NEPAL

EXECUTIVE SUMMARY

Nepal is endowed with abundant water resources from the availability point of view. The waters are regarded as the key strategic natural resources having the potential to be the catalyst for all round development and economic growth of the country.

The vision of the future is that Nepal's poverty can be eliminated by water resources development led through agricultural growth. The strategy for economic development, employment and poverty alleviation is based on the background of the country's unexploited potential in the agriculture sector given by suitable agro ecology, substantial irrigation potential, low technology use at present, possibility of regional cooperation and large market across the border and engagement of about 80% population in agriculture.

Water resource planning approach in the country had been concentrated at sub-sector level and investment decisions made on a project by project basis. This fragmented manner of planning by different government organizations have so far, failed to address the complex and interrelated issues. Multiple users: agriculture, domestic water agencies and industry - utilize the water resources of each river basin without any special attention to river basin water availability. The groundwater resource in the terai plains is grossly under utilized and needs legislative measures for its planned development and management. Details about issues, and constraints, trade offs about alternative choices and various alternatives are to be analyzed under the ongoing national water resources strategy formulation.

The identified outstanding issues related to irrigated agriculture include (i) developed irrigation facilities not utilized to the optimum; (ii) lack of basic inputs; (iii) organization and management

deficiency leading to inefficient program implementation; (iv) problem of cost recovery in government irrigation schemes; (v) high capital cost requirements for physical infrastructure development; (vi) problem of river management; (vii) absence of objective investment criteria in the development of irrigated agriculture; (viii) lack of cooperation among the users and government agencies; etc.

Farmer managed irrigation systems (FMIS) have played important roles and contributed to the evolution and development of irrigated agriculture in Nepal. Over 75% of irrigated area is under these FMIS and are managed by farmers on self-help basis. The FMIS are operated in a demand-driven mode and have assured participation of users at every stage. Nepal's vision in the promotion and development of irrigated agriculture is to initiate and retain these characteristics in government operated irrigation schemes as well. The current irrigation policy of the government calls for the promotion of participatory mode of program implementation and the FMIS provide excellent examples for learning.

In this vision paper a review of the country's policy on water resources with a focus on irrigation potential has been presented. Brief discussion on status of water, food and rural development in the country has been outlined. Issues, constraints and actions needed in policy, institutions and irrigation have been identified.

The Policy Dialogue Model (PODIUM) has been used to determine increasing water demand and the production of the required cereals in 2025 as a result of population growth and changing diets.

1. NATIONAL POLICIES AND DEVELOPMENT PLANS

1.1 OVERVIEW OF PREVIOUS PLANS

Planned development efforts in Nepal began shortly after the political reforms in 1951. Prior to 1951, the main focus of the government was maintaining law and order and revenue collection. After 1951, the new government placed emphasis in disbanding the pre-existing feudal agrarian system and developing agriculture through various reform measures. Accordingly, Tenancy Rights Acquisition Act 1952 was enacted and a Land Reform Commission was commissioned to take up problems on tenancy rights, land revenue and agricultural credit. The year was also crucial as a first step of government policy towards ensuring adequate food production by creating the Ministry of Agriculture and two separate departments for Agriculture and Irrigation to look after the sustainable development of agricultural production and irrigated agriculture.

In 1955, a thirteen point program largely to safeguard the interest of the farmers was declared by the government. Then the first five year development plan was implemented in 1956. So far eight development plans have already been launched and ninth five year plan is underway. All the periodic plans have given agriculture as the top priority sector of the economy and irrigation is the component of major investment. The need to increase agricultural production through widespread use of appropriate technologies and inputs and better co-ordination of related line agencies was always felt by the government. Accordingly, various policies and strategies for increasing agricultural production (food production) were taken up by the government in each five year development plan.

Beginning 1988, a number of policy reforms have been introduced emphasizing participation of user beneficiaries of irrigation development and management. Water Resources Act (1992), Water Resources Regulation, 1993 and the 1997 amendment of Irrigation Policy (1992) have attempted to create policy environment to enable and foster users' participation in government sector irrigation schemes.

The Eight Five Year Plan (1992 - 97) earmarked 25.7% of the development budget for the agricultural sector. The plan had following objectives for agricultural development: (i) to assist in

boosting national economy by increasing agricultural production by specializing cropping areas on topographical basis;, (ii) to increase overall production and productivity for meeting national demand for food; (iii) to increase production and productivity of raw materials required for the development of agro-based industries; (iv) to create opportunities for productive employment for a large number of small and marginal farmers; and (v) to maintain balance between agricultural development and environmental protection.

The strategic policies of the Eight Plan were as follows: (i) to develop agricultural service centers in local areas for disseminating technology transfer; (ii) to arrange parental seed for production and monitor regularly the production activities; (iii) to promote private participation in the supply of chemical fertilizers; (iv) to hand over or lease out government farm to private sector; (v) to develop long term agricultural development plan; (vi) to accord top priority for private sector participation in providing veterinary and pathological services; (vii) to boost the activities of Nepal Agricultural Research Council (NARC) for quality and intensive agricultural research; (viii) to encourage women's participation in agricultural development activities; and (ix) to lift restriction in the mobility of agricultural product across the districts of the country.

1.2 LONG TERM DEVELOPMENT CONCEPT

The basic objective of the ongoing Ninth Plan (1997 - 2002) is poverty alleviation. This plan was formulated on the basis of the long-term Agriculture Perspective Plan (1995 - 2015) which convened only in 1997. Unlike in the previous plans where there were too many priorities, in the present plan limited priorities are taken to effectively deal with. The major goal of the long-term vision is to reduce the poverty figure of over 45% to 10% of the population in 20 years time.

The long-term development vision is summarized as follows :

- to follow the global trend in liberal, open, free market oriented philosophy
- to increase private sector participation with attraction for bringing foreign investment and also to increase competitiveness of private sectors (local)
- to involve public sector for promotion of poverty alleviation which will be gradually decreased.
- to create enabling environment for fostering private sector to increase economic and social development.

In general, macro policy in Nepal is favorable to the development of the agricultural sector. The major problem lies with the effective implementation. Though the overall objectives of the APP are reported to confirm with government's macro policy, there remain considerable doubt about how the plan will be implemented with the lack of substantial fund. The plan has predicted on acceleration of the agricultural growth rate by two percent point per annum so that the growth rate of agricultural output per capita of the total population increases by five times from its current 0.5 percent to a 2.5 percent. The APP has also emphasized on (i) a priority package program that set a small number of essential priorities for growth and integrating them in a package which is to be applied block by block in each district, (ii) increase in real rural income to stimulate growth in demand for high value agricultural and non-agricultural production and (iii) non-agricultural growth which will generate substantial employment in the rural areas. This is expected to contribute in a sharp decline in poverty and diffusion of urbanization associated with accelerated agricultural growth. The APP strategy for growth is essentially year-round irrigation, technology and fertilizer. The APP's strategy for agricultural take off encompasses the priorities for different sectors such as input priorities, output priorities, institutional priorities and policy priorities.

Priority

The following sectors are prioritized (in the given order of merit) in the current plan with focus on poverty alleviation.

- agriculture
- electricity and energy
- human resources and social sector
- tourism and industries
- physical infrastructure

2. STATUS OF WATER

2.1 SURFACE WATER

In Nepal, the water resources are regarded us the key strategic natural resource having the potential to be the catalyst for all round development and economic growth of the country. Nepal has a monsoon type climate. The total rainfall varies between 1,000 to 4,000 mm with an annual average of 1,814 mm. More than 75% rainfall occurs during four months of the monsoon period (June - September). The total annual surface runoff has been estimated to be 225 billion cubic meters (BCM) (equivalent to over 10,000 cubic meters per capita) of which 12 BCM is estimated to be entering from the upper catchments located in China, while about 15 BCM has been estimated to be entering into the border rivers between Nepal and India from the tributaries located in the Indian side. The seasonal distribution of flow is extremely varied as low as 1.5% to 2.4% of total runoff in the months of January, February and March, and as high as 20 to 27% in the months of July and August for snowfed rivers, while these figures for purely rainfed rivers are respectively 0.5% to 3% in the months of March, April and May and 20% to 30% in the months of July and August.

There are seventeen river basins in the Nepalese river system covering a total drainage area of 191,007 km^2 of which 22% or 42,030 km^2 lies in China and 5% or 9,850 km^2 is in India. Karnali, Sapta Gandaki and Sapta Koshi are the major river basins with their origins in the Himalayas and account for around 80% runoff. The Babai, West Rapti, Bagmati, Kamala and Kankai are medium river basins accounting for about 7% of the runoff. The southern rivers, with origins in the Siwalik Hill Range, are Bering, Balan, Khutiya, Pathraiya, Lal Bakaiya, Ratu, Sirsia, Manusmara and Banganga. These rivers are seasonal with little flows during non-monsoon periods. The Mahakali and Mechi rivers form the western and eastern frontiers with India.

2.2 GROUNDWATER

Available information show that a good potential for groundwater extraction exists specially in the southern plains (Terai) and inner valleys of the hills and mountainous regions. Much of the terai physiographic region and some parts of Siwalik valleys are undertain by shallow or deep aquifers, many of which are suitable for exploitation as sources of irrigation and drinking waters.

The annual recharge estimates range from 124 to 685 mm. The corresponding volume of water available for groundwater abstractions is estimated to be between 5.8 BCM and 12 BCM, however based on the measurements of the seasonal fluctuations of the water table in shallow tubewells the groundwater reserve is reported to be about 8.8 BCM annually.

2.3 IRRIGATION POTENTIAL AND DEVELOPMENT

Including 412,000 ha (presently non-agriculture) of land, the total irrigable land of the country has been estimated to be 2,178,000 ha, of which a net command of 1,091,000 ha receive irrigation water supply. This includes both surface water and groundwater irrigation (Table 2.1). Nepal has a long history of irrigated agriculture, mainly through farmer managed irrigation systems (FMIS). About 75% of the total irrigated area is under these FMIS, whereas the agency managed irrigation systems (AMIS) irrigate the remainder. One estimate suggests that about 200,000 ha of the irrigated area is under groundwater schemes, of which 75% is again under farmer managed

shallow tubewell (STWs), and the remainder under agency managed deep tubewells (DTWs). About 37,000 STWs and 400 DTWs are installed in the terai.

It is to be noted that except one system (Banganga system with 6200 ha) all the areas under existing irrigation systems are dependent on transit flow availability at the sources, and therefore, the irrigated area varies from season to season and from region to region. The total year-round irrigated area including the farmers' systems has been estimated to be only 418,000 ha.

None of the irrigation systems in Nepal measures the quantum of water supplied to irrigation. The only available data are (i) annual diversion requirements for monsoon and year-round irrigation based on physiographic regions, and (ii) irrigation command areas splitted into seasonal (monsoon) and year-round. The Agriculture Perspective Plan (APP) estimated the water use for irrigation with a total of 17,000 million cubic meters which is less than 8% of the country's total water resource potential.

The priority in the current Ninth Plan and the APP is to develop groundwater through low cost STWs and farmers' surface irrigation systems which will be managed by the users themselves.

As mentioned earlier, the year-round irrigation coverage is still only about 38% of the potential irrigable land, that also including the land mostly irrigated by traditionals farmers' system (without full or partial control permanent structures/equipments). Thus, the withdrawal would have to be gradually increased to ultimately cover all the potential irrigable land on year-round basis with a view to increase the food production to feed the growing population. It could, however, be expected that through modernization of irrigation systems and adoption of improved water management practices, the water requirements per hectare could be greatly reduced.

The present focus has been to develop quick yielding small irrigation systems. Despite considerable investments in infrastructure development and well trained codre of technicians for design, development, operation and management, the public sector irrigation schemes have been performing below expectations. The irrigation efficiencies are around 30%, the crop productivities are stagnant or declining and the problem of system management has remained an issue.

2.4 IRRIGATION MANAGEMENT

As the government managed irrigation schemes are characterized by low performance in terms of water use efficiency, crop productivity and backlog of deferred maintenance, it has been recognized that for improved management of available supply of irrigation water the participation of beneficiary farmers is crucial. Accordingly, the following policy elements have been emphasized by the government :

Area and Use	Mountains	Hills	Terai	Total
Geographical Area	5170	6140	3410	14720
Cultivated Area	227	1055	1359	2641
Irrigable Area (including forest land)	61	373	1744	2178
Irrigable Area (excluding forest land)	60	368	1338	1766
Irrigable Area (infrastructure developed)	52	253	786	1091
Actually Commanded	40	208	520	768
Year-round	20	110	288	418
Monsoon	20	98	232	350
Area under agency managed systems	1	15	251	267
Area under agency assisted farmer managed systems	10	48	274	332
Area under farmer development and farmer managed systems	41	190	261	492

Source: Nepal Agriculture Perspective Plan, 1995; and Department of Irrigation Documents, 1997.

- The irrigation projects managed at the government level would be gradually transferred to Water Users' Associations (WUAs). Such transfer would be effected to the schemes of upto 2000 ha in the terai and 500 ha in the hills and mountains. Larger systems may remain under the joint management of the WUAs and the government;

- No water service charge would be levied to schemes transferred to WUAs; the user farmers will be made to generate the resources locally and manage the systems;

- Before transferring the schemes to WUAs, the schemes would be rehabilitated and strengthened in accordance with the demand of WUAs. For this, cost sharing mechanism would be introduced with a view to enhance their capability and provide WUAs a sense of feeling of ownership in the schemes to be turned over.

The 1997 Amendment of the Irrigation Policy, 1992 promulgated by the Ministry of Water Resources declares that the role of the government shall focus on areas of wider national importance such as review and development sectoral policy on irrigation, resource mobilization, economic analysis and technological development while maximizing the participation of the private and non-government sectors in the implementation and operation of programs for irrigation development. The policy emphasizes sustainable and environmental friendly utilization of irrigation water and demand driven approach to irrigation development.

2.5 WATER USE FOR DOMESTIC AND OTHER PURPOSES

Water withdrawal for domestic sector are from different types of sources such as springs, wells (open and tube), rivers/streams, traditional stone taps and piped system (modern). The withdrawal data exists only for publicly developed piped system, particularly the supply added since 1974. For other uses such data are not available. However, a feasibility study conducted by Thai Study Team in November 1993 on the Kodkhu Water Supply Project estimates that the industrial consumption (including commercial and institutional) for the urban valley like Kathmandu constitutes about 5% of the domestic demand in the year 1991. Based on this, estimate has been made to provide indicative idea of aggregate water use in industrial, commercial and institutional sectors.

It is reported that population covered by the piped domestic water supply reached 67% and 39% in the fiscal year 1992/93 in urban and rural areas respectively. Viewing at the statistical data on quantum of piped water supply for the fiscal year 1994/95, the average consumption per capita per day in the areas having access to piped water comes to be around 83 liters.

2.6 HYDROPOWER

Hydropower is considered as a viable means of economic growth for the country's overall development. Though there is total hydropower potential of 83,000 MW, 42,000 MW is reported to be economically viable. However, this has been only a mirage as less than 1% of the potential has been exploited so far. Nepal is in a favorable position to supply water to China and India through construction of large reservoirs.

2.7 BASIN MANAGEMENT

Nepal's population which currently stands at 21 million persons, is estimated to grow at the rate of 2.5% per annum exceeding the growth rate in food production. This is the prominent factor that has placed additional pressures on the country's water resources. Further, there is growing demand for water for higher priority non-agricultural uses that could reduce the supply for

irrigation. Population growth and urbanization will increase water demands, most notably for drinking water and sanitation. Tourism, which is fast becoming the dominant sector of the economy, will increase the demand for water for environmental and recreational purposes. These trends have set the stage for intense inter sectoral competition for water in several locations. It is not possible to improve irrigation in isolation form the management of water for other purposes. This calls for integrated water management on the basin perspective and the planners have realized this and there are moves for changes in policies and institutional reforms. Research and development activities are foreseen for the development of integrated water management plans and the development of effective water management institutions.

3. PRESENT STATUS OF FOOD

About 80% of Nepal's population are farmers. Share of agriculture in GDP continues to decline and dwindles around 40% in recent years. The decline is due to the growth in other sectors like industry/manufacturing and service sector contributing 19.8% and 37.2% respectively. Agriculture is still the single largest sector with respect to income and employment and the per capita food availability stands at 276 kilograms. Over 45% of the people are below poverty line and 90% of them live in rural areas. The country with surplus food two decades ago has gone a net importer these years. Increase in population has outpaced agricultural growth resulting higher demand for food steadily. Per capita GDP increased only by 0.9% per year during 1964 - 94.

3.1 LAND DISTRIBUTION, FOOD DEMAND AND NUTRITIONAL NEEDS

Land distribution is very skewed. Over 50% of households own only 6.6% of the total cultivated land, while more than two-thirds of the households own less than a hectare, and about 10% of the households are landless.

The National Planning Commission had fixed for a variety of planning purposes minimum daily calorie requirements based on WHO guidelines, adjusted for climatic variations and demographic composition. These are 2,140 kilo calorie (kcal) per capita for the terai and 2,340 for both hills and mountains (higher to account for higher requirements due to climate conditions), for a national average of 2,250. The daily calories intake per capita in 1995 is estimated to be 2268 Kcal.

Effective food demand is a different matter and depends on income, prices and other socio-economic factors. There is dominance of foodgrains in local food consumption. Aggregate cereal consumption is higher in the terai (a cereal surplus region) relative to the hills/mountains (a deficit region). In general, rice is preferred than maize or wheat. The current consumption pattern largely reflects the subsistence nature of the economy.

3.2 LAND USE

There are three distinct and parallel ecological zones which run east to west: the southern terai plain starting from less than a 30 meters to the midhills and then up to the northern mountains scaling higher than 8,800 meters. This variation in agro-ecology suggests corresponding microclimates ranging from tropical to temperate regimes. Hence, the physiography provides opportunity for growing large number of agricultural commodities.

The present land use suggests that some 20% of the country's land is under cultivation, about 7% further suitable for agriculture but not farmed yet (Table 3.1).

Table 3.1. Land Use Statistics ('000 ha)

Item	Area (000 ha)	Percentage
Agricultural land cultivated	2,968	20.1
Agricultural land uncultivated	987	6.7
Forest (including shrub)	6,306	42.8
Pasture	1,757	11.9
Other	2,730	18.5
Total	14,748	100.0

Source : ASD, MOA, 1998.

Forest land covers significant (42.8%) portion of the nation, and pasture about 12%. However, degraded forests and overgrazed pasture have aggravated the already deteriorating soil fertility impacting adversely on the quest for increase.

Of the kingdom's total area, 42% falls in the mid hills, 35% in the mountains and the rest 23% in the terai. In terms of the cultivated land the terai, hills and mountains account for 42%, 50% and 8% respectively. Taking into account the gross cropped area, the terai alone accounts for 53%; and 48% of the area is under food crops.

3.3 IMPORTANT AGRICULTURAL PRODUCTS

3.3.1 Food crops

Paddy, maize, wheat, barley and finger millet are the major food crops in Nepal. In terms of hectarage, paddy alone occupies 46% of the cropped area. Similarly, maize and wheat respectively are the second and third important food crops (Table 3.2.1). Millet and barley are the minor crops. On the production front the contribution of these crops to the national granary follow the same pattern as in the hectarage.

Table 3.2.1 Area, Production and Yield of Major Food Crop, 1997

Crops	Area (000 ha)	Production (000 MT)	Yield (MT/ha)
Paddy	1506.0	3641.0	2.42
Maize	799.0	1367.0	1.71
Wheat	640.0	1030.0	1.61
Millet	262.0	285.0	1.08
Barley	35.6	37.0	1.04
Total	3242.6	6360.0	

Source : Agricultural Statistics Division, Ministry of Agriculture, Nepal.

Nepalese agricultural policy is based on food deficit implying that the investment efforts are geared towards raising the productivity of agricultural commodities. Past experience with agricultural growth shows only 3 percent a year, during the past two decades. The productivity of most major food crops have not increased appreciably. The increase in production comes mostly from area expansion rather than the realization of green revolution as witnessed by some

countries in South Asia. Annual growth rates of paddy and wheat were respectively 0.54% and 0.29% in 1961-63 to 1991-93 (APP, 1995).

3.3.2 Non-cereal crops

Fruits, vegetables, potato, oilseed, sugarcane, pulses and tobacco are other non-cereal crops grown in the kingdom. These have registered slow growth over time, except in fisheries and sugarcane. Table 3.3.2 shows the area, production and yield of major non-cereal crops.

Table 3.2.2. Area, Production and Yield of Non-cereals, 1988-89 and 1997-98

Crops	1988-89			1997-98		
	Area (000 ha)	Production (000 MT)	Yield (MT/ha)	Area (000 ha)	Production (000 MT)	Yield (MT/ha)
Potato	81	641	7.86	116	972	8.4
Oilseed	155	99	0.64	179	110	0.6
Sugarcane	29	903	30.6	49	1763	36
Pulses	262*	154*	0.59*	310	211	0.68
Tobacco	7	5	0.7	4.8	3.8	0.79
Fruits	56**	378**	9.97**	65	415	9.49
Vegetables	140*	1128*	8.0*	150	1449	9.6
Fish***	4.4	6.98	1.6	5.4	12.4	2.3

*1991-92; **1993-94, yield of productive trees only; ***Data of pond fish culture only; area pertains to water surface

Source : ASD, MOA, 1998

3.3.3 Use of Modern Technology

High yielding varieties (HYVs) and chemical fertilizer are the key modern inputs that augment agricultural productivity significantly. Irrigation, of course, interacts positively to this effect. Cultural practices and judicious use of pesticides have their role to play.

A government owned Agriculture Inputs Corporation (AIC) used to be the sole distributor of chemical fertilizer. A shift in fertilizer policy has resulted into the deregulation of fertilizer sale which depends on complete importation since there is no fertilizer factory in the country. Privatization has been slow because of the absence of fertilizer act.

The consumption of chemical fertilizer is one of the lowest in the world, about 30 kilograms of nutrient per hectare. In 1997-98, area planted to HYVs in paddy, maize and wheat stood at 64%, 64% and 87% respectively. Nepal's agricultural research has placed thrust on major cereals for food security reasons. But numerous micro-climatic regimes have constrained the adoption of HYVs, among other things.

Because of the difficult and rugged terrain in the hills and mountains, farm mechanization is limited to the terai plain alone. Average landholding size is small (about 0.95 ha), and fragmentation is widespread.

Popular cropping pattern is paddy based in the irrigated lowland, followed by wheat, pulses or vegetables in the winter. In the mid hills summer maize dominates the cropping pattern in the

uplands, followed by wheat in the winter. Many cropping patterns are practiced as there are varied micro-climates.

Production losses are encountered both in the store and on the farm. Typical losses in cereals range normally from 5-15%.

Most of the cereals are traded internally as food deficit does not permit exportation.

3.4 FOOD BALANCE SHEET

Table 3.3 shows the edible cereal grain production requirement and the balance.

Table 3.3 Edible Cereal Grain Production and Requirement in Nepal, 1989-90 and 1996-97.

Crops	1989-90 (MT)	1996-97 (MT)
Rice	1,831,713	2,002,747
Maize	857,846	894,779
Wheat	667,972	827,438
Millet	184,546	236,982
Barley	7,510	10,641
Total	3,549,587	3,972,587
Requirement	3,559,011	4,079,135
Balance	-9,424	-106,548

Source : Marketing Development Division, Department of Agriculture, 1998.

The increasing food deficit is primarily due to higher population growth which has outpaced the agricultural growth. The food shortage is especially in the hills and mountains.

4. PRESENT STATUS OF RURAL DEVELOPMENT

4.1 THE COUNTRY

The kingdom of Nepal is a land-locked country between India and China. Communications with the outside world came relatively recently while the internal road network is still at an early development state. Large parts of mountain and western part of the country are almost totally undeveloped with no vehicular access. Several other rural areas of the country lack good access and essential infrastructures.

Nepal is one of the least developed countries with a per capita income of US $ 200. With a population of about 21 million, 90% earn their living in agriculture, and out of the total area of 147,181 km^2, only some 3 million ha are cultivated. The terai, hills and mountain represent 45%, 47% and 8% respectively. Female slightly outrun the male population with a ratio of 1.03.

Population growth remains high at 2.5% per year (1981 -91). The incidence of poverty is growing as the proportion of poor in the total population has increased from 31% in 1977/78, 42% in 1984 /85 to 45% in 1996. Nepal lags behind other South Asian neighbors not only in economic progress but also in key human indicators - such as adult literacy, mother and child mortality, food consumption, provision of safe water, sanitation, health services etc. The adult literacy rate is very low at around 27% (12.8% for women and 39.7% for men). The net primary school enrollment is 64 and the net secondary school enrollment rate is 30%, with the rate for girls only

about a third of that for boys. (Development Corporation Report, UNDP, 1995). About four-fifth of the total population has no access to sanitation and nearly half is deprived of potable water. Two-thirds of under-five deaths are associated with malnutrition and only six percent of births are attended by trained health personnel. The maternal mortality rate is at 8.5 per thousand and the infant mortality rate is 98 per 1000. The UNFPA report (The State of World Population 1997) shows that life expectancy at birth for male stand at 57.6 and for female 57% which is modest increase from 1991 census with 53 for female and 54 for male. Some eighty percent of the population live in rural areas and are restrained by poor natural resources, hilly and mountainous terrain and under developed infrastructure, which have combined to limit agricultural development and thus perpetuate poverty.

Various physiographical, geological and hydrological factors contribute to the high incidence of natural disasters, e.g. the seismic faults passing through the country, the high elevation of the mountain slopes, and high skewed rainfall due to monsoon. At the same time, the pervasive poverty and the rapid population growth have further compounded the disaster scenario of the country, causing the high degree of environmental deterioration, and the increased encroachment in the marginal lands. Of all the major hazards, earthquake is potentially the most devastating. Most of the housing in Nepal are vulnerable even to moderate earthquake. Earthquakes of 1934, 1967, 1980 and 1988 are considered devastating. In these earthquakes alone more than 17,000 people lost weir lives.

In Nepal, monsoon clouds bring torrential rainfall to the southern slope of the Himalayas, which causes landslides and flash floods in the middle hills and floods in the terai plains. Floods and landslides will continue to become a growing threat to the country, since the natural erosion in the hills and mountains is being accelerated by geological processes and human interventions. The increased deforestation and indiscriminate cultivation have aggravated the soil erosion in the fragile mountain ecosystem.

Drought is another disaster effecting the lives of people. The severe drought of 1981/82 caused heavy damage to crops leading to a decline of 1.4% GDP. Drought of 1994/95, also did considerable damage to agricultural production.

The incidence of poverty is much higher in hills and mountains than in the terai. More striking are the difference in the level of poverty between rural and urban areas. As a result of low income and high prices due to poor transport network, the terai surplus does not easily flow to the hills and mountains districts, rather much of the surplus goes to India. One implication of this from a food security perspective is that food adequacy at the national level is not a sufficient guarantee for Nepal's food security. The proportion of people in rural areas under poverty line is much higher as compared to the urban areas.

The rate of underemployment in Nepal is found to be about 40% of the available person days per year. With this, the rural poor lack land asset as the average operational land holding of a poor farmer is reported to be about 0.14 ha per capita in terai and 0.05 ha per capita in the hills. The absence of year round irrigation facility coupled with this small land holding keeps a farmer at subsistence level and underemployed on his farm. The major assets which a poor person possesses is the unskilled labor which s/he is compelled to sell at desperately low wage. As there is excess supply of unskilled labor force, their marginal productivity is almost negligible. In addition, the absence of off-farm employment opportunities has made the demand for labor highly seasonal.

Currently, agriculture can provide gainful employment for 55 days a year in the hilly region and 180 days in terai. Alternative employment opportunities are very limited in rural areas. It is because of this economic desperation that many laborers migrate to urban areas, and to India temporarily to work as unskilled laborers.

Ecologically, there has been a shift of population from rural to urban areas, and also from hills to terai. Total urban population accounted for 6.3% in 1981 while it registered 9.2% in 1991 and it is growing annually. Further, population growth in terai is higher than in hills and mountains. This can be attributed to hill-to-terai migration. Because of increase in population, the pressure on arable land has tremendously increased, resulting in annual deforestation of 58,000 ha (3.5% annual rate of deforestation). The very high population density to arable land (8.6 persons per ha), has forced the farmers to cultivate marginal land and encroach forest area which, in turn, leads to soil erosion and declining crop productivity. Excessive siltation and flash floods have become common due to rapid degradation of natural resource base.

4.2 ECONOMIC AND SOCIAL POLICIES

All planning documents in Nepal have recognized the high incidence of poverty and food insecurity. Hence, one of their stated objectives has been poverty alleviation. Governments have realized that poverty in Nepal is so widespread that it can only be eradicated through rapid growth in food production and incomes in rural areas, where the majority of the poor are located. Nepal, unlike many developing countries, never has a program of large-scale direct intervention in the food sector, such as generalized, or even targeted, subsidies. Therefore, general agricultural and rural development policies and programs were one and the same thing as food security programs. In view of the higher incidence of food insecurity and poverty in remote hills and mountain areas, the government implemented with donor support in the 1970s and 1980s a number of integrated rural development programs which had food and nutrition components. In addition, several programs were in operation aimed at improving nutrition situation for targeted groups.

The government also implemented a number of income generating credit programs targeted at the poor. The largest among these is the Small Farmer Development Program (started in 1975) which currently covers about 180 000 farmers throughout the country. Similar programs launched in the early 1980s were Production Credit for Rural Women (1982) and Intensive Banking Program implemented by commercial banks. More recent targeted programs include Rural Self-Help Fund, which aims to assist selected NGOs to help the poor take up productive, income generating, labor intensive activities on a group basis, and the Grameen Bikas Banks which, together with Grameen Bank Replicators established by NGOs, has a current membership of about 45 200 poor women organized in 9 100 groups. In addition, two large-scale employment generating programs that have been completed or on-going for some time are Special Public Works Program, sponsored by the ILO, and the Food-for-Work Program of the WFP.

4.3 DECENTRALIZATION / DEMOCRATIZATION

Decentralization has been one of the policy cornerstones embedded with the 1990 constitution promulgated after the restoration of democracy after a popular revolt. The main purpose is to empower local bodies, Village Development Committees and District Development Committees, to transform them into local self-governments able to bear responsibility of planning, implementing, and managing resources at local level as well as to institute sustainable development as the prime objective of decentralization. Local election has been held in accordance with the 1997 decentralization ordinance and the Decentralization Act 1999 has been enacted. With this Act, the local governments will be able to address the development issues at the local levels.

Stable government at the center backed by absolute majority in the House of Representatives is the prerequisite for attracting foreign investment and long-term planning of sustainable development activities. Recently, in May 1999, Nepal went to the national polls for the House and a government with absolute majority of a single right wing political party along with a strong opposition dominated by a communist party has been elected. This important event is expected to create a conducive environment for the country's overall development.

5. FUTURE SCENARIOUS AND AIMS

5.1 GROWING SCARCITY OF WATER RESOURCE

Increasing population and industrial expansion, together with a growing demand from urbanization and irrigation sector is to continue to result in increased competition for water. In terms of volume, irrigation is the greatest water user with over 95% of the total water consumed being used in this sector. When considering the various sectors of water users, water supply for households both socially and legally has been given high priority and this is followed by agriculture. Industrial expansion (including tourism), though at present not consuming much water, is another national objective requiring more and more water with its expansion.

On the supply side, Nepal's water sources are facing many environmental hazards. The quantity of dependable flow is reported to be declining and the peak monsoon flows increasing due to the loss of vegetative cover in the catchment area while the quality is also declining due to increased pollution.

When looking at the varying annual volumes of water available and the growing demands from the various sectors, the average total volume of water available for irrigation is expected to decrease and the variability of supply to increase. Uncertainties will increase making it more and more difficult to plan cropping calendars for irrigated agriculture.

Statistical figures indicate that there is plenty of water in Nepal, the question is how much of the water is actually available for irrigation at the time of requirement at a reasonable cost. With substantial investment already made in the irrigation sector, cost of irrigation per hectare is increasing as economically feasible schemes have already been taken up. Most of the irrigation projects constructed by the government divert water from medium size rivers originating from the middle hills. These rivers, though perennial, have wide seasonal functions in discharge. The unreliable river flows coupled with the inefficient management appear to be the factors contributing to poor performance of the irrigation systems. Tapping the large Himalayan rivers for irrigation and/or hydropower generation, though promising, needs bilateral and multilateral cooperation as well as considerable resources.

5.2 NEEDS FOR RIVER BASIN APPROACH

It is increasingly being realized that the goal of optimizing the beneficial utilization of water in all its dimensions can only be achieved by analyzing water use in the context of water balance of the whole river basin. This is essential as water resource systems are highly integrated systems and apparent gains in one part of the system can be offset by losses in other parts. Similarly, one system's drainage can be another system's water supply. Looking into the water scarce scenario in some of the river valleys, inter basin diversion (e.g. Sunkoshi - Kamala, Bheri -Babai, etc) are also planned for the future.

5.3 CONJUNCTIVE MANAGEMENT OF SURFACE AND GROUNDWATERS

Groundwater is another accessible resource in the terai. One estimate suggests that 726,000 ha of terai land have good potential for shallow tubewells (STWs) and another 305,000 ha have marginal potential. A further 190,000 ha show good potential for deep and medium tubewells. However, this area overlaps the STW area by an unstated amount.

As surface water alone because of seasonal flow variations at the systems river source, are unlikely to provide year round irrigation, development of groundwater and surface water schemes for conjunctive management is a viable option for the increased agricultural production and rural development.

5.4 REGIONAL COOPERATION

Nepal's four major rivers, Koshi, Gandak, Karnali and Mahakali contribute about 71% of the Ganges dry season flows and 41% of the total annual flows. With a high population density and an escalating demand for water in the Gangetic plain, there is an increasing tendency to use water in the territories by the upper riperian, be they sovereign nations or even states within that nation. Nepal and India have separate agreements for Koshi, Gandak and Mahakali. Similarly, India and Bangladesh have Farakka Treaty on the sharing of the Ganges waters, Regional cooperation especially on the water resource development and management among these countries would be in their common interest which could be materialized through negotiations.

5.5 HIGH PRODUCTIVITY GROWTH SCENARIO

As proposed by APP the irrigated area in Nepal is to be substantially increased in the next two decades. Year-round irrigation is the main component of APP strategy. The Plan calls for 34 thousand hectares to be added per year to the year round irrigated area, on an average of this about 70% is from groundwater irrigation. By the end of APP period, the unirrigated area will decline to 14% of the arable area in terai and 67% in the hills. In addition, it assumes increases of 50% in the growth rates of research expenditures and modern variety coverage. The APP aims at increasing the agricultural growth from the previous trend level of about 2.3% to 5%. It is expected that in an agriculture dominated economy, agricultural growth stimulates also the growth in non-agriculture sector. The growth in agriculture helps poverty alleviation first through the increase in agriculture sector and then also through induced effect in non-agriculture sector. It is estimated that through the successful implementation of this plan, poverty will be reduced to 14% from the present level of over 45% population below poverty line.

6. CHALLENGES FOR THE FUTURE

6.1 MAJOR CHALLENGES AND CONSTRAINTS

The major challenge facing Nepal in agricultural development, food security and rural development on the way to 2025 is growing food deficits, both nationally and locally, which has pushed the incidence of food insecurity to unacceptable levels. Other possible consequences include rapidly rising and unsustainable food import bills and further environmental degradation, as farming moves on to marginal areas.

A consensus exists on the constraints to rapid growth of agriculture in Nepal. Despite government efforts over the past three decades, agricultural productivity remains very low, relative to what has been proven to be economically feasible in Nepal as well as achievements in similar environments in India. Moreover, a high rate of population growth also reduced the benefits from whatever progress there was made in production and incomes. Public sector investments in key areas such as irrigation, research and extension proved to be much less effective than expected. Also, agricultural policies suffered from a lack of clear focus and implementation was weak.

Categorically there are five major problem areas which have adversely affected the performance of the agricultural sector in Nepal. First, the government assisted irrigation systems which have received the major share of investment in agriculture in the last three decades have been performing below expectations in terms of reliable and adequate water delivery to farmers, thus limiting gains from new agricultural technology. Second, the public sector, which until recently had a monopoly on the importation and distribution of fertilizer, failed to meet the demand of farmers to substantially improve crop productivity. Third, the lack of responsiveness of research system to the actual conditions of farmers in the design of new technology has been a major problem. The failure to develop technology for rainfed and low input conditions, which predominate in the country, has constrained agricultural growth. Fourth, neglect of marketing in government agricultural programs has severely limited growth even in those areas where farmers

have demonstrated their ability to generate surplus production. Fifth, the macro economic policy environment which prevailed in the past was not particularly conducive to agricultural growth. The exchange rate discouraged agricultural exports and pricing policies for major inputs and outputs remain distorted. Also, public sector undertakings enjoyed preferential treatment and private sector faced restrictions.

6.2 POLICY, INSTITUTIONAL IMPLICATIONS AND MAJOR ISSUES IN IRRIGATED AGRICULTURE

A detailed analysis of past weaknesses in the area of policy and institutional and proposed changes required for achieving the targeted high growth rate in agriculture are rumanarized in the policy and institutional matrix.

In irrigation the following issues have been identified :

- Developed irrigation facilities not utilized to the optimum/lack of basic inputs
- Organization and management deficiency
- Problem of cost recovery, adequate operation and maintenance
- Problem of high cost of irrigation projects
- Lack of objective criteria for guiding investment in irrigation development
- River management
- Adoption of new technology/poor research base.

These issues and the associated constraints along with the strategies to be taken in the future are summarized in the following matrix.

Nepal - Policy and Institutional Matrix

Policy	**Constraints**	**Actions**
Population	High population growth	Step by efforts to control population, step up women's and information education
Public sector investment	Thin distribution of agricultural investments in large areas	Concentrate public-sector resources to priority areas as identified by the APP (irrigation, fertilizer, research and agricultural roads)
Decentralization and private sector development	Weak local political bodies to plan and implement; weak private sector to provide technical services; insufficient decentralization of power and resources	Speed up decentralization program; empower local political bodies and increase their capacity to plan and implement; encourage NGOs; create a conducive environment for maximum participation of private sector in inputs delivery and services
Institutions	Slow response of institutions to changing development needs; agrarian institutions not supportive of high agricultural growth; impediments to marketing	Create new and/or reorient existing institutions as called for in the APP (e.g. capacity in agricultural roads, groundwater); reform land tenure laws to encourage investment by tillers on land; take measures, including

		legislative to create competitive markets
Inputs and technology	Insufficient supply of inputs, constrained both by subsidy policies and weak delivery capacity; fragmentation of research resources and manpower	Eliminate subsidies that have constrained aggregate supply in the past; involve private sector in delivery of inputs, credit and services; re-orient agricultural research resources as called for in the APP; shift priority to groundwater and support farmer managed irrigation systems; strengthen private sector capacity in groundwater development.

7. POLICY DIALOGUE MODEL (PODIUM)

The Podium model developed jointly by IWMI (International Water Management Institute and IFPRI (International Food Policy Research Institute) has been used to determine increasing grain requirements and water demand. The model also computes the production of the required cereals using data and estimates of yields and cultivated areas both in rainfed and irrigated conditions.

Issues, constraints and strategies in irrigation sector

Issue	Constraints	Strategies
Performance of Public Sector Irrigation Schemes	Poor Maintenance (canal and drainage system deterioration, siltation) Ineffective control structures (water losses, untimely delivery)	Management Transfer to Users Full Recovery of O&M needs from users Conjunctive Management Interbasin water transfer
River Management	Deforestation in Watersheds Flood plain encroachment Inundation in tail reaches	Integration of watershed management with rural development programs Participatory mode of implementation Promote intersectoral linkages Develop common programs with the neighboring SAARC nations
Costs of Irrigation Projects (Surface and Groundwater)	Poor planning design, technology, non-involvement of farmers Poor quality of construction Involvement of expensive consultants Weak construction industry Time/cost overruns	Strengthen planning, M&E Adoption of low cost and environment friendly technology / Groundwater legislation Use local experts/labor/ construction materials Strengthen R&D and develop linkages with sister agencies.
Criteria for guiding investment in irrigation development/management	Investment based on supply considerations and ad hoc decisions inefficient water use	Investment plans based on objective criteria Promote conjunctive water management

	Seasonal irrigation Lack of conjunctive water use Policy gaps/implementation	Participatory mode of program development On-farm water management introduce micro irrigation.
Organization and Management	Lack of accountability of public institutions to users Limited skills/motivations of agency staff Weak agriculture - irrigation sister agency linkage Lack of data	Strengthen water users associations (WUAs) Active involvement of women farmers Involve private sectors (NGOs) Strengthen planning/design Develop linkages with other institutions Strong monitoring

RESULTS

According to the UN medium projection, in the next 25 years Nepal's population will grow from 21.9 to 38.0 million people. The urban population is growing at a faster rate than the rural. In 1995, 90% lived in rural areas, whereas in 2025 it is predicated that 77% will live in rural areas. It is foreseen that the calorie intake will increase along with income from 2268 Kcal/day/cap in 1995 to 2700 Kcal/day/cap in 2025. Meat consumption increases slightly but the bulk of food consist of grain (70%). The population growth combined with changes in diet will lead to an increase of grain requirements from 3.97 million ton in 1995 to 8.3 million ton in 2025. This is compatible with predictions made by Thapa and Rosegrant (Winrock, 1995), using the high-income scenario. Over the last decades Nepal tried to be self-sufficient in grains. The last few years the gap between consumption and production is increasing since the population growth is higher than the growth in agricultural production. Still, the import is very small in comparison with the domestic production. If Nepal is to be self-sufficient in grains in 2025, what will be the requirement in terms of land and water resources? The APP mentions an increase in irrigated area of 34,000 ha per annum during the coming 20 years from 1995 onwards, that is from 0.88 million ha to 1.56 million hectares in 2015. If this growth rate can be maintained till 2025 the ultimate irrigation potential of 1.7 million hectares will be reached. If the irrigation intensity improves to 150% irrigated cereal yields (milled rice equivalent[1]) need to increase from 2.0 to 3.5 ton/ha. An enormous investment will be needed to expand the irrigated area to this extent. If irrigated cereal yields would double from 2.0 to 4.0 ton/ha and the intensity reaches 175%, only 1.23 million hectares of irrigated area would be needed, instead of 1.7 million hectares. More emphasis on productivity and intensifying agriculture at the existing irrigated area might prove a cheaper and more achievable option, than doubling the irrigated area. Water withdrawals for irrigation will be around 10 km3 in the year 2025, depending on the scenario chosen. This is less than 6% of the available water resources.

CONCLUSION

Water availability will not be a limiting factor for development in the country. However, substantial increases in agricultural production will be needed if Nepal is to be grain self-sufficient by the year 2025. Over the last decades the emphasis in the irrigated sector has been laid on expanding the irrigated area. However, the productivity of the existing irrigated area is stagnating at a very low level, whereas in rainfed areas yields show even a declining trend. To achieve grain self-sufficiency yields in irrigated area should be improved considerably. If this is not achieved, Nepal will be food importer by 2025, despite the huge investments in the construction of irrigation infrastructure, foreseen in the APP.