict with society, culture, and behavior obtain the priority. Similar consideration. Js needed in the issues of "eco-crisis," and management aspect should be given due consideration rather than blaming on population size and growth. Blaming each other does not help much. We must educate people about the existing situation and the consequences of increased population growth in the environmental resources. Constant monitoring of the status of population and environment at regional and district level is a must and that prudent programs be designed so that both problems be tackled simultaneously. This needs programs that can deal with the imperatives of mountain specificities, and bring a better coordination between institutions and agencies dealing with these issues rather than approaching these problems separately. The present assessment may provide a general base for monitoring and evaluation of the environmental impact of population. Further refinements can be made to include indicators such as population quality, technological and institutional impact. Moreover, updating database and subsequent assessment is imperative and appropriate corrective measures implemented for establishing better harmony between population and environment in Nepal.

Notes

1. Relief ratio is calculated by using the following formula (Price and Wilson 1971; quoted in Morisawa, M., 1983 Geomorphology Laboratory Manual. New York: John Wiley and Sons)
((Maximum altitude - Mean altitude -)/(Maximum - Minimum)) * 100

2. A note of caution is that area under temporary crops for a particular year depends upon success of failure of monsoon, thus the cropping intensity values can very accordingly.

3. The adult conversion factor (ACF) used in this text is 0.82 which is based on the situation in the Hills. The calorie demand is considered as 2,410 kg/adult/day. The assumptions of calorie values of different crops such as rice, maize, and wheat are taken as 3,450 /kg, 3,410/kg and 3,420/kg respectively. Likewise, the calorie values for millet, potato and barley are taken as 3,280/kg, 970.kg, 3,400/kg respectively.

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