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THE INCOME, EMPLOYMENT, AND NUTRITIONAL IMPLICATIONS OF NEPAL'S AGRICULTURAL POLICY

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FOREWORD

The Cornell Food and Nutrition Policy Program (CFNPP) was created in 1988 within the Division of Nutritional Sciences to undertake research, training, and technical assistance in food and nutrition policy with emphasis on developing countries. The Nutritional Surveillance Program (CNSP), which was formed in 1980 with support from the Agency for International Development, is part of the CFNPP.

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In this lecture professor Daniel Sisler discusses existing agricultural policies in Nepal in the context of the country's development plans, the ecolological opportunities and constraints, and the nutritional situation. Severe poverty, poor sanitation, and widespread health problems contribute to a high prevalence of malnutrition among Nepalese children. A series of links between malnutrition and agriculture are identified and analyzed and the author examines a number of options for improving nutrition through changes in the agricultural sector including technological change, expanded livestock production, changes in land tenure, and price policy.

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Per Pinstrup-Andersen
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THE INCOME, EMPLOYMENT, AND NUTRITIONAL IMPLICATIONS OF NEPAL'S AGRICULTURAL POLICY

by

Daniel G. Sisler*

I. INTRODUCTION

Nepal is a small landlocked country sandwiched between its giant neighbors—China on the north and India on the south. The nation's spectacular beauty, composed of the highest mountains in the world, cascading rivers, lush valleys and symmetrical stair-step terraces, conceals the poverty, unemployment, illness and malnourishment of its people. Per capita national income is less than $185, making it one of the poorest countries in the world. Income is not only meager, but it is poorly distributed. A recent study indicated that over 40 percent of the people live in households with per capita income less than $90 per year. Nepal is one of the most densely populated agricultural countries in the world. There is only about .16 of a hectare available to produce food for each member of the population. Despite land reform efforts, land holdings are highly skewed. The poorest half of the farm families own only 7 percent of the agricultural land which corresponds to one-tenth of a hectare per household. The nation's health facilities are very limited. There is only one doctor for every 30,600 people, and infant mortality is more than 14 percent. Descriptive statistics of Nepal are presented in Table 1.

*This lecture is primarily a compilation of the findings of other researchers. The author is particularly indebted to Pradeep Tulachan, Ganesh Thapa, Ram Yadav and Bishnu Bhandari for substantial inputs. Their research was invaluable in preparing this lecture.

TABLE 1. CHARACTERISTICS OF NEPAL WHICH BEAR ON NUTRITIONAL STATUS OF ADULTS AND CHILDREN, 1985

Annual Population Growth (1974/84)	2.7 percent
Cultivated Land/Capita	0.16 hectares
Fertilizer Used Per Hectare	11.4 kilos
Grain Yields	
Paddy	2.1 met. tons/hectare
Maize	1.2 met. tons/hectare
Wheat	1.5 met. tons/hectare
Grain Production	160 kilos/capita
Per Capita Income	$185
Literacy Rate	19.0 percent
Population per Doctor	30,600
Life Expectancy (females)	46 years
Infant Mortality (per 1,000 under one year)	142

Sources: World Bank 1986; Wallace 1987, Working Paper 1987.

More than 90 percent of Nepal's population depends on agriculture for their livelihood. Agricultural output constitutes two thirds of the nation's gross domestic product (GDP) and in recent years agricultural exports have earned about 40 percent of Nepal's foreign exchange. If genuine economic development is to take place in Nepal, it will have to be led and supported by growth in the agricultural sector.

Nepal may be divided into four distinctly different regions: the terai, the middle hills, the mountains and the Kathmandu Valley. The zones are roughly parallel east-west bands with altitude being the dominant factor of demarcation. The terai is subtropical, the hills and Kathmandu Valley temperate and the mountains alpine. The terai region lies along the southern border of the country. The topography of the terai or plains region is flat to gently undulating with elevations ranging from 75 to 300 meters. This region is the grainery of Nepal. The major food crop is rice; however, with the advent of adopted varieties of wheat in the early 1970's, this crop has become increasingly important. The terai also produces sugarcane, tobacco and jute. Land is relatively abundant in the terai. The population density is approximately four people per arable hectare.

The middle hills comprise a wide band of steep topography, with elevations ranging from 300 to 3,000 meters. Maize is the main staple crop of the hills; millet, barley and pulses are also important crops. A large proportion of Nepal's horticultural products, meat and dairy products are produced in the middle hills. This region is one of the most densely populated agricultural areas of the world with an average of 16 people per hectare cropped.

The mountains lie along Nepal's northern border. They range in elevation from 3,000 to 8,500 meters. Potatoes, millet and barley are the food staples of the mountains and many farmers graze yaks and cattle on steep alpine pastures.

The Kathmandu Valley is important politically and as a center of population, commerce and industry. It is designated as a separate region of the middle hills. This rich agricultural valley is approximately 1,400 meters above sea level. Rice, maize, wheat and a wide variety of fruits and vegetables are produced in the valley for the

nearby population centers.

The terai produces surplus quantities of rice and wheat which are shipped to the Kathmandu Valley, the hills and mountains. The hill and mountain regions are food deficit areas; however, they export high value fruits, vegetables and livestock products primarily to markets in the Kathmandu Valley. Historically, Nepal has been a net food exporter, shipping rice and maize to India. Unfortunately in recent years agricultural production is failing in its attempt to feed a rapidly growing population. In the 1982-83 crop year, Nepal imported cereal grains—and it appears that it has been a food deficit nation for the past two years.

Between 1971 and 1981, the nation's population increased by 30 percent, from 11.6 million to 15.0 million—an average of 2.3 percent per year. During the same period the production of major food grains grew by less than 12 percent from about 3.5 million metric tons to 3.9 million metric tons—an average increase of 1.1 percent per annum. In 1971 the average food grain availability was approximately 220 kilograms per person per year. By 1981, grain availability per person had fallen to 180 kilograms, and today the level is probably below 160 kilograms. This translates to about 435 grams per person per day. This amount of grain will supply approximately 1,485 calories per person per day and about 27 grams of protein. Potatoes, pulses, vegetables and livestock products increase these totals to approximately 1,800 calories and 33 grams of protein per person per day.

Nutrition in Nepal is at a low level and the nutritional status of the population is worsening. The National Nutrition Survey of 1975 indicated that 66 percent of the children under five are suffering from moderate to severe protein energy malnutrition (HMG 1975). More recent studies from various parts of the country indicate a higher

prevalence of protein calorie malnourishment, and severe shortages of iron, iodine, vitamin A and other micronutrients (Martorell et al. 1984). These statistics paint a bleak picture of the status of the nation's people. Nepal's lack of infrastructure, particularly roads, electrification and communication, severely limit the prospects of government policies designed to improve the economic and nutritional well-being of its people.

II. AGRICULTURAL POLICY

Against this backdrop of poverty, malnourishment and declining availability of food per capita, Nepal has introduced agricultural policies designed to increase the availability of food and improve the equity of its distribution. Nepal's agricultural policy in recent years has focused on four broad goals: (a) to achieve sufficient growth to feed the rapidly growing population; (b) to improve the equity of food distribution; (c) to improve the nutritional status of the nation's population; and (d) to provide for greater food security by buffering annual variability in grain production.[1] To reach these goals, His Majesty's Government (HMG) has primarily emphasized increased production of grain—particularly paddy, wheat and maize.

The history of Nepal's agricultural policies over the past 35 years can be traced through the emphasis given to the agricultural sector in the seven five-year development plans.

The central focus of the first four five-year plans (1956-1975) was to improve the infrastructure and institutions required to increase agricultural production. Emphasis was given to roads, irrigation systems and rural electrification. During this period, a rudimentary

[1]For material in this section of the lecture, the author is deeply indebted to Dr. Michael Wallace for his excellent analysis of Nepal's food pricing policy (Wallace 1987).

agricultural extension service was established. A significant number of development grants and loans from China, India, Great Britain, the United States and the World Bank were used to construct an improved farm-to-market road system.[2]

The fifth five-year plan (1975-1980) gave specific emphasis to the agricultural sector. A basic strategy for agricultural development was to be built on the differential comparative advantage of the terai, the hills and the mountains. The terai was to specialize in cereal grains and commercial crops such as jute, sugarcane and tobacco. Farmers in the hills were to concentrate their efforts on the production of fruits and vegetables, while farmers in the mountains were to increase production of livestock products.[3] During this planning period the government of Nepal instituted nominal price supports for paddy and wheat, and provided fertilizer at a uniform subsidized price throughout the nation. By the sixth five-year plan (1980-85) it was recognized that a combination of factors made the strategy of exploiting regional comparative advantage infeasible. The road system was inadequate to either provide agricultural inputs in a timely fashion or to move agricultural products, and hill farmers were unwilling to rely on a distant and precarious source for their grain requirements. The sixth five-year plan called for a 180 degree switch in strategy. Grain production was to be emphasized in the hills in order to meet chronic deficits. Hill farmers were also encouraged to increase production of livestock and horticultural products; however, with increasing land pressure, it was unclear as to how these strategies were to be carried out. Under this plan, the terai was to increase rice and wheat

[2]For a complete discussion of improvements in Nepal's highway system form 1960-75, see Ender (1980).

[3]For a complete discussion of the fifth five-year plan, see Calkins (1976).

production and provide increasing quantities of agricultural raw materials and grain for industry and export.

The seventh five-year plan (1985-90) was drafted in an atmosphere of food crisis. The government stated that national food production was insufficient to meet the needs of the people and in the hills food shortfalls were so frequent that they had "almost become an annual feature" (NPC 1984, p. 87). The plan stated that the cost of transferring food from the terai to the hills and mountains was imposing an increasingly large burden on government funds. It went on to point out that as these transfers within the nation rose, Nepal's agricultural export earnings had fallen dramatically. The seventh plan gave agricultural production the highest priority and set several ambitious goals.

Gross domestic product was projected to increase at an annual rate of 4.5 percent during the plan period. The agricultural sector was expected to grow at an annual rate of 3.5 percent and the non-agricultural sector at a rate of 5.7 percent. Food grain production was targeted to grow at an annual rate of 4.1 percent. The plan also stated that the hills and mountains were to be self-sufficient in food by 1995. These goals were to be reached by increasing agricultural research, increasing area under irrigation, improving availability of fertilizer and the distribution of high-yielding varieties of grains (NPC 1984).

It is instructive to examine the various agricultural policy tools used during the three most recent five-year plans (1975 to the present). The tools may be divided into three broad categories: price supports for cereal grains, fertilizer subsidies and agricultural research. This list ignores government efforts to increase the area under irrigation. Irrigation has undoubtedly been an important factor in increasing food production in Nepal, but statistics are not available to

document the increase in hectarage of land irrigated. Where data are available, it is extremely difficult to separate the increase in irrigated area attributable to governmental projects from the area irrigated as a result of private enterprise.

A. Price Supports

The government of Nepal has had nominal price supports for wheat and rice for more than a decade. In 1976-77 support prices for these two grains were established by the Central Food Management Committee on the basis of estimates of: production levels in recent years, transport costs and the level of price supports in India. Support prices for paddy and wheat have not significantly influenced the production of grain nor the prices paid by consumers. Typically, procurement prices have been consistently lower than open-market prices. The government announces prices well after harvest. This timing is inappropriate in terms of influencing planting and does not affect the purchase of fertilizer or other agricultural chemicals. By the time planting decisions are made, market prices have risen well above support levels. Until HMG makes a firm commitment to forward pricing and sets price levels high enough to encourage the use of modern inputs, price incentives will not serve as a tool for increasing cereal grain production. If price supports are provided at the correct time, it is imperative that the government have sufficient funds to back up these price guarantees by purchases through the Nepal Food Corporation. It must also be kept in mind that the Indian support price is crucial to any decision which Nepal makes. The border is open and Nepalese price support levels in the terai cannot exceed those of India by more than transportation costs.

Seasonal price swings continue to be acute in Nepal despite

government price supports. This is particularly harsh on poor farmers, most of whom are forced to oversell grains soon after harvest to pay off debts. At this time, prices are at their seasonal low. Prior to the next harvest, these farm families need to buy back grains at inflated prices to meet food requirements. Since few off-farm employment opportunities are available, the farmers borrow to purchase these grains and the "debt-price treadmill" is perpetuated.

B. Fertilizer Price Policy

Nepal has a very high number of cattle and buffalo per hectare of arable land. Historically manure has been the principal source of plant nutrients. With increasing amounts of land irrigated, double cropping and improved varieties of rice, wheat and maize, increased use of chemical fertilizer is essential. All chemical fertilizer used in Nepal is imported by the government. The farm-level price of fertilizer is highly subsidized and kept uniform throughout the nation. This policy of a single nation-wide price represents an attempt to insure equity and encourage fertilizer use in remote areas which are chronically short of food. In some cases the transport costs are equal to, or exceed, the value of the fertilizer. The government reasons that it is more costly to transport food to the deficit hill and mountain districts than to transport fertilizer.

Fertilizer sales have quadrupled over the past fifteen years and clearly increases in food production over this period are in part attributable to increased availability of fertilizer. Annual fertilizer sales are now over 100,000 metric tons and are increasing at approximately 15 percent per year. A large part of the fertilizer is donated as development assistance, and in recent years the Asian Development Bank and the World Bank have provided substantial

loans for importing fertilizer. Despite increasing use of fertilizer in Nepal, farmers apply only about 11 kgs of chemical fertilizer per hectare. This is one of the lowest application rates for any nation in the world. Fertilizer use in Nepal varies greatly by region. About two percent of the cultivated land of Nepal is in the Kathmandu Valley, while fertilizer sales in the Valley amount to about 20 percent of national distribution. The terai has about 58 percent of the nation's arable land and terai farmers use about 60 percent of the total national fertilizer disbursements. Hill and mountain farmers cultivate 40 percent of the nation's crop land, and buy less than 20 percent of the fertilizer. Regional sales data indicate that Kathmandu farmers use roughly 140 kgs of fertilizer per hectare while terai farmers use 16 kgs, and farmers in the hills and mountains use less than 9 kgs of fertilizer per hectare. The uniform fertilizer price, which has been in effect since 1972, theoretically benefits the farmers in the hill and mountain districts. Two factors mitigate against increased fertilizer use in these two chronically food-deficit areas. First, supply of fertilizer is erratic, and often arrives too late for use at planting and early growth stages. Before hill farmers use fertilizer in larger quantities, they must be assured that it will be available and that the time of arrival is appropriate. A second factor is also important. Maize, millet and barley are the most important cereal crops in the hills, and lower elevations of the mountain districts. Unlike wheat and, to a lesser degree rice, a relatively small area of agricultural land in the hills is planted to fertilizer responsive varieties of maize, millet and barley.

C. Government Allocations to Agriculture

Although the last three five-year plans have all emphasized the importance of growth in the agricultural sector, HMG did not allocate

funding commensurate with plan goals. Governmental expenditures on agriculture, excluding irrigation, have never been more than 10 percent of the total governmental budget. The funds allocated by HMG to agriculture have never had a value of more than $2.50 per capita. Foreign aid in the form of grants and loans have been a significant part of total allocations to the agricultural sector. In 1985 total foreign assistance amounted to 65 percent of the funds set aside for agriculture. In particular, agricultural research has been given a very low priority when allocating governmental funds. Of the total funding provided to agriculture in the fourth five-year plan, about 32 percent was earmarked for research. In the fifth five-year plan, this percentage had fallen to 15 and by the sixth five-year plan to 8 percent. It is difficult to determine total funds allocated to research for the current five-year plan; however, it is unlikely that they will exceed 9 percent of the agricultural budget. Yadav has estimated that actual expenditures on research amount to only about .1 percent of agricultural GDP (Yadav 1987). Of the total funds allocated to agricultural research, approximately 70 percent is spent on crops, 7 percent on livestock, 9 percent on horticultural products, and 14 percent on other.

It seems apparent that Nepal must devote a greater share of agricultural research funds to improvements in buffalo, cattle, goats, sheep and forage crops. The commodity research programs, for example paddy, maize, wheat and oil seeds, are concerned with solving a specific problem or developing a high-yielding variety without considering differences in cropping patterns, resource endowments or social status of farmers. To overcome this problem, a separate farming system research unit was established. Yadav reports "that this is not a satisfactory solution since while this intermediary agency called the

Farming Systems Research Division does test research findings under actual farm conditions, it only rarely reports to the commodity research program that their technologies are inappropriate for farmers' needs" (Yadav 1987, p. 10).

III. PERFORMANCE OF THE AGRICULTURAL SECTOR

Performance of the agricultural sector in recent years has been poor. Over the past fifteen years the nation's real GDP grew at an annual rate of about 1.4 percent while the population grew at approximately 2.6 percent. Therefore there has been a decline in real per capita income. The slow growth in national income is in large measure due to stagnation in agricultural production, particularly cereal grains.

Between 1970-71 and 1980-81, production of cereal grains in Nepal increased at an annual rate of .95 percent. Over this time period cereal grain yields fell at a yearly rate of .46 percent. This was offset by an annual increase in area planted of approximately 1.42 percent. Table 2 presents annual changes in production, area and yield for major cereal grains in the hills and terai. Cereal grain production in the hills remained constant, growing at only .12 percent per year. Due to increased erosion, loss of soil fertility and expansion onto less productive land, hill yields fell at an annual rate of 1.14 percent per year. An annual increase of crop area of 1.27 percent was the only factor which kept cereal grain production in the hills from dropping precipitously. In contrast, grain production in the terai grew at an annual rate of 1.44 percent. With yields being static in the terai; the production increase was all due to expanded area.

Wheat production in the terai grew at the remarkable rate of 12.8 percent per year. As a result of increases in both yield and area,

TABLE 2. NEPAL—PERCENTAGE ANNUAL GROWTH RATE OF CEREAL CROP AREA, PRODUCTION, AND YIELD BY REGION 1970/71-1980/81

Cereal Crop/ Growth Segment	Hills	Tarai	Total Nepal
Paddy			
Area	1.98	0.71	0.93
Production	0.72	0.73	0.73
Yield	-1.24	0.01	-0.20
Wheat			
Area	2.08	8.50	5.82
Production	3.86	12.79	8.64
Yield	1.74	3.96	2.67
Barley			
Area	0.24	-3.35	-0.71
Production	-1.61	-0.20	-1.19
Yield	-1.85	3.25	-0.49
Millet			
Area	0.69	-0.24	0.54
Production	-0.54	0.16	-0.44
Yield	-1.22	0.41	-0.97
Total Cereals			
Area	1.27	1.50	1.42
Production	0.12	1.44	0.95
Yield	-1.14	-0.06	-0.46

Note: 1979/80 is omitted because it was a drought year.

Source; Yadav 1987, pg. 19.

wheat production grew at an annual rate of 3.9 percent in the hills. Among the cereal grains, wheat was the star performer. By 1987, over 97 percent of all wheat land in the nation was planted to high yielding varieties.

Rice production in the hills and the terai grew at an annual rate of approximately .7 percent. In both areas, paddy yields fell and the increased grain production was due entirely to increases in the area cropped. Absolute production of maize, millet and barley fell during the 1970-71 to 1980-81 period. This is a sobering trend since these grains are the principal grain staples for most families of the middle hills.

IV. FOOD SUBSIDIES

In addition to agricultural policies designed to increase food production, HMG has also attempted to improve the equity of food distribution. The Nepal Food Corporation (NFC) provides food subsidies to consumers by procuring grain and then reselling at prices well below market levels. The food subsidy policy has had three goals: to provide food to deficit areas, to reduce price uncertainty, and to make food available to the poorest households. The NFC was established in 1974 to procure food, operate warehouses and distribute grain in food deficit areas.

The Nepal Food Corporation procures less than one percent of its grain by purchasing directly from farmers since it offers no price incentive. Starting in 1984 the NFC began procuring grains through a levy on grain mills using engines larger than 25 horsepower. In 1986, Nepal obtained approximately 50 percent of its grain from this levy and the rest from open-market purchases from mills and cooperatives. Most of the balance of the grain is obtained from a system of

government cooperatives, private traders, and its own field offices. The vast majority of the grain procured by the NFC comes from the terai. Between 1974 and 1985 the NFC has distributed more than 400 thousand metric tons of grain.

Distribution has, by no means, been equitable nor in accord with true needs. For example it has been calculated that in 1983 the deficit in the Kathmandu Valley was 35,700 metric tons. The NFC targeted 18,000 metric tons for distribution in the Kathmandu Valley. Distribution was then over 50 percent of calculated need. In contrast, the deficit in the middle hills was calculated to be 10,100 metric tons and the distribution target was set at 2,700 or approximately 25 percent of the deficit. The Midwest mountains had a deficit of 33,700 metric tons, while the distribution target to this area was a scant 1,050 tons or less than three percent of the supposed deficit (APROSC 1984). The prices the NFC charged for grain distributed increased very little between 1975 and 1981, even though procurement prices rose significantly. As a consequence NFC losses increased markedly. As a consequence NFC losses increased markedly. To offset these losses, distribution prices were increased significantly in 1982. In some districts, prices more than doubled. The result is that NFC has lowered its budgetary losses; however, prices to consumers have risen sharply.

The Nepal Food Corporation has a management committee in each district to allocate grain allotments. Coupons are issued which entitle bearers to a given quantity of grain. A 1982 study revealed that 24 to 33 percent of NFC grain distributed was sold to the army and other government officials. It also indicated that most of what was sold to the general public went to rich households with very little reaching the poor (APROSC 1982). Other facts make the food

distribution process onerous. A significant proportion of the grain distributed is purchased by the affluent for resale to poor people, to be distilled into liquor, or for export to Tibet. Most of the grain purchased and distributed by the NFC is rice, although wheat and maize have higher calorie and protein availability per dollar of NFC expenditure. Virtually all facets of the NFC activities work to the betterment of a favored few and do not significantly help the poor.

V. NUTRITION, CROP TECHNOLOGY AND THE ROLE OF LIVESTOCK IN THE TERAI

We have seen that the performance of agriculture in the Nepalese terai will be pivotal to the nation's success in reaching objectives of economic growth and adequacy of food supply. This region has an excellent natural resource base and considerable potential for increased food production. Farms are larger than in the hills, transportation and irrigation systems are better developed, and fertilizer and high-yielding seed varieties are increasingly available. The extension service is better established in the terai than in other parts of Nepal. These factors indicate considerable opportunities for increasing the yields of most crops. There is an agricultural research station at Rampur in the Chitwan Valley which is conducting applied research on a variety of crops including forages and fodder trees. Research at this station is also in progress which will improve strains of buffalo, cattle and goats.

There is one disquieting factor relative to the terai—rapid population growth. A recent study based on in-depth surveys of two hill and two terai districts found that population of the terai is growing at an annual rate of nearly 4.3 percent while the population growth rate in the hill districts was only 2.1 percent (Karki 1988). The differential population growth rates are due in large measure to

migration of families from the hills to the more land-abundant terai. The study found that differentials in the man/land ratio between the hills and the terai are closing. The terai may experience extreme population pressure within the decade of the 1990s.

We are fortunate to be able to compare and integrate findings from three studies recently conducted in the terai. One study examines the nutritional status of terai children (Bhandari 1985). The second study contrasted the impact of agricultural technology in two terai villages: one of which has irrigation; the other does not (Thapa 1989). The third study determined the potential of livestock enterprises to improve employment and income on small farms of the terai (Tulachan 1989).

A. Nutrition

There is considerable evidence that the nutritional status of Nepalese children and adults is poor. It would be reasonable to expect that because of better food availability and higher income levels the nutritional status of children in the terai would be better than in other regions of Nepal. It would then follow that if we examine the nutritional status of terai children and find that they are suffering from protein calorie malnourishment (PCM), the problem would be more acute in other areas of the country.

In 1983, Bhandari conducted a survey of children in the Chitwan District of the terai (Bhandari 1985). Anthropometric measurements, including height, weight and upper arm circumference, were taken for 358 children to determine their nutritional status. The central focus of the study was to determine the level of protein calorie malnourishment in children under six and to identify the determinants of PCM in children of the terai. This study used the Gomez, Waterlow and upper arm circumference indices to determine the degree of malnourishment.

Bhandari's findings suggest that the prevalence of protein calorie malnourishment amongst children under six years of age in the study villages was very high, ranging from 60 to 85 percent depending on which standard was used. Ten percent of the children suffer from third degree malnutrition,[4] and about five percent suffer from concurrent stunting and wasting.

Tables 3 and 4 summarize findings from Bhandari's study. The study found a weak relationship between nutritional status of children and selected socio-economic characteristics of the households in which they live. Data from Table 3 indicate that the general nutritional status of lower caste children is somewhat better than that of higher-caste children. Several factors may explain this unexpected finding. First, it is possible that a larger number of low- caste children that would have been classified as severely malnourished have died, thereby lowering their number in the sample. Secondly, the children of low-caste households may have a more nutritious diet including barley, millet and maize as opposed to polished rice consumed by higher-caste families. Children of low-caste families may eat a greater variety of foods including eggs, poultry, pork and buffalo meat than the children of high-caste Brahmins. Kshetry children seem to have the poorest nutritional status, even though this is the second highest caste. Findings indicate that Tharu children are better off than other low-caste children. This again may be due to a more varied diet and possibly resistance to malaria. Table 4 presents the relationship between PCM and the size of land holdings. The findings indicate a weak relationship between the size of land holdings and nutritional status of children. It is interesting to note that the children of families

[4]Third degree malnourishment is present when a child's measurments are below 60 percent of the National Center for Health Statistic Standard.

TABLE 3. PERCENT OF CHILDREN UNDER FIVE WHO ARE MALNOURISHED RELATED TO CASTE, CHITWAN DISTRICT, NEPAL 1985

		Gomez Classification[1]			
Caste	N	Normal	1st Degree	2nd Degree	3rd Degree
Brahmin	99	15.2	34.3	43.4	7.1
Kshetry	68	10.3	35.3	44.1	10.3
Gurung/Magar	31	19.4	22.6	38.7	19.4
Tharu	24	16.7	45.8	37.5	00.0
Bote	32	12.5	31.3	43.8	12.5
Others	45	15.6	33.3	40.0	11.1
Lower Caste[3]	59	16.9	44.1	27.1	11.9
Total	358	14.8	35.5	39.7	10.1

		Waterlow Classification[2]			
Caste	N	Normal	Stunted	Wasted	Stunted/ Wasted
Brahmin	99	45.5	40.4	8.1	6.1
Kshetry	68	33.8	54.4	7.4	4.4
Gurung/Magar	31	22.6	64.5	12.9	0.0
Tharu	24	62.5	29.2	8.3	0.0
Bote	32	21.9	53.6	15.6	9.4
Others	45	40.0	28.1	22.2	8.9
Lower Caste[3]	59	49.2	28.9	13.6	1.7
Total	358	40.3	43.3	11.7	4.7

[1]First degree = 75-89% of National Center for Health Statistic Standard.
Second degree = 60-74.9% of National Center for Health Statistic Standard.
Third degree = below 60% of National Center for Health Statistic Standard.
[2]Stunting below 90% height for age. Wasting below 85% weight for height.
[3]Includes nontouchables.

Source: Bhandari 1985, p. 13.

TABLE 4. PERCENT OF CHILDREN UNDER FIVE WHO ARE MALNOURISHED RELATED TO FARM SIZE AND NON-FARM ACTIVITIES CHITWAN DISTRICT, NEPAL 1985

Category: Head of Household[3]	N	Gomez Classification[1] Normal	1st Degree	2nd Degree	3rd Degree
Landless	68	14.7	33.9	35.3	16.2
Nearlandless	85	15.3	35.3	41.2	8.2
Marginal Farmer	94	12.8	37.2	40.4	9.6
Small Farmer	72	16.7	33.3	44.4	5.6
Large Farmer	17	11.8	47.1	29.4	11.8
Craft Worker	13	15.4	30.8	46.2	7.7
Total	358	14.8	35.5	39.7	10.1

Category: Head of Household[3]	N	Waterlow Classification[2] Normal	Stunted	Wasted	Stunted/ Wasted
Landless	68	29.4	47.1	16.2	7.4
Nearlandless	85	37.6	47.1	11.8	3.5
Marginal Farmer	94	41.5	45.7	9.6	3.2
Small Farmer	72	48.6	38.9	8.3	4.2
Large Farmer	17	52.9	17.6	23.5	5.9
Craft Worker	13	46.2	46.2	0.0	7.7
Total	358	40.2	43.3	11.7	4.7

[1]First degree = 75-89% of National Center for Health Statistic Standard.
Second degree = 60-74.9% of National Center for Health Statistic Standard.
Third degree = below 60% of National Center for Health Statistic Standard.

[2]Stunting below 90% height for age. Wasting below 85% weight for height.

[3]Near landless = 0.1 – 0.6 bigha; Marginal = 0.6 – 1.5 bigha; Small = 1.54 – 4.0 bigha; Large = more than 4 bigha (one bigha = .68 hectares).

Source: Bhandari 1985, p.12.

with small land holdings appear to be somewhat better off than either children of the landless or the larger land holders. There are several possible explanations for this finding. It is likely that caste and size of land holdings are related, thereby confounding interpretation of the results. Higher-caste families might be expected to have larger land holdings. A positive impact of higher income associated with more arable land may be offset by the nutritional implications of caste-related dietary restrictions. It is also possible that households with larger land holdings sell a higher proportion of their home production for cash and use the proceeds to buy back less nutritious foods.

The amount of time women spend in food preparation and child care is an important determinant of the nutritional status of children. Women of landless households may be expected to work away from the home, leaving child care to older children, grandmothers, or neighbors. In addition, the pressure to earn income may cause landless women to shorten the duration of breast feeding. Having even a small amount of land provides household security which leads to a reduction in the need for off-farm earnings by women. Therefore, the availability of even a very small parcel of land can contribute to better nutrition for children by providing food, better child care and a longer period of breast feeding.

There are a number of additional reasons why PCM may not be closely correlated with socio-economic status. In this sample of households, there may be too little variability in socio-economic status for the results to show up in statistical analysis. The use of water contaminated by bacteria, virus and parasites is the main cause of dysentery and diarrhea. The incidence of morbidity from these diseases is high and clearly contributes to high incidence of PCM as does the prevalence of malaria, hook worm, round worm and intestinal

parasites. Children of all castes and economic strata are equally exposed to these health conditions which importantly effect growth.

It seems apparent that the nutritional status of children in the terai is very poor. The data does not present definitive evidence concerning how this malnourishment may be lessened through improved availability of food; however, it does provide us with some insights to suggest that increased agricultural production, availability of jobs and improved income distribution may be helpful. The following two sections of this lecture will discuss how agricultural technology influences the level and equity of income between households with differing amounts of land, and the role of livestock as a determinant of household income and employment.

B. Agricultural Technology, Farm Income, Employment and Equity

In recent years, the Nepalese economy has been characterized by sluggish growth in GDP, widespread unemployment and extreme inequity in income distribution. Since farming activities will dominate the Nepalese economy during the foreseeable future, the agricultural sector must play a pivotal role if economic conditions are to improve. Nepal is a nation with very limited land resources; consequently, if the agricultural sector is to be an engine of growth, improvements will have to come as the result of increased land productivity.

In 1987, Thapa conducted a detailed study in the terai to ascertain how increased use of agricultural technology affects farm income, agricultural employment and the equity of income distribution (Thapa 1989). He selected two villages which were similar in terms of size, ethnic composition and access to non-farm employment opportunities. The Village of Anandban has a well-

maintained irrigation system and a high proportion of farmers are using improved varieties of seeds and chemical fertilizer. In contrast, Ramapur does not have an irrigation system and has been by-passed by agricultural technology.

Average farm size in the two villages was very similar; however, average farm income in Anandban was approximately 76 percent higher than in Ramapur. There were two primary reasons for the income differentials. First, rice yields and income were considerably higher in Anandban; and secondly, income from non-rice crops was more than three times higher in Anandban than in Ramapur. The remarkable difference in farm income from crops other than rice was due to the fact that the availability of irrigation allowed Anandban farmers to produce wheat, pulses, mustard and several other crops during the dry season.

There was considerable income inequality in both villages. This inequality was associated with a very skewed pattern of land holdings. Significantly the income inequality was greater in Anandban (the favored village) than in Ramapur. It would appear that when technology is adopted, greater inequality in income from rice occurs. The income from non-rice crops had a tendency to lessen income inequality, but this force was insufficient to offset the greater disparity caused by changes in income from rice.

The results indicate that with the advent of agricultural technology, a higher share of total income goes to land and management while a smaller share of total income goes to labor. We must be careful in interpreting these results. Modern technology generates a higher demand for labor—particularly in crop care activities such as weeding and handling irrigation water; consequently the absolute income earned by labor in Anandban was higher than for

Ramapur, but labor's share of the income in Anandban was lower. It would be reasonable to presume that a higher demand for labor, both family and hired, in Anandban would push up wage rates. There was an unexpected finding! Wage rates in the two villages were nearly identical, suggesting that there was migration of labor to the favored village in order to take advantage of improved job opportunities. The research also determined that tractor mechanization of land preparation and hauling greatly lowered the labor requirements per hectare of cultivated land.

As incomes rose in Anandban the proportion of total labor supplied by the farmer and his family declined, suggesting that modern technology creates a desire for leisure. Labor opportunities for the landless and near landless may be increased by modern crop technology.

In the Nepalese terai, there are two broad types of tenancy relationships: cash rent and share-cropping. For most of the terai, crop share rental arrangements are illegal, although the practice is still widely followed. Cash rentals are fixed by law with rates varying according to land quality. The fixed rental rates were put in place prior to widespread adoption of technology and have remained essentially unchanged. When agricultural technology increased yields the position of cash renters improved markedly. They still pay the same level of rent, but earn a considerably higher income from improved yields. Rental rates are often fixed for the rice crop only but tenants have the right to use the land throughout the year. With the advent of irrigation, the possibility of using the land for dry season crops has further increased the income of cash renters.

Artificially low rents can have a significant impact on equity and the efficiency of production. Even when a large farmer has more land

than can be farmed using his family labor, he may be reluctant to rent out if rental rates are kept at a level below that implied by potential yields. The owner will attempt to work the land using family labor. The result may be that the land is used at a low level of intensity. The practice of withdrawing land for rent may also preclude the landless from becoming cash renters. Fixed cash rents can also lead to multi-stage landlordism. Under this arrangement, the first tenant would rent at a low fixed rate and then re-rent to a secondary tenant. This practice has proven to be very exploitive in other countries--notably the Philippines.

Thapa's research leads to three main conclusions: (a) modern crop technology leads to a considerably higher income per household and per hectare; (b) adoption of new technology creates increased employment particularly for landless laborers and family members of renters; (c) modern technology has the potential of exacerbating the inequality of income distribution.

These results imply that policy makers consider the issue of increasing agricultural productivity from several perspectives. To the extent that food production and jobs are increased, the technology is "good"; however, it must be determined if it is possible to obtain these gains without worsening income distribution.

Nepal initiated a land reform law in 1964; however, this reform has not had the desired effect of lessening inequality in land holdings. Provisions of the law focussed primarily on abuses in tenancy relationships and the law itself left many loopholes which enabled large land owners to evade its intent. The law stated that in the terai the upper limit on land holdings would be 18 hectares per family, while in the middle hills this limit would be four hectares. A generous interpretation as to what constitutes a family, placing the title of the

land in the name of a relative and other techniques have been used to skirt these ceilings. On the basis of Thapa's study, it can be demonstrated that a much lower ceiling on land holdings in the terai could be justified. Care must be taken in establishing the minimum. From a political standpoint, it would not be feasible to lower the ceiling dramatically. The effect of increasing the land ceiling on productivity is another important consideration. If the ceiling is too low, the farm will not be able to generate sufficient income to afford fertilizer, herbicides and high yielding seeds. Consequently, potential yields would not be realized.

Land taxes in Nepal average less than three percent of the value of farm sales. There is potential for a land tax which is graduated in accord with farm size. Proceeds from such a progressive tax could be loaned to small farmers who wished to enlarge the size of their holdings.

It seems likely that fixed land rental rates should be adjusted upward to reflect the increased productivity of the land when modern technology is used. This would encourage landlords to rent out more land and increase the opportunities of the landless to become tenants.

A comparison of Anandban and Ramapur indicates that the availability of irrigation and modern technology can lead to great disparity of income between villages. This is an important dimension of the equity issue since we must not consider equity as only a within-community problem, but as a between-communities problem as well.

Currently only about 21 percent of the crop land in Nepal has access to irrigation water. It would be tempting to recommend a greater allocation of research funds to the improvement of rainfed agriculture, since it is unlikely that irrigation can be made available to all communities. Targeting research to rainfed areas would not be a

cost effective way of improving income distribution, and there would be a great sacrifice in production efficiency.

A major conclusion of Thapa's study was that irrigation is the most important factor influencing the adoption of technology. HMG must increase efforts to expand the area under irrigation. There is considerable potential for increasing yields and food production in Nepal through the use of larger amounts of fertilizer. Without irrigation, the risk associated with fertilizer usage is high and farmers are reluctant to invest precious capital in fertilizer which has, at best, an uncertain pay out. This reinforces the observation that added emphasis on irrigation is extremely important. Thapa concluded his doctoral dissertation with the statement:

> To sum up, a land reform policy which encourages efficiency but discourages land concentration is needed to mitigate the adverse effects of new technology on income distribution. A lower ceiling on landholding, progressive land tax, and deregulation of tenure contracts are some possible measures which can help achieve this development and dissemination of new technology through investment in irrigation infrastructure, greater emphasis on research and extension, and improvements in the input delivery system" (Thapa 1989, p. 245).

C. The Role of Livestock in Terai Farming Systems

We have seen that HMG has retrenched from its position of the fifth five-year plan which called for the hills to concentrate on the production of horticultural products and the terai to emphasize cereal grains. Interestingly, HMG's shift in policy emphasis has been only a halfway move away from the concept of comparative advantage. More recent plans have called for actions that will increase grain production in the hills; however, very little attention has been given to the livestock sector in the terai. From the standpoint of technical

efficiency, resource endowments and even economic theory, it may be rational to continue to stress added grain output in the terai.

Unfortunately, technical efficiency, differential resource endowments and economic theory do not always provide the proper blueprint for economic development. It is argued here that if by economic development we mean sustained improvement in the income, employment and nutrition of the people, livestock can, and must, be an integral part of the farming systems practiced on small farms in the terai.

In 1987, Tulachan conducted an in-depth study to examine the role of livestock on small farms of the Nepalese terai (Tulachan 1989). He tested two fundamental hypotheses. First, existing enterprise combinations, which include livestock, are economically rational from the farmer's standpoint and that to specialize in grain production would lower income, employment and the well-being of farm families. Secondly, he argued that increased forage production, coupled with improved livestock—particularly milking buffalo, would add to income, make better use of resources, and dampen seasonal swings in family income. Tulachan asserted that on small farms, livestock could combine underutilized resources such as rice, straw, weeds, grass growing along roadsides and paddy buns with surplus agricultural labor to produce meat, milk, much needed manure and draft power. He suggested that as population pressures in the terai continue to increase and farms become smaller and smaller, livestock should become a more important part of the farming system.

In his study, Tulachan sampled 75 households in two villages of the Chitwan District of the terai. The lowland village (Kirangaj) was representative of communities where the bulk of farm land was lowland "Khet" fields which could be irrigated while the upland

village (East Rampur) represented conditions where the bulk of farm land was rainfed and where maize, millet, wheat and mustard were more important components of the cropping system. In the lowland village, Tharus were the dominant caste and Brahmins a minority. In the upland village, Brahmins were the majority caste.

Tulachan stratified his sample according to the amount of land owned or controlled by the household. Detailed information on cropping pattern, yields, sales of agricultural products and the allocation of labor was collected by visiting the sample farms regularly over a 12-month period.

It was found that livestock are an extremely important component of farms of all sizes in both villages. In the upland village livestock products constituted 47 percent of the value of agricultural production while in the lowland village livestock were 36 percent of the value of agricultural production.

For purposes of analysis, this data was used to construct a "typical" or representative farm for each of three land resource categories in the upland and lowland villages. Farms classified as having a low resource base were those with less than .68 of a bigha of land.[5] Medium size farms are those with 1.7 bigha of land and high resource farms those with an average of 3.2.

Linear programming was used to determine what would happen on each of these six representative farms if they either: (a) specialized completely in crop production; (b) set aside a part of their crop land to produce forage crops which in turn would be fed to animals of the type found in the Chitwan Valley; or (c) allocated a part of their crop land to produce forage which would be fed to improve breeds of milking buffalo.

[5]One hectare equals .68 of a bigha.

Table 5 summarizes Tulachan's findings. The analysis indicates that on farms of all three size categories in both the upland and lowland villages the current practice of keeping livestock is economically rational. In each case, shifting from present production patterns to specialize in crop production would lower net farm income. In addition there would be a reduction in the use of family labor.

If small resource farms in the upland village totally specialized in crop production, their income would drop by 56 percent or 2,116 rupees and income on high resource farms in the upland village would fall by 4,512 rupees. Similar results can be observed for farms in the lowland village, although the reduction in their income would be somewhat less since crop production constitutes a larger part of income.

It will also be seen that if farmers devote a part of their crop land to the production of forage which would be used to provide more feed for local buffalo, income would decline. If farms of the three different size categories followed this practice, their income would fall by an average of 2,500 rupees. This finding is particularly useful since researchers at the local experiment station have identified forages which would grow well during the dry period of winter when feed for livestock is a limiting factor. The extension service is encouraging the diversion of the land from maize, pulses and mustard seed during the winter months to allow for increased forage production. If this advice was followed, and farmers continued to use local breeds of buffalo, the strategy would lead to a reduction in farm income and the use of family labor. In addition, farmers would lose trust in the recommendation of the experiment station and extension workers. The problem is that local breeds of buffalo do not have the genetic capacity to increase milk production even when provided with more

TABLE 5. THE CONTRIBUTIONS OF LIVESTOCK TO INCOME AND EMPLOYMENT ON FARMS IN UPLAND AND LOWLAND VILLAGES, CHITWAN DISTRICT, 1987

	Present situation	Crop enterprise only	Local buffalo improved forage	Improved buffalo
Net income (Rs)				
Upland village farms:				
High (3.3 bighas)[1]	16,550	12,038	12,421	19,699
Medium (1.7 bighas)	8,694	5,734	6,251	12,790
Low (0.7 bighas)	3,802	1,686	2,874	6,702
Lowland village farms:				
High (3.3 bighas)	22,079	18,033	19,392	27,045
Medium (1.7 bighas)	16,131	12,694	14,498	20,554
Low (0.7 bighas)	4,637	3,793	4,172	8,020
Employment (person-days)				
Upland village farms:				
High				
Household (own)	536	270	582	660
Hired	140	138	164	126
Medium				
Household (own)	373	141	405	459
Hired	74	79	66	59
Low				
Household (own)	289	98	304	344
Hired	4	6	3	4
Lowland village farms:				
High				
Household (own)	536	271	628	690
Hired	357	357	324	318
Medium				
Household (own)	407	142	526	487
Hired	211	211	167	185
Low				
Household (own)	264	72	366	280
Hired	44	45	11	36

[1]One bigha equals 0.68 hectare.

Source: Tulachan 1989.

and higher quality feed. In the two villages, milk yields averaged only 772 kilos per lactation. If land was diverted from crop production to forage, there would be only modest increases in milk output to about 890 kilos. The added value of milk would be insufficient to offset the decline in value of crop sales.

It appears that given the available breeds of milk buffalo, the present practices of farmers are rational and they have approximately the correct mix of crop and livestock enterprises. The third linear programming analysis examined the implications of diverting land to the production of forage which in turn would be fed to improved breeds of milking buffalo. The small resource farm of the upland village provides an example of the magnitude of this change. Current income on this farm is 3,802 rupees with a family size of over six. This means that families with a comparable resource base are living in abject poverty. If forage production on this representative farm was increased and if improved breeds of milking buffalo were available, its net income would rise to 6,702 rupees—a 76 percent improvement.

In the lowland village, the small size farm had an average income of 4,637 rupees. If improved forage practices were used on this farm, coupled with better animals, its income would rise to 8,020 rupees. In the upland village, the low resource farm would increase the use of family labor from 289 person days per year to 344 person days if the improved livestock/forage practice was followed. This farm would not have to hire any additional labor, so the added income realized by adopting forage and improved buffaloes would be realized entirely from the use of family labor and a better crop livestock mix. An interesting point is that in all cases shifting to improved forage with more productive milking buffalo would increase family labor requirements and lower the amount of hired labor. It is particularly

important for enterprise combinations to generate a demand for family labor. Labor on farms of these small size categories is underutilized and there are no opportunities for off-farm employment to supplement agricultural income.

Most of the land diverted to forage production had been producing maize, lentil and mustard during the winter or dry season. The diversion would cause a decline in the production of these crops, and to lowered availability for home consumption and sales. The loss of grain production would be modest relative to the area of crop land diverted to forage, since an increase in the quantity of manure would lead to higher yields on existing crop land.

There are several other positive features that would result from the production of added dry season forage and the use of improved buffalo. (1) Milk is sold on a daily basis; consequently, the marked seasonality of income associated with crop production would be dampened. (2) The incidence of malnourishment, particularly PCM, is most severe in the monsoon season. At this time, labor requirements for farm work are at their peak. Women spend less time with their children, the incidence of disease and parasites is highest and food is in short supply since the new cereal crop is not yet available. Increased emphasis on livestock production could lessen peak labor requirements for both men and women. (3) Milk, butter and cheese are highly nutritious foods, and amongst the foods preferred by Brahmins and others of high caste. The availability of increased milk production could lead to improved nutritional status of children in high-caste families. (4) Income on these farms would not only be higher, it would be more stable year to year. Most of the forage land would be taken from maize, lentil and mustard grown during the dry season. Crop production in this period is erratic with uncertain rains and hail often

limiting crop production. Evidence in the Chitwan Valley indicates that farmers obtain "average" maize yields during the winter period only two out of five years; consequently, a shift to increased emphasis on livestock products would considerably lessen year-to-year income variability.

Tulachan concludes "this study argues that past government efforts and priorities of not providing adequate attention to livestock development in the terai were inappropriate. This argument is supported by the fact that despite high research expenditures on crop production, specifically paddy, maize and wheat, the yields of these crops have been falling. This suggests that it would be rational to switch research efforts and funds towards minor crops, forages and to the livestock sector... The present land scarce-labor surplus situation is likely to worsen in the future because of population growth in the terai. The considerable labor requirements of livestock production could make excellent use of surplus household labor, particularly in the slack labor periods of the crop production cycle. In addition, livestock converts unsalable farm products such as crop by-products, natural herbage and other farm wastes into highly nutritious animal products. Milk and meat have a high income elasticity and it can be expected that demand for these products will increase rapidly" (Tulachan 1989, p. 245).

VI. SUMMARY AND CONCLUSIONS

Nepal is a small landlocked nation with virtually no natural resources other than its industrious people, a limited amount of agricultural land and the potential to produce a significant quantity of hydroelectric power. It is one of the least industrialized nations in the world and currently more than 90 percent of Nepalese households

depend directly on agriculture for their livelihood. If this Himalayan kingdom is to emerge from poverty, unemployment and malnourishment, the agricultural sector will have to shoulder the burden of sustained economic development.

The performance of the agricultural sector has not been stellar in recent years. Over the past decade the Nepalese population has been growing at an annual rate of 2.6 percent while production of cereal grains has increased at less than one percent per annum. Agriculture's contribution to foreign exchange earnings has fallen from 70 percent in the late 1960s to under 40 percent at present.

Each of Nepal's last four five-year plans has stressed the importance of agriculture and has laid out a blueprint to show how agricultural production could be increased. Unfortunately, His Majesty's Government has not allocated resources to the agricultural sector commensurate with the role it must play in the development process. Government allocations to agriculture amount to less than $2.40 per capita, and of this meager amount less than 10 percent has been earmarked for agricultural research. Nepal is one of the most densely populated agricultural countries in the world, with only 0.16 hectare of arable land available for each member of the population. It is therefore imperative that funding in research be directed to increasing the productivity of land and making better use of unemployed farm labor. Enlarging the area under irrigation, greater use of high yielding varieties of cereal grains, and higher applications of agricultural chemicals are the principal techniques available to improve yields.

It has been argued in this lecture that increased emphasis must be given to expanding the area irrigated. It is imprudent to expect that rainfed fields, which depend on an erratic and uncertain monsoon,

can produce adequate quantities of agricultural output to simultaneously improve the nutritional status of the people, provide raw materials for industry and generate precious foreign exchange. Irrigation not only allows for double and triple cropping of farm land, but it also reduces the risk associated with investments in fertilizer.

Perhaps the most distressing single measure of the failure of Nepal's food system is the nutritional status of its children. Recent surveys indicate that from 60 to 80 percent of terai children under six suffer from moderate to severe protein-calorie malnourishment, and ten percent from third degree malnourishment. Over five percent of the children surveyed exhibited concurrent stunting and wasting. There does not seem to be any consistent relationship between the caste or socio-economic status of a household and the nutritional status of children in that household. This points to the fact that protein calorie malnourishment is, in part, due to diseases and parasites. If the nutritional status of children is to be enhanced, efforts must be made to improve sanitation and the availability of potable water while simultaneously working on the food side of the nutritional equation.

Economics has been referred to as the dismal science. As I think back over the preceding pages, it would seem that this lecture does nothing to alter that assessment of the profession. I have pointed out that Nepal has a sluggish growth in GDP, declining yields of the major cereal grains, poverty, unemployment and malnourishment. The suggested remedies may be viewed as politically infeasible or beyond what is reasonable to expect given available funds and trained personnel. The question then arises—can an applied economist make summary observations which provide other than a bleak forecast for the future? I believe the answer to this question is yes! With carefully

chosen targets of opportunity, political will and careful planning, the agricultural sector can make a positive contribution to the economic development of Nepal during the decade of the 1990s.

His Majesty's Government can adopt a system of guaranteed price supports for grains which would serve as an incentive to encourage the use of modern inputs and reverse the decline in yields. The Nepal Food Corporation could buy sufficient quantities of maize, millet and barley to insure that the farm-level prices of these grains was supported at/or above guaranteed levels. The grain thus acquired could be distributed at concessional prices to needy families in the middle hills and mountains. If funds currently being used to purchase and redistribute rice were allocated to the acquisition of these less-costly grains, the Nepal Food Corporation could distribute a considerably larger quantity of grain with the same budget outlay. At no extra cost, the food subsidy program could be operated in such a way that it would improve the nutritional status of poor people rather than being used as a largesse for government employees and the affluent.

A revitalized land reform could increase productivity on large farms in the terai; thereby, increasing total grain production. Lowering the ceiling on farm holdings in the terai from 18 hectares to 10 hectares would lead to increased productivity. Recipients of the redistributed land would farm it more intensively than tenants operating the land through an arrangement of low fixed cash rentals. Redistribution of land, coupled with improved availability of irrigation and modern technology could also increase labor requirements by as much as 30 percent.

Research concerning the productivity and marketing of minor crops—particularly fruits and vegetables—could increase the output of

these high-value products to meet the demands of the urban market and tourists. Livestock, particularly milking buffalo, can provide opportunities for small farmers with underutilized family labor to increase their income. The research reviewed here suggests that the number and productivity of milking buffalo on small farms could be increased by diverting a small amount of dry-season crop land to the production of improved forages. If this forage was fed to improved breeds of milking buffalo, the resulting increase in milk production could expand the net income of farms with approximately one hectare of crop land by more than 75 percent. Increased production of milk, meat, manure and draft power would not only increase farm income, it would reduce seasonal and year-to-year fluctuations in income, create additional employment and improve the nutritional status of children.

Yes, the discipline of economics is probably predestined to be dismal--the future of Nepalese agriculture is not!

REFERENCES

APROSC. 1982. "Nepal: Foodgrain Marketing and Price Policy Study." Final Report, Vols. I-III (July). Kathmandu.

APROSC. 1984. "Study on Subsidized Foodgrain Distribution Programme in Nepal," (October). Kathmandu.

Bhandari, B. 1985. "Nutritional Status of Rural Children in Nepal: A Case Study of Chitwan District," Winrock International, No. 28, November.

Calkins, P. 1976. "Shiva's Trident: The Impact on Income Employment, and Nutrition of Developing Horticulture in the Trisuli Watershed, Nepal." Ph.D. Dissertation, Cornell University.

Ender, G. 1980. "The Development of Road Transportation in Nepal and its Relationship to Agricultural Development. Ph.D. Dissertation, Cornell University.

His Majesty's Government (HMG). 1975. "Nepal Nutrition Status Survey." Kathmandu.

Karki, V. 1988. "Deterioration in Size of Farm Holding in Nepal Case Study of Hill and Tarai Villages," Rural Poverty Research Paper Series, No. 15, HM: G-USAID-GTZ-IDRC-Ford-Winrock, August.

Martorell, R., J. Leslie, and P.R. Mook. 1984. "Characteristics and Determinants of Child Nutritional Status in Nepal," *American Journal of Clinical Nutrition*, 39.

NPC. 1984. "Basic Principles of the Seventh Plan (1985-1990)," (March). Kathmandu.

Thapa, G. 1989. "The Impact of New Agricultural Technology on Income Distribution in the Nepalese Taria." Ph.D. Dissertation, Cornell University.

Tulachan, P. 1989. "The Potential Contribution of Livestock Sector Development to Farm Income and Employment in the Chitwan Valley of Nepal." Ph.D. Dissertation, Cornell University.

Wallace, M. 1987. "Nepal: Food Pricing with an Open Border," Winrock International.

World Bank, Work Development Reports. 1986.

Working Paper on Basic Needs Program. 1987. 12th Session National Development Council, HMG.

Yadav, R.P. 1987. "Agricultural Research in Nepal: Resource Allocation, Structure and Incentives," Research Report 62, (September). Washington D.C.: International Food Policy Research Institute.

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