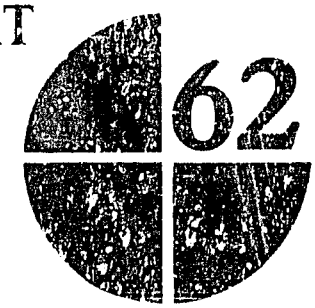
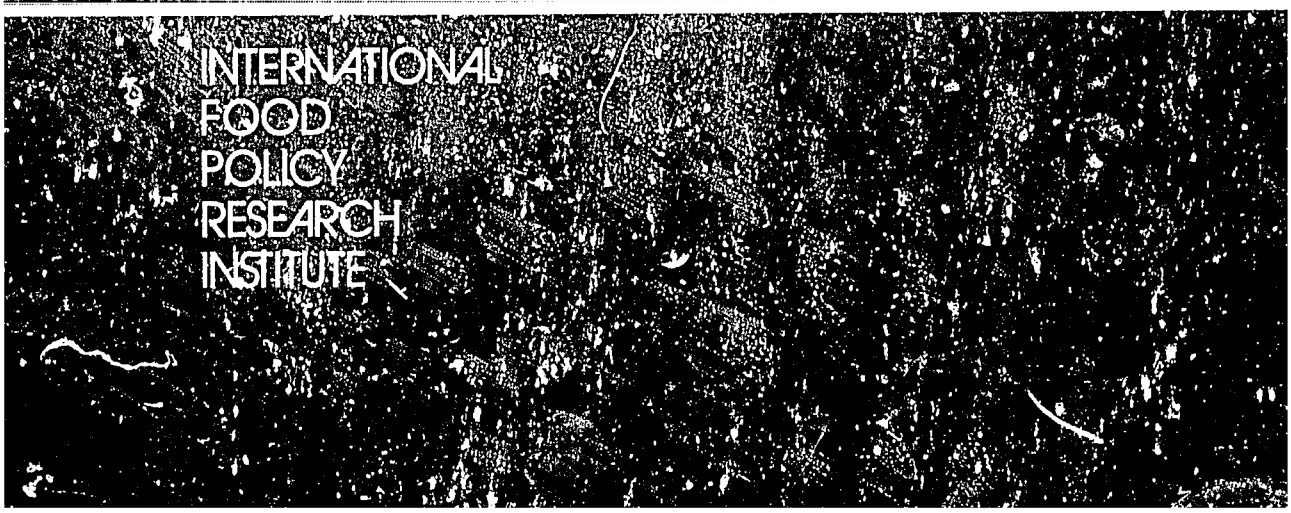
RESEARCH REPORT



AGRICULTURAL RESEARCH IN NEPAL: RESOURCE ALLOCATION, STRUCTURE, AND INCENTIVES

Ram P. Yadav

September 1987



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FOREWORD

If agriculture is to play a major role in economic development, the productivity of the factors of production used in agriculture (land, labor, and capital) must be increased. Because of the limited land base, the development of new technologies by means of agricultural research is essential to achieving these productivity increases. Ram Yadav's analysis of Nepal's agricultural research system shows dramatically that only a strong national research system can effectively adopt or adapt such technologies from the research of other countries.

In the period analyzed in this study, the government of Nepal and the foreign assistance community spent large sums on regional development programs and agricultural extension. In the developing world generally, and neighboring countries in particular, new agricultural technologies were developed and successfully applied, raising both aggregate growth rates in agriculture and aggregate yields of crops. But in Nepal, compared to much of the rest of the world, yield increases were slight and in many cases even negative. During this time, neither the government of Nepal nor the foreign assistance donors were attempting to develop a research system comparable to the systems developed decades earlier in other Asian countries.

The same inattention to agricultural research and the concomitant poor growth are apparent in the countries of Sub-Saharan Africa. Thus it is instructive to examine this Asian case in detail, not only for the direct lessons to Nepal, but also for the opportunities it offers for comparative analysis.

The interest of the International Food Policy Research Institute (IFPRI) in the issues raised by the case study of Nepal derives not only from our broad concerns with the role of agriculture in economic development (development strategy), but also from the point of view of optimal technology development policy. What is the relative emphasis needed on research—with what assumptions about how research resources can be made productive?

IFPRI has recently completed a case study of Nigeria as well as this one on Nepal. Comparative analyses of several African countries are in progress, and an integrative analysis will be prepared relating these analyses more broadly to technology policy.

For now, Ram Yadav's analysis suggests the need for a much higher level of budgetary support to agricultural research than has been the case in Nepal, a much larger training effort sustained for many years to provide the Ph.D. leadership essential to good research and to linking with other national and international systems, an effective overall coordinating and priority-setting council for agricultural research, and an incentive system that fosters stability of personnel and continuity of research. A large number of detailed recommendations also emerge from this analysis.

We are grateful to the International Development Research Centre (IDRC) for sponsoring Ram Yadav at IFPRI under an IDRC Professional Development Award that enabled the completion of this report; to Ram Yadav; and to the International Centre for Integrated Mountain Development (ICIMOD), where he is now deputy director, for his time to accomplish this valuable research at IFPRI.

John W. Mellor

Washington, D.C.
September 1987

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1

SUMMARY

Agriculture, which is the predominant sector of Nepal's economy, provides the major source of livelihood to 94 percent of the population and therefore must take the lead in Nepal's development. Accordingly, the agricultural sector received high priority for resource allocation in the three five-year plans between 1970 and 1985. Nevertheless, the achievements in agriculture have remained behind the targets in all development plans. Agricultural productivity has remained stagnant in most crops and has declined in maize and millet. From 1970/71 to 1980/81, gross foodgrain production increased at an annual rate of less than 1 percent, while the population increased at about 2.7 percent. This discrepancy resulted in a decline in the per capita net foodgrain production from 185 kilograms in 1970/71 to 160 kilograms in 1980/81. Production and productivity declined much faster in the hills and mountains than in the more fertile Tarai plain during this period.

The decomposition of agricultural growth trends carried out in this study indicates that increase of cropped area is the dominating factor in the growth of agricultural output. Overall, productivity decreased between 1961/62 and 1980/81, although it improved in the second half of that period, probably because of adoption of improved technology. In the same 20-year period, most cash crops showed greater production increases than did cereal crops. Although traditionally a food-exporting country, Nepal is on the verge of importing foodgrains to feed its rapidly growing population.

The objectives of this study include an assessment of national policy in Nepal toward improving agricultural technology, and an analysis of the institutional factors that affect agricultural production. The study is primarily based on secondary data and official documents that enabled an examination of the trends in agricultural production and productivity and of the resource allocation patterns from 1970/71 to 1980/81. In addition, 120 researchers at various levels were interviewed to learn their views regarding their status, authority, responsibility, performance, evaluation, salary, promotion rules, training needs, guidance and supervision, and research facilities.

In terms of financial resource allocation, the share of expenditure for the agricultural sector (which comprises agriculture, irrigation, forestry, land reform, and cadastral survey) increased over several five-year plans. However, the growth rate of the budget for the agriculture component alone was lower than that for other components of the agricultural sector. The real expenditure in agricultural research from 1970/71 to 1980/81 increased at about 4 percent annually, compared with 7 percent in agricultural extension and 14 percent in agricultural support services and other programs. The share of agricultural research expenditure as a percentage of agricultural GDP remained almost constant at around 0.22 percent during that period.

The low priority accorded to agricultural research is reflected in the substantial decline of agricultural research expenditure as a proportion of the agriculture budget (from 32 percent in 1970/71 to 14 percent in 1980/81). The proposed research expenditure for the Sixth Five-Year Plan (1980-85) showed a further decline to only 8 percent. Also, the money spent and manpower engaged in the disciplinary and commodity sections, research stations and farms, and commodity research programs were not all utilized for real research purposes. The three-year (1978/79-1980/81) average of the total research budget expenditure was about Rs 35.4 million, whereas the expenditure on actual research work was estimated to be only Rs 12.5 million, about 35 percent of the total. The remaining 65 percent was used for such nonresearch activities as producing and distributing improved

seeds, plants, livestock, and fingerlings on farms; providing training to local farmers and extension workers; and providing technical assistance to farmers. On this basis, research investments represent only 0.1 percent of agricultural GDP in Nepal.

Of the total estimated actual research expenditure between 1970/71 and 1980/81, crop research constituted about 70 per cent and 30 percent was directed to livestock (7 percent), horticulture (9 percent), and others (14 percent) consisting of fisheries, food, socioeconomic studies, and agricultural inputs. In crop research, cereal grains accounted for about 80 percent of research expenditure. Thus, research activities were largely limited to foodgrains, particularly rice, wheat, and maize. The 1970s also witnessed relatively greater research emphasis on hill agriculture. Factor-oriented research was almost negligible except in the use of chemical fertilizer. Input research accounted for 2 percent of the estimated actual research expenditure.

Presently, agricultural research is carried out by four departments in the Ministry of Agriculture and by other institutions outside the ministry. Even in the Department of Agriculture, the technical sections and commodity research programs are not unified. The unification of all agricultural research activities would allow a single body to effectively plan, organize, manage, control, and evaluate agricultural research activities throughout the country.

The eight commodity research programs (rice, wheat, maize, potato, citrus, sugarcane, pulses, and oilseeds) are concerned with solving a specific problem or developing a high-yielding variety without considering differences in the cropping patterns, resource endowments, or socioeconomic levels of farmers. Therefore, separate cropping system or farming system research is initiated to test the suitability of such agricultural technology in the existing farming system, but this is not a satisfactory solution. If researchers in the commodity research programs were fully cognizant of the farming systems, they could develop technologies to fit farmers' requirements. At present, an intermediary agency or unit called the Farming System Research Division tests these technologies under actual farm conditions and commonly reports to the commodity research programs that their technologies are inadequate to meet farmers' needs.

Researchers cite low salary, absence of job descriptions, low accountability, and poor training, guidance, supervision, and evaluation as causes of low motivation. Their productivity is affected by lack of proper research plans and programs, inadequate financial and administrative authority, lack of facilities for publication of research results, poor libraries, temporary appointments, and long delays in promotion. Improved management could provide the clear focus and direction that are needed to develop a strong and effective research system.

The project support approach of donors has not strengthened the overall agricultural research system in Nepal, though it has undoubtedly contributed to training researchers and building physical infrastructure in some components of agricultural research. This approach has distorted priorities and given rise to conflict between project and nonproject research staff because of differences in opportunities and privileges provided through the projects. To avoid these problems, a comprehensive plan of agricultural research is required. Donors invited to support such a plan could aid in strengthening and balancing the development of research. Currently, 32 foreign-aided projects supported by 13 different donors are in operation.

The research contact and collaboration of national research agencies with external research systems are extremely limited; such collaboration with neighboring countries is particularly low. Increased collaboration with the international research centers would be valuable. Since agricultural research is not given high priority and the capability of the system is low, there is little incentive to pursue collaboration. Nepal cannot afford to build and sustain a large, expensive agricultural research system and must rely greatly on technology from other national and international research systems. However, borrowing technology requires a certain minimum level of national research capability to carry out necessary adaptive

research. Also, to collaborate effectively, Nepal's research capability needs to be expanded so that interaction with counterpart scientists in collaborating institutions becomes possible.

Another important consideration for strengthening agricultural research is the level of training required for agricultural researchers. The M.S. degree should be the minimum qualification for research scientists. Of the 400 researchers engaged in agricultural research in Nepal, more than half have only undergraduate training and only 14 have Ph.D. degrees. To meet the national training requirements of an M.S. degree in different fields of agriculture and animal science, the Institute of Agriculture and Animal Science at Rampur could be strengthened and developed into an agricultural university within the next 7 to 10 years. Doctoral training may have to be accomplished outside the country for quite some time. A research manpower development program is needed, with M.S. and Ph.D. training given high priority.

A high turnover of people at senior executive, planning, and policy levels indicates lack of continuity and commitment in implementing policies and plans. Simplification of budgetary procedures would be beneficial, as would delegation of financial and administrative authority to operational levels. Establishing a high national priority for research, unifying all agricultural research activities under an autonomous body, and improving the motivation of researchers through better personnel policies are the keys to a productive research system in Nepal.

2

INTRODUCTION

Nepal is a small Himalayan kingdom and one of the world's poorest nations, landlocked between China and India in an area of 147,482 square kilometers with a population of approximately 16 million. It is one of the least developed countries, with an estimated per capita GDP in 1982 of about U.S. $140.

The physical features of the country pose a serious constraint to its development. Nepal is divided into three physiographical belts: the Tarai (a plain that lies along the southern border between 75 and 300 meters above sea level), a wide band of hills (between 300 and 3,000 meters), and the northern mountains (from 3,000 to 8,500 meters). These three belts contain, respectively, 23, 42, and 35 percent of the total land area, and 44, 48, and 8 percent of the population. Approximately 16 percent of the total land area is under cultivation, 42 percent is under forest, 12 percent is permanent pastureland, 15 percent is under perpetual snow, and the remaining 15 percent is wasteland.[1] The Tarai, which accounts for about 54 percent of the country's total cultivated area, is the most fertile and is called the "granary of Nepal."

The considerable differences in climate within Nepal are due primarily to the variation in altitude. The Tarai is subtropical, the hills are temperate, and the mountains are alpine. These dramatic changes in climatic conditions occur over a north-south distance of only 240 kilometers.

Agriculture is the mainstay of the nation's economy, providing roughly 80 percent of employment and accounting for about two-thirds of total GDP and 80 percent of export earnings. If genuine economic development is to take place in Nepal, it will have to be led and supported by growth in agriculture, which will provide a base in the form of wage goods and capital for the development of other sectors.

In recent years, declining agricultural output has been the most crucial concern of policymakers and administrators. Accordingly, enhancing agricultural production, particularly food crop production, has been the central theme of a succession of annual agricultural development programs. All the agencies of the Ministry of Agriculture have been mobilized in direct support of the production effort, and three different types of programs are launched each year. The Intensive Program provides an integrated supply of inputs such as extension services, improved seeds, fertilizer, and credits to irrigated land in the Tarai. The Pocket Program furnishes a concentrated supply of inputs to potential pocket irrigation facilities in the hills[2] and the Tarai. The Normal Program offers encouragement in the use of improved seeds in partially irrigated areas or rainfed areas in the hills and the Tarai.

In addition to their regular work, senior officials from all government agriculture agencies, including the research division, are assigned responsibilities as district supervisors to supervise officials (program implementors) already working at the field level. These senior officials are required to identify problems faced during the execution of district agriculture programs and to provide solutions on the spot, if possible, or to present the problems at the national level. Thus, already inadequate research resources are diverted from the development of viable modern technology, which is essential for long-term development of agriculture, to augment the efforts of extension

[1] Nepal, Agricultural Projects Services Center, *Perspective Land Use Plan (1985-2005)* (Kathmandu: APROSC, 1986).

[2] Unless otherwise specified, further references to "the hills" or "hill agriculture" will include both the hill and mountain areas of Nepal.

services and input supply management.

The main thrust of these efforts has been on expanding extension services, conducting training programs, and making inputs and credit available to farmers. Although these aspects are unquestionably important, their effectiveness is greatly dependent upon improved agricultural technologies developed through a productive research system.

Agricultural research has been given insufficient importance and does not have clear objectives and well-defined strategies and programs. The functions of agricultural research stations and farms are ambiguous and change frequently. These research sites also suffer from insufficient equipment, financial resources, and trained personnel.[3]

A thorough reappraisal is needed of the role that research could be playing. Recognition of research as the crucial subsector is vital to solving Nepal's problems of underdevelopment. A comprehensive study to examine resource allocation in depth, to analyze the factors inhibiting development of a viable and productive research system, and to develop a strategy for a long term agricultural research system aimed at sustained development of the agricultural sector is long overdue. This study is designed to meet that need.

First, the appropriateness of national policies regarding the generation and adoption of improved agricultural technology is reviewed, and the performance of the agricultural sector is examined with particular emphasis on the foodgrain subsector. Second, a review is made of the resource allocation patterns to and within the agricultural sector in general, and agricultural research in particular. Financial and personnel allocation patterns for agricultural research in the varied ecological regions are studied in detail: for example, the hills versus the Tarai; enterprises such as crops, livestock, and horticulture; and factor-oriented research topics such as soil, water, land use, conservation, and inputs. The components of the expenditure budget in terms of capital, staff salaries, and operational expenses for each subsector are also examined. Third, the institutional development of agricultural research is reviewed and the present organization and management of research vis-à-vis the research environment is examined. An analysis is made of research planning, implementation, monitoring, and incentives as they influence research productivity. Fourth, a broad based strategy for a national research system is suggested. This strategy includes consideration of research priorities, organizational structures, staff development, and institutional linkages within a long-term development perspective for the agricultural sector.

The study is based primarily on secondary data and official documents concerning trends in agricultural production and productivity (yield)[4] and resource allocation patterns from 1970/71 to 1980/81. In addition, 120 researchers were interviewed about their working conditions and recommendations for improving motivation in the research system. A brief description of the agricultural sector is provided. Agricultural policies, strategies, and performance during various five-year plans are reviewed. Trends in agricultural output, cropped area, productivity, and inputs use from 1960/61 to 1980/81 are discussed. The history of agricultural research and the present organization, planning, monitoring, and evaluation processes are highlighted. Financial and manpower resource allocations are discussed, as are research incentives and management. Some concluding observations are made regarding agricultural research strategies, priorities, and structures.

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[3] Asian Development Bank/Nepal, *Nepal Agricultural Sector Strategy Study*, vol. 1 (Kathmandu: ADB and Nepal Government Press, 1982).

[4] These two terms (productivity and yield) are used interchangeably throughout the report to mean output per unit of land.

3

AGRICULTURAL PLAN, POLICY, AND PERFORMANCE—A REVIEW

The development of a productive and sustainable agricultural research system in Nepal requires a full understanding of the present agricultural system—its plan, policy, and performance. This chapter presents background information on landholdings, land distribution, farming practices, plan priorities, constraints, and policies. The performance of agriculture in foodgrain and cash crops from 1970/71 to 1980/81 is discussed, and factors contributing to increased production are analyzed.

Agricultural Background

Nepalese agriculture is largely characterized by a mixed farming system, heavily dependent upon monsoon rainfall. Only 14 percent of cultivated land is under irrigation. In 1981, the average size of holdings was estimated at 1.12 hectares per family of seven persons. The physiographical features of the country distinguish the hill agriculture from that of the Tarai. The per capita cultivated land is 0.12 hectare in the hills and 0.21 hectare in the Tarai. In the hills, the average farm size is only 0.85 hectare compared with 1.47 hectares in the Tarai. Terraced cultivation is practiced in the hills, where most of the cultivated land is in the upland category, largely devoid of irrigation, and with soil that is very low in plant nutrients. In the Tarai, where some of the cultivated land is under irrigation and most of it is potentially irrigable, flatland and lowland cultivation are practiced. The Tarai also has better physical and institutional infrastructures than are found in the hills.

Land distribution in Nepal is extremely skewed. Approximately 50 percent of households have holdings of less than one-half hectare, accounting for only 7 percent of the cultivated area. Conversely, 47 percent of cultivated land is covered by holdings of more than 3 hectares owned by only 9 percent of all households. Sixty-seven percent of households have holdings of less than 1 hectare, accounting for 17 percent of cultivated land.

The land distribution is even more skewed in the Tarai than in the hills. Among households owning less than one-half hectare of cultivated land, 46 percent of Tarai households own only 3 percent of all cultivated land in the Tarai, compared with 54 percent of hill households owning 12 percent of cultivated land in the hills. Among households owning more than 3 hectares of cultivated land, 14 percent of households in the Tarai own 58 percent of the Tarai land, compared with only 5 percent of households in the hills owning 34 percent of the hill land (see Table 1).

Crops

The principal foodgrain crops are paddy, maize, and wheat, which account for nearly 86 percent of the total cropped area and almost 93 percent of total cereal production. Paddy is cultivated on about 60 percent of the total cereal crop area. Maize, 60 percent of which is produced in the hills, occupies between 20 and 22 percent of the total cereal crop area. Although wheat is a relatively new crop in Nepal, it already accounts for between 16 and 18 percent of the total cereal crop area and is increasing.

Other minor cereal crops are millet, barley, and buckwheat. Trends over the last decade have shown no significant change in cultivated areas for these crops. The pulses are also important crops, both as part of the Nepalese diet and as key components of the cropping system in Nepal.

Jute, sugarcane, tobacco, oilseeds, and potato are the major nonfoodgrain crops and

Table 1—Farm size and distribution of cultivated landholdings, 1981

Region/Size of Holdings	Number of Households	Percentage of Total Households	Total Cultivated Hectares	Percentage of Total Cultivated Land	Average Cultivated Hectares per Holding
Nepal					
Less than 0.5 hectare	1,107,902	50.5	161,987	6.6	0.15
0.5 - 1.0 hectare	355,420	16.2	264,522	10.8	0.74
1.0 - 3.0 hectares	535,964	24.4	868,201	35.3	1.62
More than 3.0 hectares	194,623	8.9	1,160,628	47.3	5.96
Total	2,193,909	100.0	2,455,338	100.0	1.12
Tarai					
Less than 0.5 hectare	434,210	45.6	38,705	2.8	0.09
0.5 - 1.0 hectare	123,250	13.0	91,367	6.5	0.74
1.0 - 3.0 hectares	262,336	27.6	463,521	33.1	1.77
More than 3.0 hectares	131,312	13.8	807,833	57.6	6.15
Total	951,108	100.0	1,401,426	100.0	1.47
Hills and mountains					
Less than 0.5 hectare	673,692	54.2	123,232	11.7	0.18
0.5 - 1.0 hectare	232,170	18.7	173,155	16.4	0.75
1.0 - 3.0 hectares	273,628	22.0	404,680	38.4	1.48
More than 3.0 hectares	63,311	5.1	352,795	33.5	5.57
Total	1,242,801	100.0	1,053,912	100.0	0.85

Source: Nepal, Central Bureau of Statistics, *Sample Census of Agriculture* (Kathmandu: CBS, 1981).

account for 10 to 12 percent of the total cropped area.

Livestock

Livestock are an integral part of the farming system in Nepal. Livestock production accounts for 21 percent of the total agricultural output and 15 percent of GDP. The most important animals are buffalo, cattle, goat, sheep, yaks, and pigs. Nepal has one of the highest ratios of grazing livestock per capita (5.8 animals per household) in the world. However, the productivity is extremely low because of low genetic potential, inadequate feeding, poor management, and widespread disease.

Horticulture

The wide climatic variation provides great scope for horticultural development in Nepal. Temperate-zone fruits can be successfully grown in the mountains and hills, citrus in the hills and the Tarai, and a range of tropical fruits in the Tarai. However, because of inadequate physical infrastructure and lack of an organized marketing network, this subsector is relatively undeveloped.

Fisheries

Because Nepal is a landlocked country, only inland fishery development is practiced. There are some river and pond fisheries. This subsector is gradually getting more attention in the country, though fish production constitutes a negligible part of the total agricultural output.

Agricultural Plans and Policies

In spite of a substantial investment in the agricultural sector (which comprises agriculture, forestry, irrigation, land reform, and cadastral survey) in the five-year plans between 1956 and 1980, agricultural productivity has remained relatively stagnant or, in some commodities, has declined.

Transport and communication received the highest priority during the first four plans (1956-75). It was only from the Fifth Plan that the agricultural sector received very high priority with an allocation of 29.80 percent (actual expenditure was 25.43 percent) of the total plan outlay (see Appendix 1, Table 37). From 1970/71 to 1980/81, the agricultural sector expendi-

ture increased from Rs 106.6 million to Rs 336.1 million (1972/73 rupees) at an annual rate of 14 percent. In the same period, total development expenditure increased at an annual rate of about 11 percent from Rs 523 million to Rs 1,356 million (see Appendix 1, Table 38). The agricultural sector was accorded the highest priority in the Sixth Five-Year Plan (1980-85) with an allocation of 30.34 percent of the total plan outlay to achieve a target annual growth rate of 3.2 percent (Appendix 1, Table 37).

Agricultural development strategy based on geographical comparative advantages was identified and initiated in the Fifth Plan. Accordingly, the plan emphasized foodgrain production in the Tarai, horticulture production in the hills, and livestock production in the mountains.

The Ten-Year Agriculture Plan (1975-85), prepared at the Investigation and Enquiry Centre of the Palace, had outlined four comprehensive objectives: to increase agricultural production and productivity on a sustained basis, both quantitatively and qualitatively, in view of rising population; to produce agricultural commodities needed to develop and sustain industry and trade and to support trade promotion and diversification; to pursue regional specialization in agricultural production based on geographical comparative advantages, needs, and priorities; and to improve the standard of living of farm families through agricultural development and creation of more employment opportunities for agricultural labor in the farm sector. Although the ten-year plan had carefully outlined the relevant objectives, strategies, and policies for agricultural development in Nepal, only the recommended organizational structure was effected; otherwise, the plan document remained mostly on the shelf.

Development Constraints

Past experience in agricultural development throughout various plans has emphasized the following constraints:

- Lack of suitable varieties of improved seeds for agricultural crops grown in different climatic regions of the country.
- Poor transport and communication along with rudimentary marketing networks; inadequate irrigation facilities, making agriculture largely dependent on the vagaries of the monsoon.
- Inadequate production support services such as improved seeds, fertilizers, insecticides, credit, and extension.
- Inadequate production incentives to farmers due to inequitable land tenure systems and an unfavorable price regime of agricultural inputs and output; insufficient motivation for researchers and extension workers to perform their work effectively.
- Lack of coordination and consistency in policy formulation, planning, and implementation for the use of land, water, and forests.
- Indiscriminate deforestation and lack of soil conservation measures leading to ecological imbalance and decline in soil fertility.

Recommended Policies

The following policies were recommended for agricultural development in the various plans:

- Generation of appropriate technologies suitable to different soil and climatic conditions; promotion of labor-intensive agricultural technology to create employment.
- Development of irrigation facilities to reduce dependency of agriculture on the vagaries of the monsoon and to raise agricultural production and productivity through intensification and multiple cropping.
- Program coordination of forestry, agriculture, and irrigation, with emphasis on scientific land use and improved conservation practices; integration and improvement in delivery of inputs, credits, and other services of various government agencies.
- Provision of incentives to increase production by instituting a favorable

price policy of agricultural inputs and outputs and implementing land reform programs to benefit the actual tillers of the land.

- Improvement in the income levels of small farmers, tenants, and landless agricultural laborers through special agricultural development projects such as the Small Farmer Development Project.
- Government directives to the commercial banks to lend a minimum of 7 percent of their total deposits to the agricultural and small-scale industry sectors.

Agricultural Performance

In the last two decades, agricultural productivity has declined in Nepal. During the same period, the cropped area has increased.

Trends in Agricultural Production and Productivity

From 1961/62 to 1980/81, total cereal grain production increased by an annual rate of only 1.10 percent, while productivity (yield) declined by 0.58 percent annually. The cropped area during this period increased by 1.69 percent annually. The annual rates of growth of foodgrain crops are presented in Table 2.

In the 1970s, total cereal grain production increased at an annual rate of 0.95 percent compared with 0.75 percent in the 1960s. Productivity declined at 0.46 percent annually in the 1970s compared with a decline of 1.0 percent in the 1960s. Similarly, the cropped area in the second period increased at 1.42 percent compared with 1.77 percent in the first period. Thus, both declines in productivity and increases in cropped area were smaller in the 1970s than in the 1960s.

Table 2—Annual growth rate of cereal crop area, production, and yield, 1961/62-1980/81

Cereal Crop/ Growth Segment	1961/62-1969/70		1970/71-1980/81[a]		1961/62-1980/81[a]	
	Percent	t-Statistic	Percent	t-Statistic	Percent	t-Statistic
Paddy						
Area	0.97	5.82	0.93	4.10	0.99	13.18
Production	0.45	1.02	0.73	1.03	0.90	4.16
Yield	-0.49	-1.25	-0.20	-0.39	-0.09	-0.51
Maize						
Area	-0.21	-0.56	0.24	1.81	0.24	2.24
Production	-1.36	-2.84	-1.06	-2.62	-0.66	-4.03
Yield	-1.15	-5.17	-1.30	-3.68	-0.90	-8.26
Wheat						
Area	10.31	4.49	5.82	10.16	8.34	15.33
Production	9.41	5.38	[illegible]	7.54	8.00	16.09
Yield	-0.84	-1.17	2.67	2.74	-0.33	-0.78
Barley						
Area	1.27	2.43	-0.71	-2.35	0.48	2.81
Production	-0.23	-0.22	-1.19	-1.83	-0.55	-1.83
Yield	-1.52	-2.08	-0.49	-1.26	-1.02	-4.30
Millet						
Area	7.61	6.01	0.54	1.78	3.48	7.05
Production	11.40	4.82	-0.44	-0.81	4.18	4.96
Yield	3.60	3.28	-0.97	-3.32	0.68	1.87
Total cereals						
Area	1.77	7.82	1.42	8.13	1.69	23.46
Production	0.75	2.21	0.95	2.10	1.10	7.60
Yield	-1.00	-2.82	-0.46	-1.39	-0.58	-4.74

Source: Unpublished data on area, production, and yield from the Department of Food and Agricultural Marketing Services, Nepal.

[a] 1979/80 is omitted because it was a drought year.

The productivity of wheat showed a positive growth rate of 2.67 percent in the 1970s. The productivity of maize, paddy, barley, and millet registered a negative growth rate. Maize, the second most important cereal grain, declined in both production and productivity at annual rates of 1.06 and 1.30 percent, respectively.

The per capita net (edible) foodgrain production declined from 185 kilograms in 1970/71 to 160 kilograms in 1980/81 (see Table 3). During this period, the real GDP grew at an annual rate of 1.53 percent while the population increased at an annual rate of approximately 2.70 percent. Therefore, the real per capita income declined. The slow growth of GDP is essentially due to stagnation in agricultural production. The real agricultural GDP did not show any trend upward and remained almost stagnant for the whole period (Appendix 1, Table 38).

Production and yield in the hills and mountains declined much faster than in the Tarai from 1970/71 to 1980/81 (see Table 4). In the Tarai, total cereal grain production increased annually by 1.44 percent and yield remained almost unchanged. During the same period, production in the hills remained constant and yield declined annually at 1.14 percent. An increase in the cropped area for the Tarai, at the rate of 1.50 percent annually, kept production rising without any change in yield, while a decline in yield for the hills was offset by a 1.27 percent increase in the cropped area that left total production undiminished.

Wheat area, production, and yield increased faster in the Tarai than in the hills. The production of wheat in the Tarai increased substantially at 12.79 percent annually because of annual increases in yield of 3.96 percent and in cropped area of 8.50

Table 3—Per capita food production, 1970/71-1980/81

Year	Population	Food Production (Gross)	Food Production (Net)	Per Capita Net Foodgrain Production
	(millions)	(1,000 metric tons)		(kilograms)
1970/71	11.56	3,486	2,183	185
1971/72	11.87	3,492	2,170	183
1972/73	12.18	3,303	2,137	175
1973/74	12.50	3,706	2,330	186
1974/75	12.83	3,781	2,410	188
1975/76	13.17	3,908	2,436	185
1976/77	13.52	3,704	2,332	172
1977/78	13.88	3,585	2,262	163
1978/79	14.25	3,653	2,302	162
1979/80	14.63	3,196	2,000	137
1980/81	15.02	3,829	2,499	166

Source: Unpublished data on gross and net food production from the Department of Food and Agricultural Marketing Services, Nepal.

Notes: Population for various years is calculated on the basis of annual rate of growth of 2.66 percent. Conversion of gross food production into net (edible) food is made by the DFAMS as follows:

Losses in storage	10 percent
Losses in milling, for rice	40 percent
Losses in milling, for other grains	3 percent
Retention for seeds	
Paddy	55 kilograms per hectare
Maize	20 kilograms per hectare
Wheat	100 kilograms per hectare
Millet	20 kilograms per hectare
Barley	40 kilograms per hectare
Other losses	1 – 1.5 percent

Table 4—Annual growth rate of cereal crop area, production, and yield, by region, 1970/71-1980/81

Cereal Crop/ Growth Segment	Hills		Tarai		Total Nepal	
	Percent	t-Statistic	Percent	t-Statistic	Percent	t-Statistic
Paddy						
Area	1.98	8.93	0.71	2.96	0.93	4.10
Production	0.72	1.45	0.73	0.87	0.73	1.03
Yield	-1.24	-3.25	0.01	0.02	-0.20	-0.39
Maize						
Area	0.72	4.94	-0.86	-3.99	0.24	1.81
Production	-1.14	-2.30	-0.88	-1.11	-1.06	-2.62
Yield	-1.84	-4.70	-0.02	-0.02	-1.30	-3.68
Wheat						
Area	2.08	3.41	8.50	6.60	5.82	10.18
Production	3.86	6.05	12.79	5.17	8.64	7.54
Yield	1.74	3.51	3.96	2.13	2.67	2.74
Barley						
Area	0.24	1.00	3.35	-1.89	-0.71	-2.35
Production	-1.61	-3.48	-0.20	-0.08	-1.19	-1.83
Yield	-1.85	-4.16	3.25	2.61	-0.49	-1.26
Millet						
Area	0.69	2.07	-0.24	-0.56	0.54	1.78
Production	-0.54	-0.86	0.16	0.31	-0.44	-0.81
Yield	-1.22	-3.54	0.41	2.41	-0.97	-3.32
Total cereals						
Area	1.27	8.77	1.50	5.90	1.42	8.13
Production	0.12	0.38	1.44	2.30	0.95	2.10
Yield	-1.14	-3.87	-0.06	-0.12	-0.46	-1.39

Source: Computed from unpublished data on area, production, and yield from the Department of Food and Agricultural Marketing Services, Nepal.
Note: 1979/80 is omitted because it was a drought year.

percent. Wheat production in the hills, however, increased at a rate of only 3.86 percent, with a productivity growth of 1.74 percent and cropped area growth at 2.08 percent.

The annual growth rates in area, production, and yield of cash crops are shown in Table 5. The area under cash crops increased at an annual rate of 2.23 percent from 1961/62 to 1980/81. From 1970/71 to 1980/81 the cash crop area increased by 1.12 percent compared with 3.19 percent from 1961/62 to 1969/70. Area and production of all cash crops, except tobacco, increased from 1961/62 to 1980/81. Sugarcane had the highest growth rate, 8.86 percent, while jute production increased only 2.46 percent. The yield of sugarcane and oilseeds increased, that of tobacco and potatoes declined, and jute yield remained almost constant. From 1970/71 to 1980/81, the area, production, and yield increased for sugarcane and oilseeds but declined for tobacco and potatoes. In the 1960s, area and production of all cash crops except oilseeds increased, while the yield of jute, tobacco, and potatoes declined. In general, the growth in yield of cash crops was better than for cereal crops, but was not highly encouraging.

Wheat and sugarcane showed an increase in production and productivity between 1961/62 and 1980/81. The data on the use of fertilizer for crops are not available on a yearly basis, so it is difficult to show empirically the effect of fertilizer use on the productivity increase of wheat and sugarcane. However, in 1981/82, chemical fertilizer was used on 17 percent of total area under wheat and 12 percent of total area under sugarcane, compared with only 3 and 8 percent of total area under maize

Table 5—Annual growth rate of cash crop area, production, and yield, 1961/62-1980/81

Cash Crop/ Growth Segment	1961/62-1969/70		1970/71-1980/81		1961/62-1980/81	
	Percent	t-Statistic	Percent	t-Statistic	Percent	t-Statistic
Sugarcane						
Area	11.72	5.10	6.12	6.18	7.43	12.50
Production	13.94	6.96	7.41	6.58	8.86	13.76
Yield	1.99	3.10	1.22	2.33	1.33	6.66
Jute						
Area	7.00	4.54	-1.18	-0.52	2.07	2.42
Production	3.60	4.77	1.38	0.75	2.46	4.54
Yield	-3.18	3.24	2.60	2.51	0.38	0.76
Oilseed						
Area	-1.67	2.83	2.06	2.61	1.10	3.20
Production	0.75	1.58	4.40	4.60	2.62	7.41
Yield	2.46	4.91	2.29	6.15	1.51	8.26
Tobacco						
Area	9.75	5.32	-1.51	-0.79	1.26	1.34
Production	3.20	0.88	-3.03	-1.70	-1.11	-1.17
Yield	-5.97	-2.82	-1.54	-2.88	-2.34	-4.14
Potato						
Area	12.42	6.96	-0.02	-0.05	4.74	2.77
Production	10.07	4.31	-0.74	-1.18	3.31	4.12
Yield	-2.09	-2.06	-0.73	-1.93	-1.37	-6.15
Total cash crops						
Area	3.19	12.48	1.12	1.60	2.23	9.41

Source: Computed from unpublished data on area, production, and yield from the Department of Food and Agricultural Marketing Services, Nepal.
Note: 1979/80 is omitted because it was a drought year.

and paddy, respectively.[5] Similarly, the national average use of fertilizer per hectare was 14 kilograms on wheat and 29 kilograms on sugarcane, compared with only 3 kilograms on maize and 4.5 kilograms on paddy. It is commonly observed that wheat and sugarcane are grown where some irrigation facilities are available, unlike paddy and maize, which are largely grown under rainfed conditions.

Decomposition of Growth Trends

Table 6 presents the annual growth rates (compound) of agricultural production and its components from 1961/62 to 1980/81. (See Appendix 2 for methodology.) This period was divided into two parts, 1961/62-1969/70 and 1970/71-1980/81, because of the possible effect of the "green revolution" in the 1970s. The growth rates of agricultural production and its components for the two periods, and for the combined period, clearly indicate that area effect is the dominating factor in the growth of agricultural production. The yield effect on production in these periods was negative.

From 1961/62 to 1969/70, negative yield effect was much greater than during 1970/71-1980/81. Moreover, the value in the second period was not significantly different from zero. Thus one may argue that the decline in production due to negative yield effect has been arrested, perhaps owing in part to improved technology. On the other hand, the cropping pattern effect was positive in the first period but negative in the second period. The positive sign of the cropping pattern implies a shift in favor of high-value crops. The first period showed

[5] Nepal, National Planning Commission, Central Bureau of Statistics, *National Sample Census of Agriculture 1981/82* (Kathmandu: CBS, 1985).

Table 6—Annual growth rates (compound) of agricultural production and its components, 1961/62-1980/81

Period	Total Value of Production	Area Effect	Yield Effect	Cropping Pattern Effect	Interaction Between Yield and Cropping Effects
			(percent)		
1961/62-1969/70	1.522	1.901	-0.637	0.296	-0.038
1970/71-1980/81	1.125	1.441	-0.270[a]	-0.214	0.168
1961/62-1980/81	1.406	1.702	-0.304	-0.004[a]	0.012

Source: Unpublished data on area, production, and yield from the Department of Food and Agricultural Marketing Services, Nepal.

[a] Not significant at 95 percent level of confidence.

an increase in the proportion of cropped area under high value crops such as sugarcane and tobacco. In the second period, there were substantial increases in the cropped area under wheat, which is a low-value crop compared with cash crops.

This analysis indicates that the application of improved technology has begun to influence the total production by arresting further decline in productivity. However, the direct positive contribution of technology to production has yet to occur. The exception is in the case of wheat, where there was a positive growth rate in productivity. The increase in production was mostly due to increases in cropped area, rather than increases in productivity, in contrast with the improvements in productivity that contributed to more than 70 percent of the food production growth in developing countries between 1961 and 1980.[6]

Trends in Use of Inputs

The use of fertilizer between 1970/71 and 1980/81 increased threefold, from 18,000 to 54,000 tons annually.[7] Despite this rapid increase, the overall rate of fertilizer application in 1980/81 was only 9 kilograms per cropped hectare, which is among the lowest in the world.[8] Also, the application of fertilizer was very uneven on a geographical basis. The most intensive fertilizer use occurred in the Kathmandu Valley (Kathmandu, Bhaktapur, and Lalitpur hill districts), accounting for more than one-third of total fertilizer use in the country. Less than one fifth of total fertilizer use was in the remaining 52 hill and mountain districts (see Table 7). The average fertilizer use rate in Kathmandu Valley was about 72 kilograms per hectare per year, while in the Tarai and the hills (excluding the Kathmandu Valley), fertilizer rates were only about 9 kilograms and 4 kilograms of nutrients per hectare, respectively.[9]

The disbursement of institutional credit from the Agricultural Development Bank increased sevenfold from Rs 19 million to Rs 134 million between 1970/71 and 1980/81. Only 24 percent of the borrowing farm families borrowed from institutional sources in 1976/77; the rest had to depend upon private sources. Of the total amount borrowed, only 42 percent came from institutional sources.[10]

[6] Leonardo A. Paulino, *Food in the Third World: Past Trends and Projections to 2000*, Research Report 52 (Washington, D.C.: International Food Policy Research Institute, 1986).

[7] All tons referred to in this report are metric tons.

[8] John M. Hill, *A Fertilizer Strategy for Nepal* (Muscle Shoals, Ala.: International Fertilizer Development Center, 1982), p. 25.

[9] Ibid., p. 27.

[10] Nepal Rastra Bank, *Agricultural Credit Review Survey* (Kathmandu: Nepal Rastra Bank, 1980).

Table 7—Annual consumption of chemical fertilizer, 1970/71-1980/81

Year	Hills	Kathmandu Valley	Tarai	Nepal
		(metric tons)		
1970/71	281	10,465	6,982	17,728
1971/72	1,145	12,368	11,921	25,434
1972/73	1,718	16,564	13,767	32,049
1973/74	2,051	15,474	19,252	36,777
1974/75	2,166	13,076	21,151	36,393
1975/76	3,340	12,039	15,750	31,129
1976/77	4,590	14,421	18,833	37,844
1977/78	6,726	15,753	22,754	45,233
1978/79	7,655	15,862	22,073	45,590
1979/80	9,593	16,503	24,191	50,287
1980/81	9,997	18,093	25,910	54,000

Source: Unpublished data from the Agriculture Inputs Corporation, Nepal.

The area under improved seeds of cereal crops, mainly wheat, paddy, and maize, increased substantially from 1970/71 to 1980/81. The area under improved wheat increased from 98,200 hectares in 1970/71 to about 380,000 hectares in 1980/81, achieving almost total saturation of wheat area under improved seed. Improved wheat varieties were introduced in Nepal only in 1960. The areas under improved paddy seed increased from 68,000 hectares in 1970/71 to 322,000 hectares in 1980/81, increasing the proportion of area under improved seed from 6 percent to 25 percent. Similarly, the area under improved maize increased from 12,000 hectares in 1970/71 to 157,000 hectares in 1980/81, raising the proportion of area under improved seed from 3 percent to 34 percent (see Table 8).

Annual data on irrigation are not collected systematically. The estimated total command area under irrigation in the country by 1980/81 was about 500,000 hectares, of which year-round irrigation facilities were available to only 115,000 hectares, which is only 4 percent of total cultivated land.[11]

District Agriculture Development offices have been opened in all 75 districts of Nepal to carry out extension services. The Training and Visit Extension System advocated by the World Bank has also been introduced in all 20 Tarai districts.

Research System Outputs

The agricultural research system released a total of 29 rice varieties between 1960 and 1985 (see Appendix 1, Table 39). Of these 29 varieties, 10 were intended for hills and 5 for rainfed conditions (Tarai only). Popular rice varieties among farmers were CH-45, Khumal-3, Taichung Native-1, Masuli, Sabitri, Janaki, Kanchan, Himali, and Bindeswari. Almost all varieties require irrigated land and high fertilization rates to perform well in the farmers' fields. An exception is Masuli, which can perform well even under medium to low levels of fertilization. No improved variety was available for upland rainfed rice cultivation during this period.[12]

Ten maize varieties were released between 1959 and 1985. Of these, three were for the Tarai, three for the hills, and four for both ecological areas. All varieties require medium to high fertilization levels and are recommended for both irrigated and rainfed conditions. Khumal yellow, Rampur composite, Arun-2, and Makalu-2 were the most popular varieties among farmers.

Fifteen wheat varieties have been released to date. Of these, 3 were for the hills, 11 for the Tarai, and 1 for both regions. All varieties are recommended for both irrigated and rainfed conditions and medium to high fertilizer use. Among these varieties, only Lerma 52, RR-21, and UP-262 were popular among farmers. Almost 80 percent of the improved wheat crop is RR-21. Lerma-52 was probably the next most popular variety but was used almost exclusively in the hills.

The progress in agricultural production does not seem commensurate with the

[11] Asian Development Bank/Nepal, *Nepal Agricultural Sector Strategy Study*, vol. 2 (Kathmandu: ADB, 1982), p. 77.

[12] Nepal, Department of Agriculture, *The Integration of Research and Extension in Farmers' Fields: The Terminal Report of the Integrated Cereals Project* (Kathmandu: Ministry of Agriculture, 1985), pp. 49-51.

Table 8—Area under high-yielding varieties (HYVs) of wheat, paddy, and maize, 1970/71-1980/81

Year	Wheat			Paddy			Maize		
	Total Area	High-Yielding Varieties Area	Percentage of HYV Area	Total Area	High-Yielding Varieties Area	Percentage of HYV Area	Total Area	High-Yielding Varieties Area	Percentage of HYV Area
	(1,000 hectares)			(1,000 hectares)			(1,000 hectares)		
1970/71	228	98.2	43.1	1,182	67.8	5.7	446	11.6	2.6
1971/72	239	115.9	48.5	1,201	81.6	6.8	434	20.8	4.8
1972/73	259	170.3	65.7	1,139	177.3	15.5	437	35.1	8.0
1973/74	275	206.8	75.2	1,226	205.1	16.7	453	74.1	16.5
1974/75	291	246.9	84.8	1,240	222.6	18.0	458	79.0	17.2
1975/76	329	233.5	71.0	1,250	216.4	17.2	450	66.3	14.7
1976/77	348	254.2	73.0	1,262	220.3	17.4	445	83.0	18.6
1977/78	366	265.2	72.4	1,264	290.5	23.0	454	98.7	21.7
1978/79	374	311.3	83.2	1,263	326.8	25.8	432	108.8	25.2
1979/80	367	367.0	100.0	1,254	323.9	25.8	457	121.3	26.5
1980/81	391	380.0	97.0	1,276	322.2	25.2	457	157.1	34.4

Sources: Dana G. Dalrymple, *Development and Spread of High Yielding Varieties of Wheat and Rice in the Less Developed Nations*, Foreign Agricultural Report No. 95 (Washington, D.C.: U.S. Department of Agriculture, September 1978); and unpublished data from the Department of Agriculture, Nepal.

achievement in application of improved agricultural inputs. Although increases in the use of agricultural inputs are large in percentage terms, they are so small in absolute terms that their impact may not be measurable, particularly if the output measures themselves are relatively weak. Also, poor quality of improved seed, lack of irrigation, and inadequate use of fertilizer may be the reasons for the low yields.

Four hill districts (Kathmandu, Bhaktapur, Lalitpur, and Kabhre) and seven Tarai districts (Morang, Dhanusha, Bara, Parsa, Chitawan, Rupandehi, and Kapilbastu) contain about one-fourth of the total cropped area (2.4 million hectares) of the country. The Agriculture Inputs Corporation indicates that about 70 percent of the total fertilizer sale occurred in these 11 of the 75 districts in Nepal. Conversely, only 30 percent (about 15,000 tons of chemical fertilizer) was used on the three-fourths of total cropped area in the remaining 64 districts.[13] Thus the overall impact of fertilizer on agricultural productivity has not been noticeable at the national level. Even though there has been significant increase in the use of improved varieties, their performance in the field has not been satisfactory because of the absence or inadequate use of fertilizer and the lack of irrigation.

Frequent examples have been found of winter wheat grown as a second crop after paddy without large applications of fertilizer, resulting not only in very poor yields but also in substantially reduced yields of the paddy that followed. The decline in fertility arises from the compounding of two factors. One is loss of soil nutrients as the crop nutrient balance is upset by increased cropping intensity. The other is physical degradation, particularly in terms of moisture and air retention. A crop-nutrient balance study carried out at several cropping system sites indicates that less than half of all nutrients removed from the soil by crops in one year are being replaced by the application of organic and inorganic fertilizers.[14]

[13] Nepal, Agriculture Inputs Corporation, *Basic Statistics of Agricultural Inputs in Nepal* (Kathmandu: AIC, 1983).

[14] S. B. Matherma, et al., "Notes on the Economics of the Use of Inorganic Fertilizer in Nepal," paper presented at the Eighth Summer Crops Workshop at Rampur, January 1981.

The five-year plans seem to have correctly identified the major constraints, outlined clear objectives, and recommended appropriate broad policy measures for the development of agriculture. However, the achievements have been disappointing, implying a lack of serious commitment to putting these policies into effect. The plans have mentioned institutional reform to motivate farmers to take advantage of improved agricultural technology, but no significant reforms seem to have been effected from 1960 to 1985 except, for a few years, the state monopoly of rice marketing, which was aimed primarily at increasing the revenue earnings rather than providing remunerative prices to the farmers. The difficulty of translating these policies into action has been compounded by adverse sociopolitical environments.

4

INSTITUTIONAL DEVELOPMENT OF AGRICULTURAL RESEARCH

Historically, agricultural research in Nepal has received low priority, since the presumption has always been that technology can be easily borrowed from outside. Researchers have been largely preoccupied with providing support services to development activities rather than concentrating on research work.

In the process of institutional development, the organization of agricultural research has evolved through three stages. First, there was a focus on a multidisciplinary approach, with research, extension, and training integrated under the Department of Agriculture. In the second stage, the Department of Agriculture was divided into five separate departments and agricultural research in the country became disintegrated and uncoordinated, since each department carried out its research and development work independently. The concept of multidisciplinary stations at the field level was abandoned during this period. The lack of coordination among the five departments emerged as a key factor for their amalgamation into one department in the third stage. Again, all agricultural research and extension activities were brought under one Department of Agriculture. All research units were made responsible for providing support services to extension, thus undermining their research capabilities. Changes in responsibilities among the deputy directors general of the department led to further disintegration of the research structure. The later creation of a separate Department of Livestock and Animal Health exacerbated this disintegration.

The Research Coordination Committee of the Ministry of Agriculture, which is at the apex of the system, has not been effective in fulfilling its planning and coordination role in agricultural research. Inadequate foreign assistance has contributed little to the development of a viable national agricultural research system, partly because of a project approach to funding. The weak research system has derived few of the benefits potentially available through greater and more active collaboration with other national and international agricultural research systems.

The beginning of agricultural research activities in Nepal can be traced back to 1924 with the opening of the Department of Agriculture and the establishment of a trial-demonstration farm in Singh Durbar, Kathmandu, and a fruit nursery farm at Godavary, Lalitpur. Agricultural farms were established later at Janakpur, Pokhara, and Parwanipur.

Starting in 1955, research sections, agricultural stations, and farms were established to test and modify technologies that were borrowed from neighboring and other foreign countries. In 1957 the Department of Agriculture, within the Ministry of Agriculture, consisted of a central directorate office with a director and two assistant directors and the following sections: Agronomy, Horticulture, Livestock and Dairy, Veterinary, Agricultural Engineering, Plant Pathology, Entomology, and Fisheries. The Department of Agriculture was responsible for overall development of agriculture in the country and carried out the three primary functions of research, training, and extension. The sections mentioned above were primarily responsible for research but also provided support services to extension programs through training and subject matter specialists.

The First Five Year Plan (1956-60) put the primary focus on adaptive research for cereal crops—mainly paddy and maize—and finger millets.[15] Japanese varieties of

[15] Nepal, Ministry of Agriculture, *A General Outline of the First Five-Year Plan for Agriculture Development* (Kathmandu: MOA, 1957).

paddy had shown considerable success in yields over local varieties. Similarly, Armillo de Cubano Flint —a variety of maize obtained from the United States—had demonstrated an increase in yield of 30 to 50 percent over local varieties on farmers' fields in the Tarai and submountain regions. Five new sections were opened in the Department of Agriculture during the First Plan: School of Agriculture, Agricultural Marketing and Farm Management (agricultural economics), Agricultural Extension, Soil, and Agricultural Botany.

During this period, the formation of a Council of Agriculture was proposed. This group was to act as an advisory body to the Department of Agriculture in all matters of departmental activities, namely, research, extension, and teaching, but the council was never established.

In the 1960s, both the government and foreign donors believed that Nepal could benefit from technologies that brought the green revolution to many developing countries by dissemination of these technologies to farmers and provision of support services to accelerate their adoption. With land reform providing the farmers more incentives to produce, and with the establishment of village cooperative societies to supply the necessary inputs and credits, Nepal appeared to be ready for "takeoff" with an extension program that would have a real effect on production.[16]

In 1965/66 an intensive, coordinated agricultural development program was initiated with the assistance of the U.S. Agency for International Development (USAID) in 9 of Nepal's most productive districts—6 in the Tarai and 3 in Kathmandu Valley. This program was expanded to another 7 districts in the Tarai in the following year, and an intensive production program was established in 16 districts with improved practices accompanied by production inputs.

An integration of research and extension is reflected in the proposed regional program of the Department of Agriculture in 1966. The field activities of agricultural development were grouped into six regions. All the subject matter specialists on agricultural stations or farms in each region and all extension personnel were collectively responsible for agricultural development in those regions. Their job descriptions and responsibilities were clearly defined. This program emphasized extension activities more than research activities, perhaps because of a political thrust to show the effect on agricultural production of the land-reform program initiated in 1964 and the presumption that varieties and practices developed elsewhere could easily be transferred to farmers' fields.

As this regional program was about to be carried out in 1966, the Department of Agriculture was dissolved and five new departments were created in the Ministry of Agriculture: Agricultural Education and Research, Agricultural Extension, Horticulture, Livestock and Veterinary Science, and Fisheries.

The Agricultural Economics Section of the former Department of Agriculture was renamed the Economic Analysis and Planning Division (EAPD) and was brought directly under the Ministry of Agriculture. Its role was to conduct socioeconomic and marketing research. In addition, it was responsible for the overall planning and evaluation of agricultural programs in the Ministry of Agriculture.

Under the new organizational arrangements, the Department of Agricultural Education and Research consisted of seven sections, five agricultural stations, and five agricultural farms. The College of Agriculture was established under this department to conduct undergraduate training in agriculture and animal husbandry.

The Department of Agricultural Extension had two sections, namely, the Agricultural Information Section and the Rural Youth (4-H) Program Section. Extension activities throughout the country were organized and supervised by this department.

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[16] U.S. Agency for International Development, *Project History and Analysis Report—Agricultural Extension and Training* (367-11-110-054) (Washington, D.C.: USAID, 1965).

The Department of Livestock and Veterinary Science, responsible for animal research and development, consisted of 3 sections, 4 livestock development stations, 3 sheep development centers, 7 artificial insemination service centers, 4 poultry projects, and 33 veterinary hospitals. The Department of Horticulture had 18 horticultural farms and the Department of Fisheries had 7 fishery centers.

Before the reorganization of the Department of Agriculture, the agricultural stations were organized on a multidisciplinary basis. Field crops, horticulture, and livestock research were integrated at each station and the station manager was the coordinator of all activities. After the reorganization, the concept of the unified multidisciplinary station was abandoned. Each department wanted to have a portion of each station under its control. This led to fragmentation of the stations, without overall coordination, since each station section was directly responsible to its respective department. This fragmentation also duplicated logistical tasks, since each section had its own administrative unit, and complicated and lengthened the coordination process.

In the formulation and implementation of programs, there was a serious lack of coordination among departments within the same ministry. Because of these coordination problems and sluggish growth in agricultural production, three top-level agricultural technicians were asked by Janch Bujha Kendra (the Investigation and Enquiry Centre of the Palace) to prepare a 10-year agriculture plan and to suggest an effective organizational setup. The 10-year agricultural development program was approved by the government, and the organizational setup, as outlined in the plan, was established in 1972/73. The five departments that had been created in 1966 were amalgamated into one Department of Agriculture. The organizational structure of the department is shown in Figure 1.

The new element in the proposed structure of the department was regionalization (to match the regional corridor development concept of the government).[17] Regional agricultural directorates were opened in four development regions of the country (Eastern, Central, Western, and Far Western)[18] to carry out agricultural development activities, with the main focus on extension services.

The crop-coordinated research program that had been initiated in 1971, under the Department of Agricultural Education and Research, received due recognition. Coordinated crop development programs were launched for paddy, wheat, maize, citrus, and potatoes, emphasizing agricultural improvement through problem-oriented, multidisciplinary research teams concentrating their attention on a major commodity or problem area.

Horticulture was divided into two separate sections, Fruit Development and Vegetable Development. Similarly, livestock was divided into Animal Development Section 1 and Animal Development Section 2. Section 1 was responsible for the development of large animals such as buffalo, cattle, and yaks, and for feed fodder and pasture. Section 2 was responsible for the development of small animals and birds such as sheep, goats, pigs, and poultry.

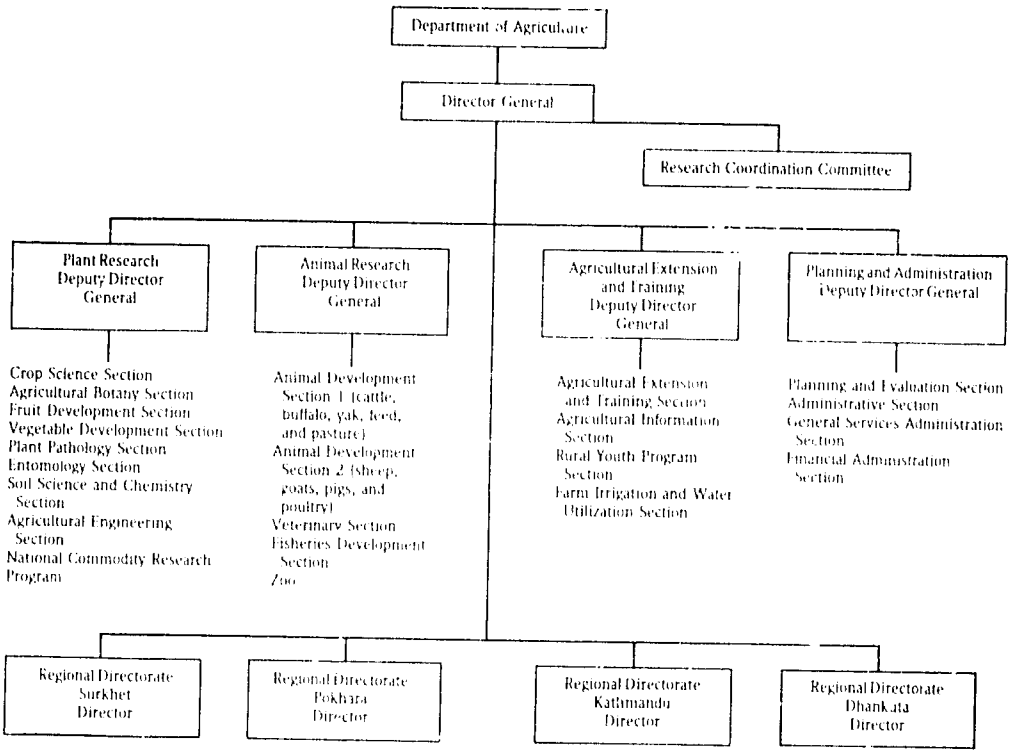
Thus agricultural research was organized into sections, partly on a commodity basis and partly along discipline lines. Each section was entrusted with the responsibilities of both research and development. This led to gradual dilution of research efforts in favor of extension activities. Research units were placed in two categories, based on their coverage of either national (central) or regional agricultural research and development programs.

The sections and agricultural stations that engaged in research to support the national agricultural development activities fell into

[17] In the Fourth Five Year Plan (1970-75), considering national development in spatial dimension, growth axes were proposed along major north-south roads. This led to creation of four development regions in 1972. For detailed discussion on regional development strategy see Nepal, National Planning Commission, *The Fourth Plan, 1970-75* (Kathmandu: NPC, 1970), Appendix 3, pp. 328-340.

[18] In 1980 the Far Western Region was split into two regions (Midwestern and Far Western), creating the present total of five regional agricultural directorates.

Figure 1—Organization chart of the Department of Agriculture, 1972/73



Source: Nepal, Ministry of Agriculture, *Ten-Year Agriculture Plan* (Kathmandu: MOA, 1972).

the first category, the Central Research Program. All the plant and animal science research sections, national coordinated crop development programs, and agricultural research stations were administered by the Central Directorate of Agriculture in Kathmandu.

Research farms specific to a commodity or discipline belonged to the second category. Agricultural Research Farms, under the Regional Agricultural Directorate. These farms engaged in three activities: providing technical backstopping to the extension program; conducting field experiments pertinent to the Central Research Program; and producing improved seeds, fruit plants, and animals.

Under reorganization, a new Department of Food and Agricultural Marketing Services was opened, and the Department of Irrigation, Hydrology, and Meteorology of the Ministry of Water and Power was brought under the Ministry of Food and Agriculture, which was renamed the Ministry of Food, Agriculture, and Irrigation. Three divisions, Planning and Coordination, Evaluation and Project Analysis, and Administration and Fiscal Management, and a Project Review Committee were established in the ministry.

A National Agricultural Development Committee, under the chairmanship of the minister of food, agriculture, and irrigation, was also set up to formulate agricultural policies and provide guidelines for agricultural development. Similarly, an Agricultural Research Coordination Committee was created under the chairmanship of the director general of the Department of Agriculture to provide guidelines for research policy and priorities. These committees remained dormant.

In 1979 a separate Department of Livestock Development and Animal Health was

again created from the Department of Agriculture. This new department opened a Regional Directorate of Livestock Development and Animal Health in each development region of the country.

The internal organization of the Department of Agriculture was further changed in 1982, and research sections were brought under three deputy directors general (see Figure 2). The Agricultural Botany and Agronomy sections, eight agricultural stations, and the national commodity programs for six crops are now under the deputy director general of crop production, whereas the Soil Science and Agricultural Chemistry, Plant Pathology, Entomology, and Agricultural Engineering sections are under the deputy director general of technical services and extension. The development sections for fisheries, fruits, and vegetables and the national commodity programs for potatoes and citrus are under the deputy director general of horticulture and fisheries. Another interesting feature of the reorganization is that the Agricultural Information Section, which is closely related to extension, is not under the deputy director general of technical services and extension, but under the deputy director general of planning and evaluation. Also, some agricultural farms are under a regional agricultural directorate, although other regional directorates currently have no farms. The production support bias and the balance of work distribution among the deputy directors general seem to be the guiding factors in the current reorganization. Thus these compartmentalizations have further disintegrated agricultural research activities.

Present Agricultural Research Structure

The Ministry of Agriculture presently consists of the Department of Agriculture, the Department of Livestock Development and Animal Health, the Department of Food and Agricultural Marketing Services, and the Central Food Research Laboratory.

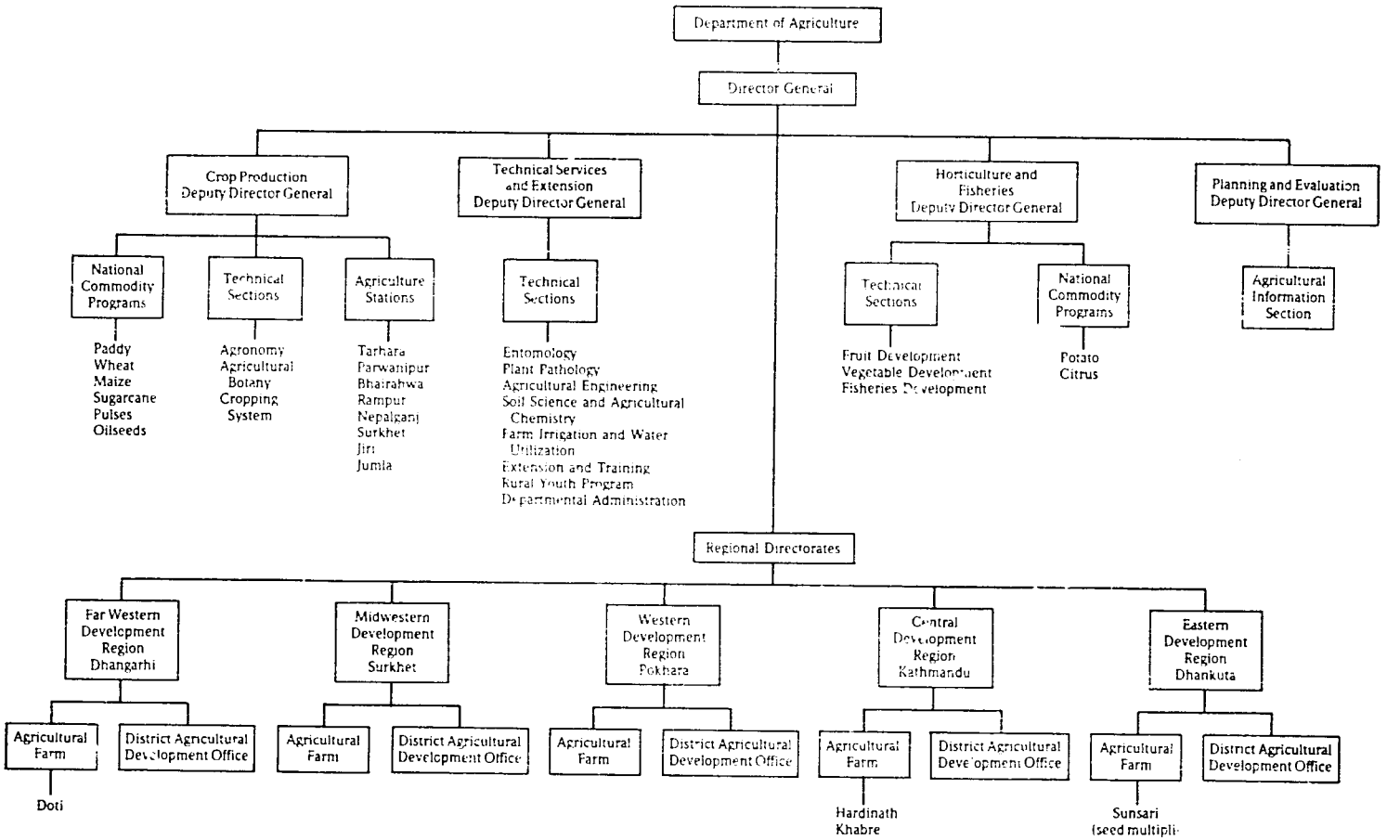
Department of Agriculture

Agricultural research within the Department of Agriculture is organized into disciplinary and commodity sections in addition to national commodity research programs. Agricultural research stations and agricultural farms have been established in various parts of the country for the purpose of research and production support programs (see Figure 3).

There are eight disciplinary sections: Agronomy, Agricultural Botany, Entomology, Plant Pathology, Soil Science and Agricultural Chemistry, Agricultural Engineering, Socioeconomic Research and Extension, and Farming Systems Research. These sections are located at Khumaltar, Kathmandu Valley. Along with the three commodity sections discussed below, they are the technical arms of the Department of Agriculture. The main functions of the disciplinary sections are to conduct and coordinate research activities in their respective disciplines at the research section, the head offices of commodity research programs, agricultural stations, and agricultural farms. The Agronomy Section carries out varietal and fertilizer trials and varietal improvement through plant breeding, and also does cropping system research. The Agricultural Botany Section does seed testing, inspection, and certification. The Plant Pathology Section conducts research on plant diseases and mushrooms. The Soil Science Section conducts soil tests and biogas research. The work of the Entomology Section includes sericulture and apiculture, besides research on insect pests of plants. The Socioeconomic Research and Extension Section conducts research on adoption of recommended technology, and the Farming Systems Research Section focuses on the suitability of technology, taking the total farming system into account.

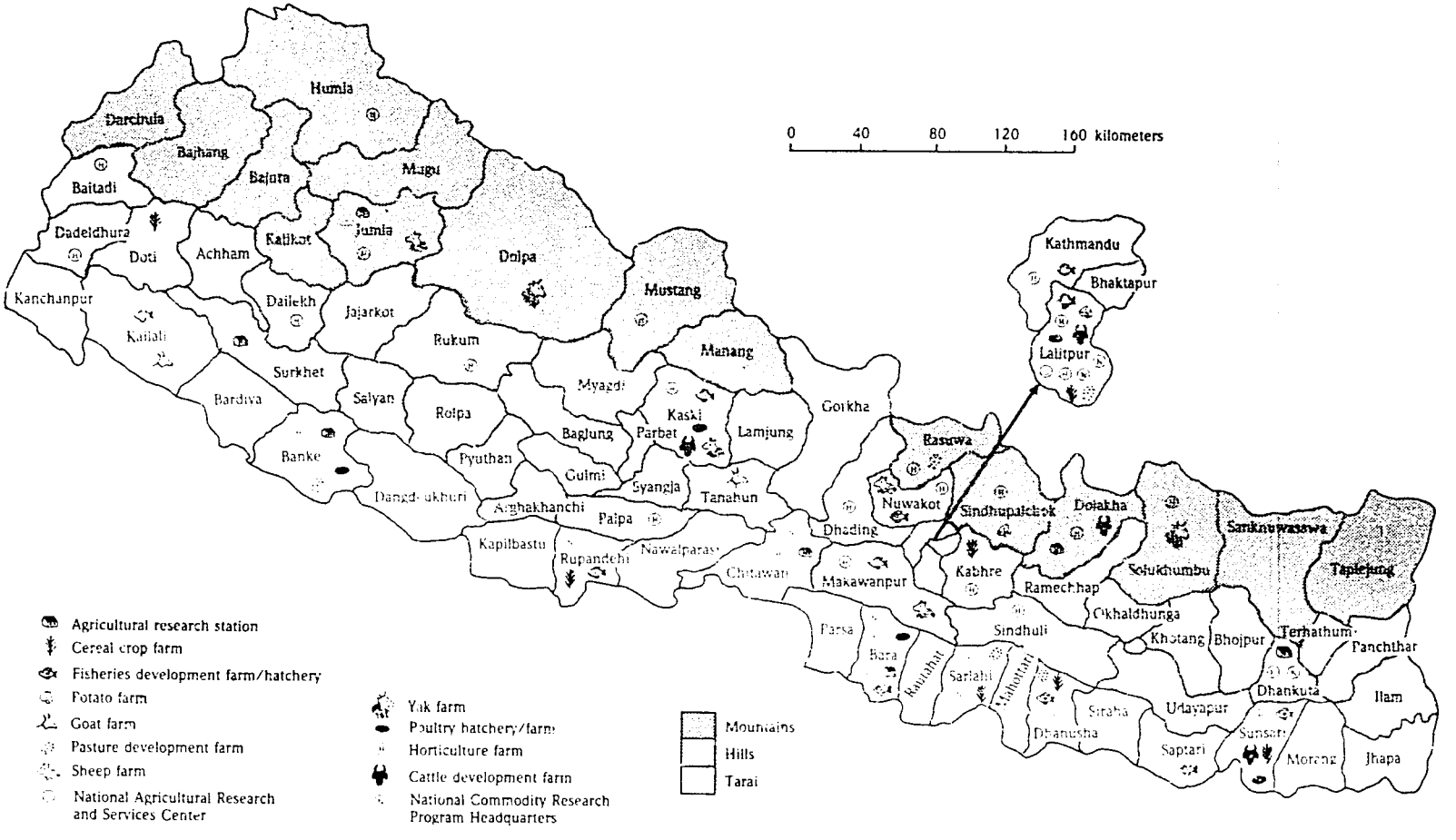
The three commodity sections are Fruit Development, Vegetable Development, and Fisheries Development. The fruit and vegetable sections are responsible for conducting and coordinating research and developmental activities in horticulture. These sections concentrate primarily on production and production-support activities. For fruits, some

Figure 2—Organization chart of the Department of Agriculture, 1982



Source: Department of Agriculture, Nepal.

Figure 3—Locations of agricultural research stations and farms



Sources: Survey Department, Topographical Survey Branch, Nepal, 1982 (for map); and Ministry of Agriculture, Nepal, 1986 (for information about the farms).

research is carried out on varietal selection and propagation methods along with plant protection measures. For vegetables, quality seed production is the major activity; some varietal trials and plant protection trials are also conducted. In all, there are 26 horticultural farms and 4 horticultural units within the multipurpose agricultural stations at various locations in the hills and the Tarai. Only a few of them are truly engaged in research; they are Marpha, Jumla, Nawalpur, Yogyapuri, Nepalganj, Pokhara, Khumaltar, Kirtipur, and Dhankuta.

The Fisheries Development Section does research and developmental work for fisheries. Of the 11 fisheries development centers in the country, 6 are involved in some research work, but their main functions are to produce fingerlings and distribute them to farmers. The research activities of the centers include induced breeding techniques, incubation of fish eggs, limnological surveys of natural bodies of water, polyculture, integrated fish farming, and cage culture.

Eight national commodity research programs have been established to coordinate all research and production activities in a multidisciplinary approach. The program commodities and headquarters are shown below.

Crop	Headquarters
Paddy	Parwanipur
Wheat	Bhairahwa
Maize	Rampur
Potato	Khumaltar
Citrus	Khumaltar
Sugarcane	Jitpur
Pulses	Khumaltar
Oilseed	Nawalpur

Of these eight commodity research programs, the sugarcane, pulses, and oilseed programs are recent additions. Only the paddy, wheat, and maize programs are reasonably well established, with the financial and technical assistance of USAID, under the Integrated Cereals Project. The potato program has received some financial and technical assistance from the government of Switzerland. The responsibility for tobacco and cotton research had been with the Ministry of Industry but was recently transferred to the Department of Agriculture. Jute research is still with the Ministry of Industry.

Eight agricultural stations have been established in different agroclimatic areas for research and development activities. They are located in Tarhara, Dhankuta (headquarters of the citrus development program), Parwanipur, Rampur, Jiri, Nepalganj, Jumla, and Surkhet. These stations are centers of multipurpose activities and provide support services to extension through training and technical backstopping in addition to research. They essentially provide links between various national commodity research programs, central disciplinary sections, extension agencies, and farmers. The headquarters of some of the commodity programs are located at these stations, which also serve as testing sites for the programs and for disciplinary sections. Additionally, they are used for on-the-job training of extension workers and farmers.

Agricultural farms are established to concentrate on a single commodity or activity. For example, there are agricultural farms that deal only with cereal crops; horticultural farms deal only with fruits and vegetables. For cereal crops, 7 farms are engaged in adaptive research, seed multiplication, and other production support activities. They are Hardinath, Navalpur, Bhairahwa, Khavre, Doti, Jhumka, and Khumaltar.

The cropping system program was initiated in 1977 after the recognition that each commodity research program and disciplinary section was concerned with solving a specific problem or developing a high-yielding variety without considering the work in the context of differences in cropping patterns, resource endowments, or socioeconomic levels of farmers. Also, the farming system in Nepal is a mixed-enterprise system, so the purpose of cropping system research is to test improved technologies under the conditions encountered by small farmers, and then to recommend appropriate technologies based on the farmers' cropping patterns. The cropping system research activities are conducted on farmers' fields at six different sites in Nepal.

For the hills, the research sites are Lele (Lalitpur), Pumdi Bhumdi (Kaski), Chaurjahari (Rukum), Khadbari (Sankhuwasawa), and in the Tarai, Sukhchaina (Parsa), and Tandi (Chitawan).[19] The program also carries out socioeconomic surveys to analyze factors affecting the adoption of improved technology and to identify the constraints of such adoptions. This program has developed methodologies of on-farm research that are useful to commodity programs and cropping systems, and to extension in carrying out production programs. The cropping system program will gradually expand to conduct a study for a total farming system, including livestock and other economic activities of farmers.

With the goal of improving the organization of research units, the Seventh Five-Year Plan (1985-90) made provision for the National Agricultural Research and Services Center (NARSC), which came into existence on December 31, 1985. NARSC's basic objective is to bring the different research activities of the Department of Agriculture together under one agency to provide coordination in research. The research units under NARSC are disciplinary and commodity sections, national commodity research programs, and agricultural stations and farms located in various parts of the country.

The functions of NARSC are to prepare short- and long-term research programs for submission to the National Agricultural Research Coordination Committee (NARCC); to execute, monitor, and supervise the programs approved by NARCC; to publish technical papers of research results; to prepare manpower and physical resource inventories for the operating and development plans of the research units; to set up a well-organized library; and to establish an Office of Biometrics to guide research centers and their staff in sound biometrical procedures for research. Since NARSC is in the Department of Agriculture, its coordination of research programs is restricted to field crops, horticultural crops, and fisheries.

Department of Livestock Development and Animal Health

The Department of Livestock Development and Animal Health has two main centers headed by two deputy directors general. The Livestock Development Center has five sections: Animal Nutrition, Animal Breeding, Animal Pasture and Fodder, Poultry, and Animal Production and Management. The Animal Health Center also has five sections: Biological Products for Production of Vaccines, Disease Investigation and Research Laboratory, Rabies Control, Foot-and-Mouth Disease, and Central Veterinary Hospital. Nepal has four cattle development farms, two yak farms, three sheep farms, two goat farms, five brooder hatcheries, and four pasture crop development farms. Research activities in livestock are limited. Livestock farms are largely concerned with the production of superior livestock breeds and their distribution. The only unit that carries out some veterinary research is the Disease Investigation and Research Laboratory. Livestock farms conduct very limited research in animal nutrition and breeding.

Department of Food and Agricultural Marketing Services

Economic and marketing analysis in agriculture is conducted by the Department of Food and Agricultural Marketing Services (DFAMS). DFAMS has three divisions: Economic Analysis, Agricultural Marketing Services, and Agricultural Statistics. Only the Economic Analysis Division is engaged in some socioeconomic research.

Central Food Research Laboratory

The Central Food Research Laboratory is a separate agency with the status of a department in the Ministry of Agriculture. Its major activities are related to regulating such functions as food testing and quality

[19] The names in parentheses are the districts in which the research sites are located.

control by fixing certain minimum quality and purity standards for different food products. The agency also conducts some research on fruit and vegetable processing in Kathmandu and analyzes the nutritional value of different foods and food products.

Other Research Institutes

Other institutes engaged in agricultural research are the Institute of Agriculture and Animal Sciences (IAAS) at Rampur, under Tribhuvan University, and the Agricultural Projects Services Center (APROSC) in Kathmandu. IAAS conducts both physical and social science research, whereas APROSC is mainly concerned with research related to project formulation, evaluation, and agricultural policy.

The fragmentation of agricultural research is further illustrated in the conduct of irrigation management research by the Department of Irrigation, Hydrology, and Meteorology in the Ministry of Water Resources; soil conservation and erosion control research by the Department of Soil Conservation and Watershed Management; and silviculture research by the Department of Forestry in the Ministry of Forestry and Soil Conservation (MFSC). The Department of Medicinal Plants is the largest unit under MFSC to be involved in research. It has four sections: Royal Drug Research Laboratory, Royal Botanical Garden, Botanical Survey and Herbarium, and Herbal Farms.

Research Planning

Each technical (disciplinary or commodity) section and national commodity research program is required to prepare its annual program along with its annual budget for presentation to the National Planning Commission and the Ministry of Finance. The inputs from crop workshops that are held twice yearly (in January for summer crops and in August for winter crops) are used in preparing the annual programs. The research achievements and planned activities of the commodity research program and those of the technical section that are related to the commodity program are discussed in the workshops. The comments and suggestions of the workshops are solicited to modify certain activities in the proposed programs. The workshops are attended by the joint secretaries of the Ministry of Agriculture, the director general and deputy directors general of the Department of Agriculture, regional directors, the chiefs of technical sections and commodity programs, and a group of district agricultural development officers. Representatives of the Agriculture Inputs Corporation, the Agricultural Development Bank, the Department of Food and Agricultural Marketing Services, IAAS, and APROSC are also invited.

The annual research programs thus prepared by technical sections and commodity programs are submitted to the Department of Agriculture. These research programs are subsequently submitted to and discussed in the Ministry of Agriculture and are then passed to the National Planning Commission and the Ministry of Finance for further discussion and budget approval.

The planning procedure using inputs from the workshops is largely restricted to main cereal and cash crops. Since the research programs for fruits, vegetables, livestock, and fisheries are limited, they are not subjected to this rigorous planning procedure.

The current target-oriented programming and evaluation has led to an undervaluation of the importance of research in agricultural stations and farms. For example, each farm is required to fix targets for production of seeds, animals, or fingerlings and for the number of persons to be trained or training courses to be conducted every year. Similarly, a target is set for the number of research experiments to be conducted. These targets are broken down on a quarterly basis and farms are expected to report in their quarterly evaluation the number of research experiments carried out and other targets achieved. Thus a farm with multiple functions can achieve 70 to 80 percent of its targets, showing a good performance without doing research. This problem is due not only to the low priority accorded to research but also to a faulty evaluation system based on physical targets.

Research Coordination

The Agricultural Research Coordination Committee, constituted in 1972/73 under the chairmanship of the director general of the Department of Agriculture, was reestablished in 1980/81 under the chairmanship of the secretary of agriculture but remained inactive. The other committee members named were the joint secretary of the Evaluation and Project Analysis Division of the Ministry of Agriculture; the joint secretary (agriculture) of the National Planning Commission; the director general of the Department of Livestock Development and Animal Health; the deputy director general (crop research) of the Department of Agriculture; the deputy director general of the Department of Food and Agricultural Marketing Services; the chief of the Central Food Research Laboratory; subject matter specialists in the fields of crop science, agricultural botany, horticulture, plant protection, livestock and veterinary science, fisheries, agricultural engineering, and farm irrigation; and two farmers' representatives.

The designated functions of the research committee were to determine agricultural research priorities and policies; to approve research projects submitted by research agencies after ascertaining that the projects are consistent with research priorities and policies; to provide the necessary financial and personnel resources to carry out the projects effectively; to conduct regular monitoring and evaluations of research projects; and to initiate contacts and develop relations with other national and international agencies in the field of agricultural research. No separate secretariat was ever established for this committee.

The need for an effective and functioning research coordination committee at the national level to streamline the agricultural research system was again recognized in the Seventh Five Year Plan (1985-90). Therefore, the existing Agricultural Research Coordination Committee has been reconstituted and renamed the National Agricultural Research Coordination Committee (NARCC) under the chairmanship of the secretary of the Ministry of Agriculture. The other committee members are the joint secretaries of the Planning and Coordination Division of the Ministry of Agriculture, the National Planning Commission (agriculture), the Ministry of Finance, and the Ministry of General Administration; the directors general of the Department of Agriculture, the Department of Livestock and Animal Health, and the Department of Food and Agricultural Marketing Services; representatives from the Royal Nepal Academy of Science and Technology and the Institute of Agriculture and Animal Science of Tribhuvan University; the chiefs of the Central Food Research Laboratory and the National Agricultural Research and Services Center; two farmers' representatives; and three representatives from a group of eminent scientists.

A permanent secretariat of the committee has been established in the Ministry of Agriculture. There is now a provision for a full time member secretary (joint secretary level) who also acts as the chief executive officer and has a panel of technical personnel and supporting staff.

Donor Assistance and Research Collaboration

Apart from greater national effort, two other important factors can help build the national research system: external assistance and collaboration with other national and international research systems.

Project Versus Program Assistance

Generally, external agencies support agricultural research on the basis of a project, rather than a program, approach. This causes both distortions in the resource allocations and conflict among project staff and nonproject staff due to differences in opportunities and privileges throughout a project. For instance, under the Integrated Cereals Project, USAID support was limited to three major foodgrain crops, namely, paddy, wheat, and maize, and was not extended to livestock and horticulture. Dr. Vernon W. Ruttan, whose work in the field of agricultural research systems is well known,

contends that "the project support approach to agricultural development assistance has rarely been effective in contributing to the development of viable national agricultural development institutions."[20] There are currently 32 foreign-aided projects supported by 13 different external agencies to help in agricultural research, resource assessment, and data acquisition in Nepal (see Appendix 1, Table 40).

USAID has been the major donor agency to support agricultural research in Nepal. From 1957 to 1984, USAID contributed about U.S. $23 million to assist in establishing research and extension systems, with the main emphasis on foodgrain crops, through technical assistance, equipment and material, and training. The *Report of the IFAD Special Programming Mission to Nepal* emphasizes development of fruit and livestock to effect a shift toward an appropriate balance among commodities.[21] To bring about a balanced development of the total agricultural research system, a long-term comprehensive plan for agricultural research in terms of its structure, physical facilities, and staff development needs to be prepared. Similarly, the commitment of funds on a long term basis to implement such a plan needs to be sought.

Collaboration with External Research Systems

Nepal's collaboration with other national and international agricultural research systems is extremely limited. One reason for this limitation is the weak Nepalese research system. Unless the level of research and scientific staff improves, it will be difficult, if not impossible, to establish and maintain contacts with other systems and to realize mutual benefit for collaborators. Nepal could benefit greatly from collaboration with the Indian agricultural research system, which is relatively well developed in the region, but only the Nepalese wheat, rice, and sugarcane programs have established contacts with the respective programs in India. Even these contacts were initiated entirely on a personal basis among the scientists. Useful collaboration could also be established with India in many other areas of crops, livestock, and horticulture. Other collaborators include the Asian Regional Maize Program in Thailand and at the University of Hawaii, and the International Winter Wheat Nursery Program at the University of Nebraska in the United States.

As for contacts with the international agricultural research centers, Nepal has some collaboration with the International Rice Research Institute (IRRI) and the International Center for Maize and Wheat Improvement (CIMMYT), but only limited collaboration with the International Potato Center (CIP), the International Crops Research Institute for the Semi Arid Tropics (ICRISAT), the International Center for Agricultural Research in the Dry Areas (ICARDA), and the International Food Policy Research Institute (IFPRI). Exchanges of germplasm and visits of scientists between Nepal and these international centers have taken place. Some Nepalese research scientists have also received short-term training at IRRI and CIMMYT.

Comparison with Neighboring Research Systems

Compared with the agricultural research systems of India, Pakistan, and Bangladesh, which are organized under autonomous councils, the Nepalese system has three important distinguishing features. First, the Nepalese agricultural research system operates under government departments within the rules and regulations of the civil service. Second, Nepal's research units or activities are not unified under one

[20] Vernon W. Ruttan, "Reforming the Global Agricultural Research Support System," *Bulletin 83.2*, Economic Development Center, University of Minnesota, March 1983.

[21] International Fund for Agricultural Development, *Report of the Special Programming Mission to Nepal* (Rome: IFAD, 1979).

body, but operate separately within different departments of the government and have serious problems of coordination. Third, the research sections, commodity research programs, and agricultural stations and farms are entrusted with responsibilities of both research and development (production support) activities.

Need for Social Scientists

An important factor missing in the present research system is the involvement of social scientists with biological scientists in agricultural technology development. There is no social scientist working with any disciplinary or commodity section, commodity research program, or farming research unit anywhere in the country. A single Nepalese agricultural economist who had worked with a farming system research unit returned recently from IRRI after completing his Ph.D. In the development of improved technology, omission of the socioeconomic aspect is a serious constraint in recommending technology consistent with farmers' problems and resource endowments. The need for social scientists to work closely with physical and biological scientists has recently been recognized.

5

ALLOCATION OF FINANCIAL AND PERSONNEL RESOURCES FOR RESEARCH

The agricultural sector includes agriculture, irrigation, forestry, land reform, and cadastral survey. From 1970/71 to 1980/81, the rate of annual increase in expenditure on the agriculture component was only 11 percent in real terms, compared to 15 percent on irrigation and 19 percent on forestry. During the same period, the agriculture expenditure constituted about 42 percent of the total agricultural sector budget (calculated from Table 9). The average shares of expenditure on agriculture as a percentage of agricultural GDP and of development expenditure were 1.2 and 10.2 percent, respectively.

Real expenditure in agricultural research increased annually at about 4 percent, from Rs 14.5 million in 1970/71 to Rs 18 million in 1980/81 (see Table 10). Similarly, real expenditure in agricultural extension increased annually about 7 percent from Rs 6.3 million in 1970/71 to Rs 10.9 million in 1980/81.

Table 11 presents the average shares and annual growth rates of expenditure on research, by discipline, between 1970/71 and 1980/81. Crops, livestock, and horticulture together constituted 81 percent of the total expenditure. Though the expenditure on socioeconomic research constituted the lowest share, its annual growth rate has been the highest (12.5 percent) because of a low base value. On the other hand, crop research constituted the highest share (37 percent), but its growth rate was the lowest (less than 3 percent). The real expenditure on input research, which comprised expenditures in the agricultural engineering section, soil science, and agricultural chemistry, declined during this period. The annual

Table 9—Agricultural sector budget expenditures, 1970/71-1980/81

Year	Irrigation	Forestry	Land Reform and Cadastral Survey	Agriculture	Total Agricultural Sector
			(1972/73 Rs million)		
1970/71	42.2	10.0	8.8	45.53	106.6
1971/72	49.8	14.7	9.2	45.07	118.7
1972/73	34.3	13.2	11.0	61.81	120.3
1973/74	68.4	14.3	10.6	75.03	168.3
1974/75	55.2	18.0	15.3	66.12	154.6
1975/76	69.5	26.2	16.3	146.92	259.0
1976/77	90.0	31.7	22.3	128.55	272.5
1977/78	91.9	48.9	22.1	121.55	283.7
1978/79	140.5	41.5	28.3	122.00	332.3
1979/80	131.0	53.0	20.8	86.44	291.3
1980/81	143.1	44.3	21.1	127.59	336.1
			(percent)		
Annual growth rate	14.89	18.89	11.85	10.95	13.56
t-statistic	8.06	9.77	6.68	3.87	9.13

Source: Nepal, Ministry of Finance, *Budget Speeches*, various fiscal years (Kathmandu: MOF, various years).
Note: Irrigation, forestry, land reform and cadastral survey, and agriculture are the components of the agricultural sector.

Table 10—Budget expenditures on agricultural research and extension and other agricultural items, 1970/71-1980/81

Year	Agricultural Research	Agricultural Extension	Other Agricultural Expenditures[a]	Total Agriculture
		(1972/73 Rs million)		
1970/71	14.468	6.308	24.75	45.53
1971/72	14.456	8.626	21.99	45.07
1972/73	14.280	8.503	39.03	61.81
1973/74	15.966	8.534	50.53	75.03
1974/75	16.031	7.661	42.43	66.12
1975/76	18.693	11.196	117.03	146.92
1976/77	20.162	13.745	94.64	128.55
1977/78	20.024	13.325	88.20	121.55
1978/79	21.814	15.087	85.10	122.00
1979/80	19.351	13.188	53.90	86.44
1980/81	18.079	10.859	98.65	127.59
		(percent)		
Annual growth rate	3.92	7.16	14.35	10.95
t-statistic	4.61	4.18	3.70	3.97

Source: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).

[a] Includes expenditures on administration and subsidies on seed, fertilizer, credit, and food distribution.

Table 11—Agricultural research expenditures, by discipline, 1970/71-1980/81

Year	Crop Research	Livestock Research	Horti-cultural Research	Fisheries Research	Input Research	Food Research	Socioeconomic and Marketing Research
			(1972/73 Rs million)				
1970/71	5.624	4.269	1.627	1.232	0.898	0.556	0.260
1971/72	6.476	3.129	1.989	0.974	0.992	0.533	0.362
1972/73	5.791	3.222	2.598	0.900	0.676	0.914	0.179
1973/74	5.181	3.747	3.345	1.049	1.052	1.182	0.409
1974/75	5.141	3.647	4.127	1.049	0.778	0.663	0.626
1975/76	6.214	3.670	4.649	2.188	0.615	0.812	0.544
1976/77	7.536	3.883	4.739	1.858	0.758	0.733	0.654
1977/78	7.206	4.108	4.884	1.424	0.820	0.805	0.777
1978/79	8.858	4.217	4.713	1.590	0.851	0.894	0.691
1979/80	6.318	5.541	3.878	1.361	0.774	0.791	0.688
1980/81	6.678	4.532	3.555	1.288	0.538	0.783	0.704
Annual average	6.457	3.993	3.642	1.355	0.796	0.788	0.536
			(percent)				
Average share	37.00	23.00	21.00	8.00	4.50	4.50	3.00
Growth rate	2.84	3.34	8.78	4.13	-3.03	2.35	12.47
t-statistic	2.06	2.84	3.35	1.67	-1.83	1.08	4.26

Source: Calculated from Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).

Note: The detailed components of these classifications are presented in Appendix 1, Tables 41 through 46.

growth rate of real expenditure for horticulture was 9 percent; livestock, 3 percent; fisheries, 4 percent; and food, 2 percent.

Between 1970/71 and 1980/81, the expenditure on agricultural research in the hills increased from Rs 5.6 million to Rs 7.4 million at 6 percent annually, while the expenditure in the Tarai (where fisheries research is concentrated) increased from about Rs 5.7 million to Rs 6.6 million, at an annual rate of 3 percent (see Table 12). Expenditures for crop, horticulture, and livestock research in the hills increased at 8, 9, and 4 percent a year, respectively (see Table 13). Thus it is evident that during the 1970s, hill agricultural research was accorded a high priority.

Real expenditures on the single-discipline research programs of the technical sections increased by only 2 percent annually during the same period, from Rs 3 million to Rs 4 million.

Annual budget expenditures of technical sections, agricultural stations, and farms fluctuated widely during this period, and in most cases their expenditures in real terms were constant or declined, particularly after 1975/76 (see Appendix 1, Tables 41-46).

Agricultural research expenditure as a share of agricultural GDP has remained around 0.22 percent between 1970/71 and 1980/81 (see Table 14). However, agricultural research expenditure as a share of total development expenditure declined from 2.76 percent in 1970/71 to 1.33 percent in 1980/81. Similarly, agricultural research as a share of the agricultural sector and agriculture budget expenditures declined substantially from 13.60 and 31.77 percent, respectively, in 1970/71 to 5.40 and 14.17 percent in 1980/81. The proposed research expenditure as a share of the agriculture component for the Sixth Five-Year Plan (1980-85) shows a further decline to only 8.0 percent (see Table 15).

The money and personnel used in the technical sections, research stations, commodity research programs, and agricultural farms are categorized as research expenditures in government budget documents, although the real research expenditure is less (see Table 16). For analysis purposes, the budgeted research expenditure and the actual research expenditure are separated. What the government considers research expenditure, which is generally reported, has been termed "budgeted" research expenditure, while expenditure on activities that would qualify as actual research work has been termed "actual" research expenditure. The actual research expenditure was estimated as the expenditure that is made exclusively for research purposes from total budget expenditure in the technical sections, commodity research programs, agricultural stations, and farms. A three-year average (1978/79-1980/81) of the total budgeted research expenditure was about Rs 35.4 million, of which crop research constituted 38 percent; livestock, 24; horticulture, 20; fisheries, 7; food, 4; socioeconomic, 4; and input, 3 percent. The average budgeted recurrent research expenditure was about 26.6 million, which was 75 percent of the budgeted research expenditure for the three years. The estimated

Table 12—Agricultural research expenditures on hill, Tarai, and disciplinary research, 1970/71-1980/81

Year	Tarai	Hill	Disciplinary	Total
	(1972/73 Rs million)			
1970/71	5.734	5.569	3.163	14.466
1971/72	6.127	4.917	3.412	14.456
1972/73	6.219	4.997	3.064	14.280
1973/74	5.817	6.086	4.063	15.966
1974/75	5.712	6.376	3.943	16.031
1975/76	7.382	7.788	3.523	18.693
1976/77	8.277	7.801	4.084	20.162
1977/78	7.988	8.028	4.008	20.024
1978/79	9.000	8.523	4.291	21.814
1979/80	6.816	8.823	3.712	19.351
1980/81	6.642	7.440	4.000	18.078
	(percent)			
Growth rate	3.02	5.74	2.33	3.93
t-statistic	2.38	5.43	2.79	4.61

Source: Calculated from Nepal, Auditor General's Office, *Auditor General Annual Report,* various issues (Kathmandu: AGO, various years).

Table 13—Agricultural research expenditures, by region and discipline, 1970/71-1980/81

Year	Tarai				Hill			
	Crops	Horticulture	Livestock	Fisheries	Crops	Horticulture	Livestock	Fisheries
	(1972/73 Rs million)							
1970/71	3.592	0.444	1.016	0.682	0.583	1.183	3.253	0.550
1971/72	4.222	0.450	0.849	0.606	0.730	1.539	2.280	0.368
1972/73	4.102	0.449	0.984	0.684	0.394	2.149	2.238	0.216
1973/74	3.411	0.518	1.094	0.793	0.586	2.827	2.418	0.256
1974/75	2.986	0.892	1.092	0.742	0.628	3.234	2.207	0.307
1975/76	4.134	1.300	0.893	1.055	0.887	3.349	2.420	1.133
1976/77	5.030	0.994	1.093	1.160	1.209	3.745	2.148	0.698
1977/78	5.062	0.950	0.962	1.014	1.069	3.934	2.614	0.411
1978/79	5.929	1.102	0.811	1.159	1.497	3.611	2.983	0.431
1979/80	4.240	0.798	0.544	1.234	0.999	3.080	4.616	0.127
1980/81	4.256	0.797	0.680	0.908	0.796	2.762	3.501	0.380
	(percent)							
Growth rate	3.03	8.75	-4.12	6.37	8.20	8.90	3.87	-2.04
t-statistics	1.79	2.99	-2.45	4.27	2.79	3.25	1.84	-0.35

Source: Calculated from Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).

Table 14—Agricultural research expenditure as a share of agricultural GDP and of expenditures on development, agricultural sector, and agriculture, 1970/71-1980/81

Year	Agricultural Research Expenditure Shares			
	Agricultural GDP	Total Development Expenditure	Agricultural Sector Expenditure	Agriculture Expenditure
	(percent)			
1970/71	0.19	2.76	13.6	31.77
1971/72	0.16	2.31	12.2	32.07
1972/73	0.19	2.35	11.9	23.10
1973/74	0.18	2.43	9.5	21.28
1974/75	0.19	2.22	10.4	24.25
1975/76	0.23	2.13	7.2	12.72
1976/77	0.28	1.90	7.3	15.68
1977/78	0.27	1.73	7.1	16.47
1978/79	0.26	1.78	6.6	17.88
1979/80	0.25	1.49	6.6	22.39
1980/81	0.23	1.33	5.4	14.17

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years); and Nepal, Ministry of Finance, *Budget Speeches*, various fiscal years (Kathmandu: MOF, various years).

Note: The agricultural sector comprises agriculture, irrigation, forestry, land reform, and cadastral survey.

Table 15—Proposed expenditures for agricultural research and extension in the Sixth Five-Year Plan (1980-85)

Category	Research	Extension	Total Research and Extension
		(Rs million)	
Foodgrains	102.0	428.9	530.9
Cash crops	16.3	10.8	27.1
Horticulture	35.6	24.3	59.9
Special programs	...	100.0	100.0
Livestock	21.7	443.5	465.2
Fisheries	8.1	37.0	45.1
Total	183.7	1,044.5	1,228.2

Source: Nepal, National Planning Commission, *The Sixth Five-Year Plan* (1980-85) (Kathmandu: NPC, 1981).
Note: Total proposed agriculture expenditure was Rs 2,300 million.

actual research expenditure was only Rs 12.5 million, which was about 35 percent of the budgeted research expenditure. Similarly, the actual recurrent research expenditure was only Rs 8.5 million, or about 32 percent of the budgeted recurrent research expenditure. Of the estimated actual research expenditure, crop research constituted 69 percent and other categories amounted to less than 10 percent each.

The estimated actual research expenditure for individual crops is shown in Table 17. The research on cereal grain crops accounted for about 80 percent of all research expenditure on farm crops. The share of three main cereal grains—paddy, wheat, and maize—is 80 percent of the total value of all farm crops and 82 percent of the total cropped area. This implies perfect congruity in research allocation for cereal grains. The congruity index computed for all farm crops is 0.90, which is high, indicating a fair allocation of research resources among commodities. However, when the research allocation is examined for each commodity with respect to its contribution to agricultural GDP, the research expenditure for paddy appears to be comparatively low. Paddy alone constituted about 50 percent of the total value of all crops and 51 percent of the total cropped area, but accounted for only 23 percent of total research expenditure and only 19 percent of operating expenses. Research expenditure per million rupees of paddy production is the lowest for any crop, at only Rs 383. The recurrent research expenditure per million rupees of paddy production is even lower, at Rs 194.

Wheat research has received more favorable support, since it accounted for only 13 percent of the total value of crops but received 23 percent of the crop research resources.

Among cash crops, tobacco received the highest research allocation, accounting for only 1 percent of the total value of crops but receiving 6 percent of the crop research resources. The research expenditure per million rupees of tobacco production was Rs 4,883. Low budgetary allocation to sugarcane research was aptly described by the sugarcane coordinator:

> The sugarcane program is virtually a one-man program at present. Some posts are lying vacant due to study leave, deputation to other places, or transfer of the concerned personnel. Other posts are serving now as shunting stations for personnel with temporary appointments. Frequent changes of staff make no fruitful contribution to the program. Under such circumstances, quality research work cannot be done, nor is it possible to undertake essential research tasks. An annual budget of Rs 300,000-600,000, mostly covering salary, is absolutely inadequate for running the research projects of utmost need.[22]

[22] Arun Kumar Rai, *National Report on Sugarcane—1982/83* (Kathmandu: National Sugarcane Development Programme, Department of Agriculture, 1983).

Table 16—Budgeted and actual research expenditures, 1978/79-1980/81 average

Category	Budgeted Research Expenditure	Percentage of Budgeted Research Expenditure	Budgeted Recurrent Research Expenditure[a]	Percentage of Budgeted Recurrent Research Expenditure[a]	Actual Research Expenditure	Percentage of Actual Research Expenditure	Actual Recurrent Research Expenditure[a]	Percentage of Actual Recurrent Research Expenditure[a]
	(Rs 1,000)		(Rs 1,000)		(Rs 1,000)		(Rs 1,000)	
Crops	13,047	38	8,821	33	8,639	69	5,187	61
Livestock	8,587	24	5,826	22	859	7	583	7
Horticulture	7,216	20	6,382	24	1,082	9	957	11
Fisheries	2,525	7	1,935	7	202	2	155	2
Food	1,474	4	1,317	5	590	5	527	6
Socioeconomic	1,252	4	1,227	5	789	6	773	9
Input	1,276	3	1,062	4	306	2	255	3
Total	35,377	100	26,570	100	12,467	100	8,437	100

Sources: Calculated from Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years); and Nepal, National Planning Commission, *Agriculture Plans and Programs for 1982/83* (Kathmandu: NPC, 1982).

Note: The 1982/83 plan provides the annual budget and the work plan for each unit and program, along with the weightage of different activities to be carried out under them. The proportion of the research expenditure in each sector is calculated as a weighted average: livestock, 10 percent; horticulture, 15 percent; fisheries, 8 percent; food, 40 percent; socioeconomic, 63 percent; and input research, 24 percent. The actual research expenditure for crops was estimated differently (see Appendix 1, Table 41).

[a] Recurrent expenditures are labor and operating expenses.

Table 17—Average total research expenditure and recurrent expenditure, by commodity, 1978/79-1980/81

Commodity	Actual Research Expenditure	Percentage of Actual Research Expenditure	Research Expenditure per Million Rupees of Value of Production	Share of Each Crop in Total Value of All Crops	Share of Each Crop in Total Area of All Crops	Recurrent Research Expenditure[a]	Percentage of Recurrent Research Expenditure[a]	Recurrent Research Expenditure per Million Rupees of Value of Production[a]
	(Rs 1,000)		(Rs)	(percent)		(Rs 1,000)		(Rs)
Paddy	1,958	23.0	383	49.5	50.1	990	19	194
Wheat	1,946	23.0	1,477	12.8	15.0	1,030	20	782
Maize	2,809[b]	33.0[b]	1,289[b]	18.1	17.3	1,628[b]	31[b]	745[b]
Millet				3.0	4.9			
Barley	...	...	...	0.6	1.1	...	...	...
Potato	397	4.0	583	6.6	2.1	306	6	450
Sugarcane	348	4.0	3,071	1.1	0.9	289	6	2,551
Oilseed	409	5.0	803	4.9	5.8	262	5	521
Jute	...	...	...	1.7	1.8	...	...	...
Tobacco	521	6.0	4,883	1.0	0.3	505	10	4,733
Tea	...	...	...	0.1	0.1	...	...	...
Ginger	46	0.5	912	0.5	...	46	1	912
Cardamom	206	2.0	9,075	0.2	...	131	2	5,771
Total	8,640	100.0[c]	837[d]	100.0[c]	100.0[c]	5,187	100	502[d]

Sources: Computed from Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years); and unpublished data on area and production from the Department of Food and Agricultural Marketing Services, Nepal.

Notes: Research expenditure is the average of three years: 1978/79, 1979/80, and 1980/81. Total value of all crops is the average of two years: 1978/79 and 1980/81. The year 1979/80 is omitted because it was a famine year.

[a] Recurrent expenditures are labor and operating expenses.

[b] Combined figure for maize and millet.

[c] Parts do not add to total because of rounding.

[d] Expenditure per million rupees of all crops.

The research expenditure per million rupees of all crops was Rs 837, while the recurrent research expenditure per million rupees of all crops was Rs 502.

The total budgeted agricultural research expenditure was about 0.25 percent of the agricultural GDP (see Table 18). However, the actual research expenditure was only about 0.10 percent of the agricultural GDP. Thus the budgeted research expenditure is highly overestimated compared to the actual expenditure.

An IFPRI/ISNAR study indicates that the average level of agricultural research investment in relation to agricultural GDP for 51 developing countries was 0.56 per cent for 1980.[23] A desirable investment target for research in countries with poorly developed agricultural research systems would be an annual expenditure equivalent to about 2 percent of agricultural domestic product.[24] Nepal compares poorly with other developing countries in this regard.

The total budgeted research expenditures were 6.61 percent of the agricultural sector expenditure and 17.48 percent of the agriculture component expenditure, whereas the actual research expenditures were only 2.39 and 6.80 percent, respectively (Table 18).

Capital, Staff Salaries, and Operating Expenses

The components of the research budget expenditure in terms of capital, staff salaries and allowances, and other operating expenses are analyzed in this study. On average, from 1970/71 to 1980/81, capital expenditure constituted 29.6 percent, staff salaries were 36.6 percent, and other operating expenses amounted to 33.80 percent of agricultural research expenditure. However, the share of capital expenditure declined from 45.9 percent in 1970/71 to 21.6 percent in 1980/81, while the shares of staff salaries and other operating expenses increased from 25.2 and 28.9 percent to 42.7 and 35.7 percent, respectively.

A declining trend in capital expenditure and an increase in recurrent expenditure implies that some basic minimum physical infrastructure has been built over the years. Almost 75 percent of the research cost was recurrent expenditure. Of the recurrent costs, on average, salary constituted 55 percent in crops, 34 percent in livestock, and 63 percent in horticulture. In the case of livestock, most of the recurrent expenditure was incurred for the purchase of feed and veterinary medicines for livestock.

Table 18—Budgeted and actual research expenditure as a share of agricultural GDP and of expenditures on development, the agricultural sector, and agriculture, 1978/79-1980/81 average

Category	Research Expenditure Shares			
	Agricultural GDP	Development Expenditure	Agricultural Sector Expenditure[a]	Agriculture Expenditure
	(percent)			
Total budgeted research expenditure	0.25	1.51	6.61	17.48
Total actual research expenditure	0.10	0.59	2.39	6.80

Sources: Calculated from Nepal, Ministry of Finance, *Budget Speeches*, various fiscal years (Kathmandu: MOF, various years); Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years); Nepal, National Planning Commission, *Agriculture Plans and Programs for 1982/83* (Kathmandu: NPC, 1982); and Nepal, Ministry of Finance, *Economic Survey*, various issues (Kathmandu: MOF, various years).

[a] The agricultural sector comprises agriculture, irrigation, forestry, land reform, and cadastral survey.

[23] Peter A. Oram and Vishva Bindlish, *Resource Allocations to National Agricultural Research: Trends in the 1970s* (The Hague and Washington, D.C.: International Service for National Agricultural Research/International Food Policy Research Institute, 1981).

[24] World Bank, *Agricultural Research Sector Policy Paper* (Washington, D.C.: World Bank, 1981).

Budgetary Procedure

Budget expenditure in Nepal is classified under 12 major items, with some subitems (see Appendix 1, Table 47). The budget allocation is not based on the research projects. According to a treasury rule introduced in 1981, funds are released every four months through the District Treasury and Controller Office (DTCO). Financial control is strictly enforced in terms of total expenditure vis-à-vis total budget and of the expenditure under different items. Authority for transferring the budgeted expenditure from one item to another, as well as from one development activity to another, lies ultimately with the Ministry of Finance. The internal auditor of DTCO must audit the expenditure of the first four months (first installment) before the money is released for the second installment. From 1970/71 to 1980/81, the average annual released money for expenditure on agricultural research was only 71 percent of the planned allocated annual budget. The inflexibility in transferring funds and a long transfer process discourage researchers from undertaking any research into a problem that may have been identified in the current year.

The above analysis indicates that, despite the high priority given the agricultural sector in previous five-year plans, the financial allocation to the agriculture component of the sector is relatively low. Government priorities for agricultural research are apparent in the inadequate resources being invested in the national agricultural research system. Sixty-five percent of the budgeted agriculture research expenditure is spent to provide support services to production, leaving only 35 percent for actual research.

Trained Agricultural Personnel

Between 1970/71 and 1979/80, the trained personnel in agriculture increased by almost 2.5 times. In 1970/71, the total number of trained personnel was 1,397,[25] of which 352 employees were at the high level (officer rank) and 1,045 at the low level (junior technicians and junior technical assistants or their equivalents). The minimum training requirement for an officer-rank employee is an undergraduate degree in agriculture or the equivalent. In 1979/80 the total number of trained personnel in agriculture was 3,383, of which 873 employees were at the high level and 2,510 at the low level. Further breakdown of trained personnel in 1979/80, by department, is presented in Table 19. About 95 percent of the total trained personnel were

Table 19—Total trained agricultural personnel, 1979/80

Organization	High Level[a]	Low Level[b]	Total
Within the Ministry of Agriculture			
Ministry Secretariat	22	0	22
Department of Agriculture	442	1,761	2,203
Department of Livestock and Animal Health	108	268	376
Department of Food and Agricultural Marketing Services	53	0	53
Corporations	148	421	569
Subtotal	773	2,450	3,223
Outside the Ministry of Agriculture	100	60	160
Total	873	2,510	3,383

Source: Nepal, Agricultural Projects Services Center, *Trained Manpower for the Agricultural Sector*, vols. 1 and 2, (Kathmandu: APROSC, July 1981).

[a] Class 1, 2, and 3 officers. A graduate in agriculture begins work as a Class 3 officer.

[b] Junior technicians and junior technical assistants.

[25] Nepal, Ministry of Agriculture, *Ten-Year Agriculture Plan* (Kathmandu: MOA, 1972).

employed in the Ministry of Agriculture and its allied institutions. The Department of Agriculture alone employed 65 percent of the total trained personnel. The agricultural institutions, namely, the Agriculture Inputs Corporation, Agriculture Development Bank, and Agricultural Projects Services Centre, are semiautonomous agencies. Outside the Ministry of Agriculture, the largest employer was the Institute of Agriculture and Animal Science under Tribhuvan University.

The number of trained personnel in agricultural research, agricultural extension, and agricultural education in 1979/80 is given in Table 20, which indicates that 44 percent of high-level trained personnel were engaged in agricultural research, 21 percent in extension, and 8 percent in education. Of low-level personnel, 59 percent were employed in extension service and 23 percent in agricultural research. Though a large proportion of high-level trained personnel was employed in agricultural research, the work of those employees was related more to extension than to research. (This was explained in the earlier discussion of budget and time allocation of researchers.)

The number of trained personnel working in various fields of agricultural research in 1979/80 is shown in Table 21. At that time, there were 104 Class 1 and Class 2 officers and 284 Class 3 officers. Employees of officer rank are divided into special, first, second, and third classes. A graduate in agriculture begins his career as a Class 3 officer.

Crops, livestock, and horticulture accounted for about 75 percent of the total research staff and 82 percent of the total budgeted research expenditure (Tables 16 and 21). The greatest concentration of research personnel was in crop research, which accounted for about 41 percent of the officer-level researchers and 38 percent of the total research expenditure, followed by livestock with 17 percent of researchers and 24 percent of research expenditure, and horticulture with 17 percent of researchers and 20 percent of research expenditure.

The data in Table 21 also include researchers who did not have undergraduate degrees in agriculture but were promoted to officer level on the basis of seniority. On average, there were 1.5 research assistants per research worker.

A 1983 survey by the author of personnel in agriculture indicated that there were 1,052 employees with baccalaureate or higher degrees, of whom 34 had Ph.D.'s, 414 had master's degrees, and the remaining 604 had B.S. degrees. Within the Ministry of Agriculture and its parastatals, there were 964 degreed personnel, of whom 29 had Ph.D.'s, 351 had M.S.'s, and the remaining 584 had B.S. degrees (see Appendix 1, Tables 48 and 49). Agricultural economics dominated all other disciplines in the number of employees with Ph.D. and M.S. degrees (Appendix 1, Table 49). The majority of these officials worked at the Agricultural Projects Services Centre.

In all, about 400 trained high-level personnel worked in agricultural research; almost half of them had postgraduate degrees. Of the 14 Ph.D.'s, 10 held administrative posts. Since an administrative post, such as chief of a section or department, is more lucrative and higher in status, personnel with Ph.D.'s will seek these positions. As their numbers increase, however, most of them will probably be employed full time in conducting research. The Ph.D. component now constitutes only 4 percent of the personnel in agricultural research—well below the target of 20 percent suggested by the World Bank.[26] The weakness in the national research system for conceptualizing, planning, and directing research may be due partly to such a low percentage of Ph.D.'s in the system. A breakdown by discipline shows that the plant sciences have 60 percent of research staff who hold B.S. degrees and above, while livestock has only 15 percent of the total research staff (see Table 22).

Training

The Institute of Agriculture and Animal Science is the only institute that offers middle- and high-level training in agriculture. All training for junior technicians and junior

[26] World Bank, *Agricultural Research Sector Policy Paper.*

Table 20—Trained personnel in agricultural research, extension, and education, 1979/80

Category	High Level[a]	Percentage of High Level	Low Level[b]	Percentage of Low Level	Total	Percentage of Total
Agricultural research	388	44	586	23	974	29
Agricultural extension	184	21	1,480	59	1,664	49
Agricultural education[c]	73	8	4	. . .	77	2
Total	645	73[d]	2,070	82[d]	2,715	80[d]

Source: Unpublished data collected by the Agricultural Projects Services Center, Nepal, for a study of trained personnel in the agricultural sector.

[a] Class 1, 2, and 3 officers. A graduate in agriculture begins work as a Class 3 officer.

[b] Junior technicians and junior technical assistants.

[c] Institute of Agriculture and Animal Science.

[d] Twenty seven percent of high level and 18 percent of low level trained agricultural personnel are otherwise employed in such organizations as the Agricultural Development Bank and the Department of Irrigation, Hydrology, and Meteorology and as administrators in the Ministry of Agriculture.

Table 21—Trained personnel in agricultural research, by rank and research category, 1979/80

Research Category	High Level[a]			Low Level[b]	Total
	Classes 1 and 2	Class 3	Subtotal		
Crop[c]	45	114	159	202	361
Livestock	20	46	66	148	214
Horticulture	17	49	66	99	165
Fisheries	6	24	30	55	85
Food science and nutrition	5	15	20	20	40
Input	8	24	32	37	69
Socioeconomic	3	12	15	25	40
Total	104	284	388	586	974

Source: Unpublished data collected by the Agricultural Projects Services Center, Nepal, for a study of trained personnel in the agricultural sector.

[a] A graduate in agriculture begins work as a Class 3 officer.

[b] Junior technicians and junior technical assistants.

[c] Includes the research staff of disciplinary sections, such as entomology, plant pathology, soil science, agricultural botany, and agricultural engineering.

Table 22—Trained officers in agricultural research, by education and discipline, 1979/80

Subject	Ph.D.	M.S.	B.S. or Equivalent	Total
Agronomy	2	20	55	77
Botany	3	10	10	23
Horticulture	1	18	40	59
Plant pathology	1	14	21	36
Entomology	1	13	7	21
Soil science	0	13	7	20
Fisheries	0	14	8	22
Agricultural engineering	0	5	22	27
Agricultural economics	3	22	0	25
Livestock and veterinary science	1	12	47	60
Food science and nutrition	2	16	0	18
Total	14	157	217	388

Source: Unpublished data collected by the Agricultural Projects Services Center, Nepal, for a study of trained personnel in the agricultural sector.

technical assistants is conducted within Nepal. The institute started a program for a B.S. degree in agriculture in 1977 and graduated the first group of students in 1979. The present enrollment capacity for undergraduate training is about 100. All graduate training (M.S. and Ph.D.), except in the social sciences, takes place in foreign countries.

The institute's staff comprises 5 Ph.D.'s, 53 M.S.'s, and 20 B.S.'s. The real expenditure of the institute increased at the rate of only 1.8 percent annually between 1972/73 and 1980/81. During this period, the average real annual expenditure was only Rs 1.6 million. Thus the training component of agriculture, like research, suffers from a shortage of financial resources and Ph.D. staff. Both research and training have received low priority, even though they play a significant role in the development of agriculture.

6

RESEARCH MANAGEMENT AND INCENTIVES

Motivation of researchers is the key to productive agricultural research. The strengthening of agricultural research systems is often thought of in terms of training, building research laboratories, and other physical facilities without regard for the human element, which is the key to performance. The essence of good management is to keep employees interested and motivated in their work. This can be brought about through a reward system based on work performance.

Researchers in Nepal are performing much below their capacity. Interviews with a selected group of them have highlighted some problems and issues related to management and incentives in agricultural research.

Researchers' Opinions of Management and Incentives

In Nepal, government employees are classified into two broad categories, gazetted and nongazetted. Employees of the officer rank fall under the gazetted category. Gazetted officers are further grouped into four classes: special, first, second, and third. Graduates in agriculture begin their careers as Class 3 officers. Technical professionals are rarely promoted to the special class, since it is restricted to the general administrative cadre. Permanent government secretaries are considered special class employees.

A total of 120 researchers from different disciplines and geographical regions were interviewed. There were 10 Class 1, 24 Class 2, and 86 Class 3 officials. About 10 percent were women. In terms of academic qualifications, there were three Ph.D.'s, 52 M.S.'s, and 60 B.S.'s (agriculture) or the equivalent. Promotion between classes takes many years. All Class 1 officials had served more than 20 years. Six Class 2 officials had served for more than 20 years, 17 for between 11 and 20 years, and only one for less than 10 years. In Class 3, 6 had served more than 20 years, 33 from 11 to 20 years, 13 from 6 to 10 years, and 34 for less than 5 years (see Table 23).

Table 23 also shows a high frequency of personnel transfer in research work. Fifteen officials of Classes 1 and 2 had been transferred more than three times, 5 were transferred three times, and 9, two times. Thirty four of the 86 Class 3 officials had been transferred two or more times.

Table 23—Classification of 120 research officers by sex, education, and number of years and transfers in service

Category	Officer Class[a] 1	2	3	Total
	(number of researchers)			
Sex				
Male	10	19	78	107
Female	0	5	8	13
Education				
High school	0	1	4	5
B.S.	2	4	54	60
M.S.	6	18	28	52
Ph.D.	2	1	0	3
Outside training[b]	5	15	23	43
Years in service				
0–5	0	0	34	34
6–10	0	1	13	14
11–20	0	17	33	50
More than 20	10	6	6	22
Transfers in service				
0	0	0	30	30
1	0	5	22	27
2	3	6	18	27
3	2	3	9	14
More than 3	5	10	7	22

Source: Interviews with 120 agricultural researchers in Nepal.

[a] Graduates in agriculture begin their careers as Class 3 officers.

[b] Nondegree education, such as a participant training program, for periods of 1–12 months.

When researchers were asked for their opinions of existing promotional rules, only 25 percent were satisfied (see Table 24). In another study, 61.5 percent of 307 officers surveyed disliked the present pattern of promotion because of defective evaluation systems and frequent rule changes.[27] A longtime resident adviser on agricultural research in Nepal, Dr. Wayne Freeman, made the following comment on the promotion system:

> The system of promotion with the Department of Agriculture is slow and cumbersome. . . . The promotion system lacks objectivity and is subject to pressures and manipulation. "Fighting for promotion" is not an idle expression, but is literally, if not physically, true.[28]

The majority of the researchers interviewed said that their authority, accountability, flexibility, status, and salary were inadequate. Almost everyone favored higher levels in those areas but claimed that their responsibilities were already high (see Table 25). It is important to note that although the responsibility given to researchers is high, their accountability is relatively low, which implies some lack of concern about completing assigned work. Similar results were found in another study, which inferred that "job performance at present is unsatisfactory and is suffering from lack of adequate authority, accountability, status, and salary."[29]

About 64 percent of the researchers spent 50 percent or less of their time in research. Only 9 percent of the researchers spent all their time on research. Seventy percent spent time in administration, extension work, or both, and 54 percent felt that their time was not properly allocated. Consequently, 83 percent indicated that their time should be geared more to research (see Tables 26, 27, and 28).

Table 24—Researchers' opinions of promotion rules

Opinion	Officer Class 1	2	3	Total
	(number of researchers)			
Satisfactory	1	8	21	30
Unsatisfactory	9	14	56	79
No opinion	0	2	9	11

Source: Interviews with 120 agricultural researchers in Nepal.

Table 25—Researchers' ratings of job-satisfaction criteria

Criterion	Present Self-Rating High	Moderate	Low	Preferred Self-Rating High	Moderate	Low
	(percentage of researchers)					
Authority	6	37	57	69	31	0
Responsibility	54	40	6	86	14	0
Accountability	25	36	39	54	36	10
Status	10	43	47	70	30	0
Flexibility	10	36	54	55	40	5
Salary	2	13	85	81	17	2

Source: Interviews with 120 agricultural researchers in Nepal.

[27] T. B. Shrestha, *Job Environment and Job Consciousness of Agricultural Graduates Under the Ministry of Food, Agriculture and Irrigation (1978-79)* (Kathmandu: Agricultural Projects Services Center, 1980), p. 2.
[28] U.S. Agency for International Development, *Nepal Integrated Cereals Project Evaluation Report* (Kathmandu: USAID, 1983), p. 60.
[29] Shrestha, *Job Environment and Job Consciousness*, p. 6.

Table 26—Amount of researchers' time spent on research

Time Spent on Research	Officer Class 1	2	3	Total
(percent)	(number of researchers)			
100	0	0	11	11
75	2	7	23	32
50	0	2	25	27
Less than 50	8	15	27	50

Source: Interviews with 120 agricultural researchers in Nepal.

Table 27—Researchers engaged in nonresearch work

Type of Work	Officer Class 1	2	3	Total
	(number of researchers)			
None	0	0	11	11
Administration	4	6	7	17
Extension	0	2	36	38
Administration and extension	6	13	10	29
Other	0	3	22	25

Source: Interviews with 120 agricultural researchers in Nepal.

Table 28—Researchers' opinions of allocation of work time

Allocation of Time	Officer Class 1	2	3	Total
	(number of researchers)			
Present time is properly allocated				
Yes	2	8	45	55
No	8	16	41	65
More time should be devoted to research				
Yes	9	20	71	100
No	1	4	15	20

Source: Interviews with 120 agricultural researchers in Nepal.

Only 66 percent of the researchers were employed in their preferred profession. Twenty-eight percent accepted jobs in agricultural research because of a lack of alternatives, and about 40 percent preferred other jobs at the time of the study interview. About 68 percent had not published a research report in the last five years (1976-81). Since the research papers published from research project assignments are not considered in promotions, there is no motivation to publish or write research monographs. Only 20 percent of the researchers had written two or more research reports in the last five years. About 17 percent of the researchers had not had a research project during that period, and 18 percent had done only one research project. Only a few were initiated as a result of the researchers' own interest (see Tables 29 through 32).

Research Constraints

Researchers were asked to rank the following research constraints: financial, research equipment, physical facilities (vehicles, laboratories, space, libraries, etc.), supporting staff, inadequate staff, lack of guidance and supervision, and lack of clear research policies and programs.

The three highest rankings were considered for analysis. The first was weighted the highest by assigning it three points; the second was assigned two points; and the third, one point. The points were aggregated in each category. It was found that inade-

Table 29—Researchers' reasons for accepting present positions

Reason	Officer Class 1	2	3	Total
	(number of researchers)			
Own interest	6	18	55	79
No alternatives available	3	5	25	33
Other	1	1	6	8

Source: Interviews with 120 agricultural researchers in Nepal.

Table 30—Researchers' preferences for different positions

Prefer Different Position	Officer Class 1	2	3	Total
	(number of researchers)			
Yes	5	8	35	48
No	5	16	51	72

Source: Interviews with 120 agricultural researchers in Nepal.

Table 31—Number of researchers' projects and publications, 1976-81

Number of Projects and Publications	Officer Class 1	2	3	Total
	(number of researchers)			
Research projects				
0	3	2	15	20
1	2	8	12	22
2	0	6	22	28
3	3	4	7	14
More than 3	2	4	30	36
Publications				
0	5	12	64	31
1	3	6	6	15
2	0	2	8	10
3	0	1	4	5
More than 3	2	3	4	9

Source: Interviews with 120 agricultural researchers in Nepal.

Table 32—Initiators of researchers' current experiments

Initiator	Officer Class 1	2	3	Total
	(number of researchers)			
Self	1	5	10	16
Colleagues	4	5	13	22
Chief	1	5	30	36
Self and chief	0	3	11	14
Colleagues and chief	0	0	9	9
No reply	4	6	13	23

Source: Interviews with 120 agricultural researchers in Nepal.

quate physical facilities and lack of clear research policies and programs were considered the most important constraints to research. A shortage of research equipment and a lack of budgetary support ranked third and fourth, respectively (see Table 33). It is interesting to note that researchers did not consider the lack of supporting staff or inadequate staff as a major constraint despite the fact that these are pointed to in many external evaluations of research.

As in most developing countries, the real problems are lack of clear research policies and programs, and ineffective utilization of manpower, both of which could be corrected internally without depending upon external aid. Most researchers in Nepal are juniors who hold only undergraduate degrees and need good supervision or guidance, but about 46 percent of them said that they did not receive this in their work. Only 30 percent of Class 3 officers, who have the greatest need for guidance, indicated that they received good or excellent supervision (see Table 34). Inadequate guidance, supervision, and monitoring seem to be serious impediments in the present system.

Agricultural research is presently carried out under government departments in Nepal. In many Asian countries, research is organized under an autonomous institution such as an agricultural research council. About 88 percent of the researchers surveyed, including 94 percent of Class 1 and 2 officers, wanted research to be reorganized under such a council (see Table 35).

Motivation and Efficiency

Researchers identified the following additional factors that have adversely affected their motivation and efficiency. Low salaries are regarded as a serious problem by most of the researchers. Almost everyone suggested an increase in salaries and other allowances. The real salary and allowance of all government officers declined by 20 to 25 percent between 1970/71 and 1980/81. The decline was about 40 percent for Class 1 and 2 officers between 1962/63 and 1980/81.[30]

[30] Nepal, *Pay Commission Report* (Kathmandu: Government Press, 1983).

Table 33—Researchers' ranking of constraints to research

Constraints	Researchers' Ranking I	II	III	Total Score[a]
	(number of researchers)			
Financial	23	18	18	123
Research equipment	19	25	21	128
Physical facilities	30	19	21	149
Supporting staff	10	18	21	87
Inadequate staff	18	10	17	91
Lack of guidance and supervision	8	24	10	82
Lack of clear research policy and program	33	14	15	142

Source: Interviews with 120 agricultural researchers in Nepal.

[a] Total score was computed on the basis of values assigned: Rank I 3, Rank II 2, Rank III 1.

Table 34—Researchers' rating of research guidance from supervisor

Rating	Officer Class 1	2	3	Total
	(number of researchers)			
Excellent	1	2	8	11
Good	7	5	18	30
Fair	0	5	18	23
Poor	0	3	12	15
No proper supervision	2	9	30	41

Source: Interviews with 120 agricultural researchers in Nepal.

Table 35—Researchers' preferred organization of research bodies

Existing Research Organization	Officer Class 1	2	3	Total
	(number of researchers)			
Stay as is, with government	1	1	12	14
Reorganize into autonomous institution	9	23	74	106

Source: Interviews with 120 agricultural researchers in Nepal.

Because of a lack of job descriptions and poor definition of responsibilities, researchers work mostly on verbal instruction from their supervisors. Frequent changes in their assigned tasks result in low motivation and an atmosphere that is not conducive to serious research.

Researchers complained that their work is not evaluated regularly and objectively. The current practice of evaluation of researchers by their supervisors to meet the requirements of the Public Service Commission regarding promotion does not reflect their actual performance (this problem is discussed in the following section on promotion rules). Researchers stated that an objective and impartial evaluation, if done regularly, would motivate them to work harder. The present system of evaluation has only encouraged inefficiency and incompetency.

Senior researchers and sectional chiefs said that they cannot make purchases of small items or materials needed for their research without the approval of higher authority. Sometimes they must delay their work while their request for action goes through the cumbersome process of approval. They indicated that the delegation of some financial and administrative authority to them would greatly improve their performance.

Almost all researchers (92 percent) expressed the need for a high-level college degree or short-term specialized training, or both, as prerequisites to becoming effective researchers (see Table 36). Fifty-five

Table 36—Researchers' desire for further training

Type of Training	Officer Class 1	2	3	Total
	(number of researchers)			
None	2	2	4	8
Higher degree	4	14	41	59
Short-term training	3	3	26	32
Higher degree and short-term training	0	4	15	19
Other[a]	1	1	0	2

Source: Interviews with 120 agricultural researchers in Nepal.

[a] Training such as a study tour of 2–4 weeks.

percent of the researchers have only a B.S. in agriculture or the equivalent. The common feeling among researchers was that the minimum level of training for a research worker should be an M.S. Only at the M.S. level of training does a person learn research methodology and statistical analysis and carry out a research project independently. There was also concern about the acute shortage of researchers with Ph.D. training to provide leadership and guidance in research. Presently there are only 14 Ph.D.'s in the entire research system, and most of them occupy administrative positions. Ruttan points out that

> At the beginning, when only limited professional capacity is available, there is a tendency for research staff to move from research into administrative and policy positions after a short research or teaching career. The capacity to provide a continuous stream of replacements is essential to the continued viability of the research efforts.[31]

The interviews also showed that junior researchers do not receive adequate guidance and supervision in their work from senior researchers.

The lack of research publication facilities is a serious constraint in promoting agricultural research in Nepal and has received little attention at the higher levels of administration. A large quantity of data has been generated by the researchers but retained only in files that are destroyed after a few years. Lack of financial support for the publication of the Nepal Journal of Agriculture and other scientific journals, and nonrecognition for promotion purposes of publications resulting from assigned research have led to this dismal situation. Researchers view publication of their research work as an important factor in boosting their work and confidence.

The research staff who work in the system on a temporary basis for a year or more were found to have the lowest level of morale or motivation. They are neither certain to continue in the field of research where they are currently employed nor eligible for any training opportunities or long-term employment benefits. The cumbersome and long process of creating permanent posts in the government and recruiting staff through the Public Service Commission delays the appointment of permanent staff. Even when they are recruited, their individual research interests are not taken into consideration.

Most researchers expressed dissatisfaction with the current promotion rules and long delays in promotion (Tables 23 and 24). They expressed serious doubts about prospects for any improvement in the current rules and for their timely promotion under the present structure. They indicated that only autonomous research institutes would be able to formulate and execute personnel policies designed to meet research requirements.

Almost all the technical sections, research stations, and farms have ill-equipped library facilities. Most of the researchers expressed the need for good library facilities to assist them in their research work and publications. Presently, research stations receive only Rs 1,000 annually for the purchase of books, journals, and newspapers.

The role of leadership in promoting any organization is extremely important. Researchers expressed a need for administrators who have vision and who could provide intellectual leadership in shaping the overall research program. Researchers strongly urged that such a person be identified and appointed to lead the research system.

Promotion Rules

Existing promotion rules contain some serious problems that hamper research. Four factors are considered in evaluating a researcher in Nepal. They are length of service; education, training, and research publication; work performance and capability; and experience. The evaluation methods are designed objectively, using numbers for each factor. A gazetted officer in the government is eligible for promotion after five years of service in a particular class. For

[31] Vernon W. Ruttan, *Agricultural Research Policy* (Minneapolis: University of Minnesota Press, 1982), p. 177.

every year of service an officer receives eight points.

The evaluation of education is done from high school through the Ph.D. For each certificate, diploma, or degree, the points given for graduating in the first, second, or third division are 24, 20, and 16, respectively. A Ph.D. degree is always assigned 24 points. For in-service or foreign training exceeding a month, an officer receives a maximum of 10 points. For a research publication, a maximum of 10 points is given. However, it is important to note that researchers cannot claim points for publications resulting from assigned work. This seems unreasonable because a researcher should be evaluated on the basis of his research output, which is usually a research report. The failure to assign credit for such publications may be one of the reasons researchers in Nepal are not motivated to publish the findings of their research.

Work performance and capability evaluations are done by supervisors. An evaluation requires two separate forms; one to evaluate the work performed by the individual every six months and the other to evaluate an individual's capabilities and other attributes annually. The maximum number of points allocated for each form is 60. The supervisor generally gives 48 or less points because if he gives more than 48 points he is required to justify the excellence of the employee's work, and this must be agreed to by the reviewer, a senior person, and finally approved by the chief secretary of the government. Also, the evaluated individual is required to give his or her consent to the evaluation score. To avoid creating tension among his subordinates, the supervisor usually gives everyone a total at or around 96 points.

The scoring of experience is based on the location of the employee in the country, which is divided into five geographical regions according to the difficulties caused by the physical terrain and the unavailability of services and amenities. In the most difficult region, an employee gets eight points for every year of service. In the least difficult region, only one point is given for every year of service. The middle three regions are assigned six, four, and two points, according to their ranking. The maximum number of points an officer can earn throughout a career is 40, and it is this restriction that causes researchers to feel the promotion rules are heavily stacked against them. Most of the research stations and laboratories are located in the least difficult region. Also, specialized research work does not permit transfers of researchers to different places, unlike administrative or extension work. Better ways could be found to compensate employees for working in difficult areas; for instance, monetary compensation would be more appropriate than points.

The current promotion rules have been designed primarily for employees of the General Civil Service and are inappropriate for researchers. Promotion rules for researchers need to be designed with the field of research in mind. This is possible only if a research organization separates itself from the general administration of the government, thus gaining control over the design of its personnel policies, recruitment, and promotion system. This autonomy is extremely important for the success of the research system.

Job Security

Government employees feel secure in their jobs. Shrestha found that only about 12 percent of the respondents complained about being insecure in their jobs.[32] A permanent employee being dismissed because of poor performance on the job is unheard of. The worst penalty imposed is transfer to difficult geographical areas. If an employee has links with a power group in the government, such a transfer can easily be nullified.

Publication

Publication of research articles universally provides both recognition and personal

[32] Shrestha, *Job Environment and Job Consciousness*, p. 3.

satisfaction to researchers. Researchers' performances are generally evaluated by the quality and quantity of their publications in research journals, so publication is an extremely important activity in a research system. In Nepal, this activity is seriously limited. There are currently three journals in which agricultural scientists can publish their research work. They are the *Nepalese Journal of Agriculture, Animal Health Bulletin,* and *Journal of the Institute of Agriculture and Animal Science.*

Publication of the *Nepalese Journal of Agriculture* was begun in February 1960 by the Nepal Agriculture Association. Most of the agricultural graduates are the members of the association and pay a nominal annual membership fee. The money collected is used to pay a part of the publication cost of the journal. The association published the journal regularly for five years, stopped publication from 1971 to 1975, and again published in 1976, 1977, and 1979, after which publication was again discontinued until 1986. Thus, in the 1970s, both the Nepal Agriculture Association and the publication of the *Journal of Agriculture* were almost dormant. The association was inactive because of lack of interest among its members, and the government provided no financial support for the publication of the journal. The Nepalese Council of Science and Technology, an independent organization that promotes scientific work throughout Nepal, awarded Rs 5,000 to the *Nepalese Journal of Agriculture* in 1977 for being an outstanding scientific journal. This indicates the potential for such a journal, but lack of funds precludes its regular publication.

The Nepal Veterinary Association began annual publication of the *Animal Health Bulletin* in 1977. This association is relatively more active than the Nepal Agriculture Association but faces similar financial constraints in publishing its bulletin regularly.

The Institute of Agriculture and Animal Science began publishing its journal in December 1977. The institute finances the publication of the journal and publishes it annually.

A total of 94 articles have been published in the *Nepalese Journal of Agriculture,* 23 in the *Journal of the Institute of Agriculture and Animal Science,* and 30 in the *Animal Health Bulletin.* The lack of support for the publication of journals demonstrates the low priority accorded to research in Nepal.

Staff Instability

Staff instability is not a serious problem in Nepal, since there are few job opportunities for agricultural technicians outside the public sector. Also, the Public Service Commission discourages movement of staff from one discipline to another. However, the instability of agricultural economists is high compared to other disciplines because job opportunities for agricultural economists are greater than for other agricultural disciplines.

Though staff instability does not seem to exist in terms of leaving the research institute, frequent transfer of staff is a serious problem. For instance, a serious manpower constraint is reported in the national rice development program because most of their trained personnel have been transferred to other posts and new staff must be recruited and trained.[33]

Instability at Policy and Managerial Levels

Frequent transfers of officials at the policy and managerial levels have also adversely affected the development of agriculture in Nepal. In a 16-year period (1967-83) there were 16 ministers of agriculture. Of the 16, 8 served less than a year and the remaining 8 served between one and two years. Similarly, in a 14-year period (January 1969 to October 1982) there were 9 permanent secretaries in the Ministry of Agriculture. Of the 9, 4 served less than one year; 2, between one and two years; and 3, between two and three years. As for directors general

[33] Nepal, Department of Agriculture, *The Integration of Research and Extension in Farmers' Fields: The Terminal Report of the Integrated Cereals Project* (Kathmandu: Ministry of Agriculture, 1985), pp. 54-55.

of agriculture, there were 4 in the nine years from 1972 to 1981. The positions of joint secretary for planning in the Ministry of Agriculture and director general of the Food and Marketing Services Department, which hold the main responsibility for agricultural planning and socioeconomic studies, both had 5 occupants within nine years. From the early 1970s to the early 1980s, the average period that the heads of the Agricultural Input Corporation, the Agricultural Development Bank, and the Agricultural Projects Services Center remained in their posts was two to three years. The deputy directors general of Agricultural Research remained in office for about four years.

Research policies and priorities are determined in the Ministry of Agriculture; the deputy director general merely carries out those policies. Thus, during the 1970s, frequent changes in personnel at the helm caused great instability in agricultural policies and programs. The frequent juggling of senior positions subsequently brought changes to the lower level of administration as well.

Instability at policy planning and executive levels also leads to administrative inefficiency. An employee may feel secure as a government employee but be vulnerable in a particular position. Therefore, officials use their energy and talents in soliciting sociopolitical support to ensure their continuity in the current position and, if possible, for advancement to higher levels. In this process, these officials are more likely to yield to sociopolitical pressures. Freeman's observation is noted here:

> . . . [the] Department of Agriculture is subject to political pressures and changes in many ways. The Director General is frequently replaced and the policies and even the administrative structure of the department are subject to change. Within the Department of Agriculture those responsible for administering research are burdened with day-to-day problems and political pressures so that research management occupies only a small portion of their time.[34]

[34] U.S. Agency for International Development, *Integrated Cereals Project*, p. 59.

7

AGRICULTURAL RESEARCH PRIORITIES AND STRUCTURE: SOME CONCLUDING OBSERVATIONS

Agricultural development is an extremely complex process. It is the balanced combination of prices, technology, infrastructure, and institutions that promotes and sustains production growth. Although all these elements are important, the pivotal factor in modernizing traditional agriculture is improved agricultural technology, without which the effectiveness of other factors remains weak.

Although Nepal is a small country, it has considerable agroclimatic variation. In the mountains, for example, there are many microregions with differing conditions. A crop variety suitable for one microregion may not be suitable for another, and the transferability of agricultural research recommendations is limited.

Opportunities for borrowing and adapting research results from abroad may be particularly advantageous for rice, maize, wheat, sugarcane, and jute cultivation in the Tarai, which is part of a large agroclimatic subregion that receives substantial research attention from international and other national research institutes, but such opportunities are extremely limited for the hill and mountain regions. The development and management of agriculture and natural resources in the hills, where 56 percent of the population subsists on only 43 percent of the cultivated land, will depend much more on indigenous development of appropriate agricultural technology that is location-specific, but there is little relevant technology to draw on from other similar areas. Worldwide high altitude agriculture is difficult and has been neglected.

Although the short-term returns on this type of research investment may not compare favorably with similar expenditures on research in more prosperous areas, the continued absence of appropriate research for the hill region is likely to result in adverse conditions for income distribution and in resource depletion of the country as a whole. Agricultural production and productivity have deteriorated much faster in the hills than in the Tarai. The food, fuel, and fodder requirements of the large and increasing human and livestock populations are leading directly to serious depletion of natural resources and to erosion through forest degradation, overgrazing, and cultivation on steep slopes. This erosion causes siltation and flooding problems in the Tarai and beyond Nepal's borders. To prevent ecological degradation, the specific areas for research would be agroforestry, forage and fodder, terracing, erosion control, soil fertility, and genetic improvements of indigenous varieties. To promote commercialization of agriculture, research on mountain infrastructure (transport), storage, agricultural marketing for inputs and outputs, and subsistence versus cash crops is crucial. When looked at in the longer term, the potential returns on investments in appropriate hill region research are substantial.

Agricultural research priorities and strategies should generally follow the overall strategy of agricultural development in Nepal. The long-term development strategies of agriculture are correctly identified in the Fifth Five-Year Plan on the basis of comparative advantages in regional specialization, whereby the predominant economic activities would be horticulture and livestock production in the hills and mountains and foodgrain production in the Tarai.

The absence of a systematic program to carry out long-term national research strategies and priorities in accordance with regional specialization has led to various ad hoc agricultural research programs in which there is no direction and allocated resources

are not used for actual research purposes. The potential returns on a carefully planned research program and on investments are considerable.

The food balance report of the Food and Agricultural Marketing Services Department indicates that 28 of the 55 hill districts had food deficits in 1974/75, 38 had deficits in 1978/79, and 47 in 1982. In the long run the Nepalese hills are unlikely to be self-sufficient in foodgrain because of a continuous decline in agricultural productivity that is exacerbated by a diminishing scope for expanding cultivated areas and by the increasing population in the hills. It should also be recognized that the hills contain a large upland region devoid of irrigation and with soil that is very low in plant nutrients. Approximately 80 percent of cultivated land in the hills is upland and more than 90 percent of the cultivated land is unirrigated. Therefore, dramatic increases in foodgrain production are unlikely. However, improving cereal production in the valleys and lowland is possible by raising crop yields, especially where yields are still at traditional levels.

Production technologies for rainfed upland agriculture are yet to be developed. A high level of investment in agricultural research pertaining to the diverse conditions of the hill area will be needed to develop agricultural technologies that will increase yield and improve soil conservation and management. Agricultural research must be central to the design of development strategies for the hills.

Any significant boost in crop production in Nepal must come from the Tarai.[35] Here the potential for improving yields in foodgrains and cash crops through increased application of improved seeds, fertilizers, pesticides, irrigation, and water management is substantial. In the past, increases in Tarai foodgrain production have resulted almost entirely from increases in cropped areas. The scope for further increasing land under cultivation is extremely limited, since this would be possible only at the cost of reclaiming land from forestry. Thus an increase in foodgrain production must largely come from increasing productivity through promotion of irrigation, greater intensity of cropping, and development and dissemination of improved agricultural technology. A substantial investment will be needed to increase irrigation facilities, build agricultural research capabilities, and establish production support programs such as extension, input, credit supply, and marketing.

The following conceptual framework for complementarities in production between the hills and the Tarai is suggested. A higher production of foodgrain in the Tarai could generate a large marketable surplus. With proper infrastructural support, this surplus could benefit hill people in two ways. First, present constraints on wage goods that are essential for an employment-intensive program could be released. Low income people spend the bulk of their additional income on food, and a high employment policy increases the income of the poor, whose demand for food subsequently increases.[36] This increase in demand for food could be met from the marketable surplus generated in the Tarai. Second, the surplus would have an effect on the domestic prices of foodgrain, depending upon the quantities exported. It is commonly believed that benefits of technological innovations in the production of foodgrains for which the demand is inelastic are passed to consumers, particularly the urban population and hill people in the case of Nepal.

Conversely, the hills will produce fruits and vegetables, livestock products, and handicrafts, the demands for which are elastic. In the production of such commodities, the benefits of technological innovations are passed to the producers. Thus, technological innovations in foodgrain production in the Tarai will not only benefit Tarai producers through an increase in production but will

[35] International Fund for Agricultural Development, *Report of the Special Programming Mission to Nepal.*

[36] John W. Mellor, *The New Economics of Growth: A Strategy for India and the Developing World,* a Twentieth Century Fund Study (Ithaca and London: Cornell University Press, 1976).

also benefit the hill people, who are potential consumers and will benefit further from technological innovations in horticulture, livestock, and the cottage industries.

The hills and mountains have a comparative advantage in the production of horticulture and livestock products. However, there is a serious lack of improved technology and marketing for both subsectors. Farmers will undertake horticultural and livestock activities on a commercial scale only if the marketing of their products is guaranteed. Both horticulture and livestock are of special significance to the poor and to small farmers in terms of employment and income, since they are more labor intensive than foodgrains, both on and off the farm.[37]

Because of the perishability of these commodities, rapid transportation is essential. Therefore, an intensive program of horticulture and livestock development should be initially concentrated in a few hill and mountain pockets that have access to a good transport network. This program could gradually expand to other regions as transport and marketing networks develop. Also, the intensity of research on horticulture and livestock is very low. To pursue more diversified high-value and low-volume agricultural products, as postulated by the government, would place high demands on the agricultural research system in the hills.[38] The prerequisite for realizing this strategy is the provision of access to markets. This access will require massive investments in the development of transport and marketing networks linking the hill economy with the Tarai and with foreign markets.

Thus the development of transportation, marketing networks, and research is essential to hill development. Regional specialization, Tarai hill integration, and trade become pivotal in the long-term agricultural development strategy of Nepal. In planning policies, care should be taken that short-term imperatives do not run counter to the long-term development potential of Nepal. For instance, every year more hill districts are becoming food-deficit districts, and the immediate national concern has been to turn all efforts toward increasing food production in the hills, albeit without much success. These efforts have diverted attention and resources from the long-term potential of horticulture and livestock development to the short-term imperatives of foodgrain production in the hills. Horticulture and livestock have attracted little or no attention from the bilateral and multilateral agencies. Without a policy change in priorities toward research and development programs for these two subsectors, the current trends of agricultural expansion into marginal lands for foodgrain production, rapid rates of deforestation, and rising population are likely to have even more serious consequences for the environment.

The allocation pattern of research expenditures between the hills and the Tarai to a large extent reflects regional specialization. For example, from 1970/71 to 1980/81 the average annual research expenditure on crops in the Tarai was Rs 4.269 million compared to Rs 0.852 million in the hills, indicating a greater research effort on food crops in the Tarai than in the hills. But the average annual research expenditures on horticulture and livestock in the hills were Rs 3.065 and Rs 2.789 million, respectively, compared with Rs 0.790 and Rs 0.910 million in the Tarai. A similar pattern is reflected in the allocation of trained agricultural manpower in agricultural research. For example, in 1979/80, 95 officer-level technicians worked in crops research in the Tarai compared with only 20 in the hills, and 116 officer-level technicians worked in livestock and horticulture in the hills compared with 16 in the Tarai.

The agricultural resource allocation patterns and disciplinary orientation of the research stations and farms in different locations of the country indicate that efforts

[37] International Fund for Agricultural Development, Special Programming Mission, proposal for IFAD assistance in National Horticultural and Livestock Research Project, 1979. Proposed project did not materialize.
[38] Ibid.

have been made to follow a broad research strategy in accordance with regional specialization. However, this strategy has not been operationally effective, largely because of the low priority given to research activities in the annual work programs of the research stations and farms. The major preoccupations of these stations and farms have been to propagate improved seeds, fruit plants, and breeds of animals and to provide training and other production support services. Research on livestock and horticulture in the hills and mountains has been almost nonexistent.

Besides horticulture and livestock, other areas of research that presently receive almost no attention are factor-oriented ones such as labor, water utilization, land terracing, and soil conservation techniques; forage crops and fodder trees essential to meet the shortage of feed for livestock; grain legumes and pulses, which constitute a significant portion of the national diet and could improve the soil nutrients through nitrogen fixation; and some minor cereal crops such as finger millet, barley, and buckwheat, which are important food crops for many poor and subsistence farmers in the hills. Since only 14 percent of the total cultivated land is irrigated, farming in Nepal is largely conducted under rainfed conditions; therefore, the major crop research program should be oriented toward rainfed agriculture.

Social science is also at a low ebb. The inclusion of social scientists in the research programs of different commodities and in farming system research is essential to developing a socially acceptable and economically viable technology. Research in the area of agricultural policies is also warranted.

Types of Research

Ruttan postulates three generalizations regarding the agricultural research system for small countries. These are relevant for Nepal. First, the research investment per hectare will have to be higher in a small system than in a large one in order to achieve an equal level of effectiveness. Second, the cost of developing productive farming systems for a small country with wide agroclimatic variation will be greater than for a small, more geographically homogeneous country. Third, a small country will have to depend on others—international agricultural research systems, research systems of large countries in the same region, multinational firms—for much of its agricultural technology. However, a small country needs to develop sufficient expertise in agricultural science to enable it to draw selectively from other national and international research systems.[39]

In accordance with the induced innovation theory, research efforts should generate technology that will ease out the resource constraint that is inhibiting output expansion.[40] In Nepal, land and capital are the constraints, so research should focus mainly on biological and chemical innovations.

Since the possibility of borrowing technology from neighboring countries and international agricultural research centers is greater for the Tarai than for the hills, Nepal would benefit by emphasizing adaptive research in the Tarai in order to test or verify the suitability of these technologies. At the same time, the government could emphasize both strategic and adaptive research in the hills to develop and modify agricultural technology suitable to the hill environment. The technology-borrowing capacity of the research system could be enhanced through active efforts to acquire current journals and other research reports, and to visit and collaborate with research systems in neighboring countries and at international agricultural research centers. Also, varietal, plant protection, and agronomical trials are needed as prime activities of Tarai agricultural research. On the other hand, the most important focus for hill research is the generation of new technology, which would require an increased number of qualified plant and animal breed-

[39] Vernon W. Ruttan, *Agricultural Research Policy*, pp. 177-178.
[40] Ibid.

ers as well as improved laboratory facilities.

The development of a viable, sustainable, and dynamic research system is a vital step toward meeting the needs of the country, and the role of foreign assistance is crucial in building such a system. Foreign aid has already provided expertise in training research personnel and building physical infrastructure in some specific components of agricultural research, but the research system as a whole is still weak, imbalanced, and underdeveloped and needs a holistic approach.

Ruttan points out that a national system designed to transfer, screen, and adapt technology requires essentially the same skills as a system devoted to the invention of new technology.[41] Therefore, advanced training should always receive high priority in building a research system that can carry both adaptive and strategic research.

Research Structure

It is evident from the earlier discussion that the Nepalese agricultural research system is poorly funded, organized, and managed. Although agricultural research is central to the success of any production support program, it has generally received lower priority than the production program. Donor assistance is readily available for the production program but not for research because research results require a long gestation period, and both donors and recipient governments want quick results or returns on their investment. Unless there is a favorable change in attitude toward research at the policy level and among donors, no substantive reform or investment can take place in research.

To substantially reform the system, the foremost prerequisite is a political will to accord high priority to agricultural research and to unify all agricultural research activities under one body. Under the present organizational structure, extension and other production support activities tend to dominate the overall program and research consequently suffers.

The experience of several other Asian countries indicates that an autonomous research organization is generally better equipped to provide an atmosphere for the necessary coordination of planning and logistical support, including attractive conditions of employment, than a research organization under government bureaucracy. An autonomous research organization can institute its own rules and regulations for staff recruitment and promotion and thereby create a better research environment. It should also have a monitoring and evaluation unit to administer the progress of research work and examine its relevancy and effectiveness.

There is some concern that reorganizing research under a separate autonomous body is likely to weaken the linkage between research and extension. However, having these two activities under the Department of Agriculture does not guarantee close coordination between them. The important consideration is that the objectives of agricultural research should be explicit, so that the research priorities and programs are related to the problems of farmers and their resources. The research system should be held accountable for its output and for the relevancy of that output. The program should be strictly monitored and evaluated so that the total research system focuses on the farmers' problems. In the past, several studies have emphasized the need for reorganization of agricultural research into a unified and autonomous structure.[42] The

[41] Ibid., p. 175.

[42] Ram P. Yadav, "Institutional Arrangements for Agricultural Research in Nepal," in *Research, Productivity and Mechanization in Nepalese Agriculture*, ed. Bhavani Dhungana, a seminar report (Kathmandu: Center for Economic Development and Administration, Tribhuvan University, 1976); Nepal, Department of Agriculture, *A Proposal for Organizing Agricultural Research in Nepal*, Mid term Preliminary Draft, April 7-May 27, 1977; ADB/Nepal, *Nepal Agricultural Sector*; FAO/World Bank Cooperative Program, *Nepal Agricultural Research Review Mission Report* (Rome: FAO, 1984); USAID, *Nepal Integrated Cereals Project Evaluation Report*, suggests a semiautonomous research and development institution that could provide a degree of freedom in personnel policy, fiscal policy, and research direction, and some insulation from political pressures; Report of the Joint Review Team, A Proposal for a Nepalese Council for Agricultural Research, March 1978; IFAD Programming Mission in 1979 supported the proposed National Council for Agricultural Research and recommended that IFAD support establishment of the council.

Ministry of Agriculture will have to play a coordinating role to effectively link research and extension.

The current decentralization plan of the government of Nepal requires that all sectoral development activities at the district level be coordinated and administered by the district development officer, and that technical support and guidance be provided through technical departments and ministries. Therefore, the agricultural extension program will have to be carried out by the Department of Agriculture through 5 regional agricultural directorates and 75 district agricultural development offices.

The Institute of Agriculture and Animal Science (IAAS) can play an important role in meeting the trained manpower needs for research and extension, especially if high priority is given to upgrading the training. Within 7 to 10 years the IAAS could be converted to an agricultural university and should maintain close contact with the proposed autonomous research organization through exchange of staff. Ultimately there could be complete amalgamation of the research organization into the agricultural university, bringing research and teaching together so that both research and training become mutually reinforcing and relevant.

APPENDIX 1: SUPPLEMENTARY TABLES

Table 37—Share of various sectors in development expenditures during five-year plans, 1965-85

Sector	Third Plan 1965-70	Fourth Plan 1970-75	Fifth Plan 1975-80	Proposed Sixth Plan 1980-85
		(percent)		
Agricultural[a]	17.56	21.72	25.43	30.34
Transportation and communications	31.29	41.15	27.68	19.45
Industry, mining, commerce, and electricity	10.03	14.54	18.74	25.75
Social services[b]	17.20	17.25	23.22	22.14
Others	23.92	5.34	4.93	2.32
Total development expenditure	100.00	100.00	100.00	100.00

Sources: Third and Fourth Plan data are based on World Bank, *Nepal: Development Performance and Prospects*, a World Bank Country Study (Washington, D.C.: World Bank, 1979); Fifth Plan data are from Nepal, Ministry of Finance, *Nepal: Economic Survey for FY 1980/81* (Kathmandu: MOF, 1981); and Sixth Plan data are from Nepal/World Bank, *Allocation of Development Expenditure in the Public Sector*, an economic memorandum on Nepal (Kathmandu: Ministry of Finance), Appendix E, p. 98.

[a] The agricultural sector comprises agriculture, irrigation, land reform, forestry, and cadastral survey.

[b] Social services include education, health, and drinking water.

Table 38—Total GDP, agricultural GDP, and budget expenditures, 1970/71-1980/81

Year	Total GDP	Agricultural GDP	Total Budget Expenditures	Total Development Expenditures	Total Agricultural Sector Expenditures
			(1972/73 Rs million)		
1970/71	11,266	7,605	866.0	523.3	106.6
1971/72	12,899	8,840	988.1	637.2	118.7
1972/73	11,165	7,037	962.6	608.6	120.3
1973/74	12,517	8,650	1,070.1	655.7	168.3
1974/75	12,366	8,534	1,129.7	721.8	154.6
1975/76	12,327	8,147	1,356.1	878.0	259.0
1976/77	12,212	7,342	1,646.9	1,058.9	272.5
1977/78	12,657	7,451	1,715.8	1,159.7	283.7
1978/79	13,790	8,296	1,874.9	1,228.3	332.3
1979/80	14,148	7,613	2,444.9	1,321.3	291.3
1980/81	13,631	7,701	2,031.9	1,356.1	336.1
			(percent)		
Annual growth rate	1.53	-0.57	10.67	10.89	13.56
t-statistic	3.20	-0.81	11.97	14.77	9.13

Sources: Unpublished data from National Planning Commission Secretariat and Central Bureau of Statistics, Nepal; and Nepal, Ministry of Finance, *Economic Survey*, various issues (Kathmandu: MOF, various years).

Table 39—High-yielding cereal varieties released in Nepal, 1959-85

Crop	Serial Number	Name of Variety	Origin	Year of Release	Recommended for		Remarks[a]
					Hill	Tarai	
Rice	1	CH-45	China	1960	x	x	Early, 1
	2	N-136	India	1962		x	0
	3	BR 34	India	1962		x	0
	4	BR-8	India	1962		x	0
	5	Taichung-176	Taiwan	1966	x		2
	6	Chainung-242	Taiwan	1966	x		3
	7	Kaoshung-24	Taiwan	1966	x		0
	8	Chainan-2	Taiwan	1966	x		0
	9	Tainan-1	Taiwan	1966	x	x	0
	10	Taichung Native-1	Taiwan	1967		x	3
	11	IR-8	IRRI	1968		x	0
	12	IR 5	IRRI	1969		x	0
	13	IR-20	IRRI	1970		x	0
	14	IR-22	IRRI	1972		x	0
	15	Khumal-1	Taiwan	1972	x		0
	16	Parwanipur-1	Taiwan	1973		x	3
	17	Jaya	India	1973		x	3
	18	Masuli (Mahsuri)	Malaysia	1973		x	1
	19	IR-24	IRRI	1975		x	0
	20	Chandina (IR532)	IRRI	1977		x	Early, 3
	21	Laxmi (IR2061)	IRRI	1979		x	Early, 2
	22	Durga (IET2938)	India	1979		x	3
	23	Sabitri (IR2071)	IRRI	1979		x	1
	24	Janaki (BG-90-2)	Sri Lanka	1981		x	1
	25	Bindeswari (IET1444)	India	1981		x	Early, 1
	26	Kanchan (IR3941)	IRRI	1982	x		1
	27	Himali (IR2298)	IRRI	1982	x		Early, 1
	28	Malika (Mala/J15)	Bangladesh	1982		x	2
	29	Khumal-3 (Ch1039XIR580)	India	1983	x		1
Maize	1	Amarillo de Cubano Flint	United States	1959	x	x	
	2	Khumal Yellow		1968	x		1
	3	Rampur Yellow		1968		x	2
	4	Kakani Yellow		1969	x		2
	5	Hetauda Composite	Nepal	1972	x	x	3
	6	Rampur Composite	Thailand	1975	x	x	1
	7	Sarlahi White	Philippines	1975		x	3
	8	Janaki Makai		1979		x	winter, 3
	9	Arun-2	UNCC XDHR	1981	x	x	1
	10	Makalu-2	(Amarillo del Bajio)	1984	x		1
Wheat	1	Lerma-52	CIMMYT	1960	x		2
	2	Petic 62	CIMMYT	1967	x		0
	3	Lerma Rojo-64	CIMMYT	1967	x		3
	4	S-331	India	1969		x	0
	5	S-227	India	1969		x	0
	6	RR-21 (Sonalika)	India	1971	x	x	1
	7	NL-30	India	1975		x	2
	8	HD-1982	India	1975		x	0
	9	UP-262	India	1979		x	1
	10	Lumbini	India	1981		x	2
	11	Siddhartha	India	1983		x	2
	12	Triveni	India	1983		x	2
	13	Vinayak	India	1983		x	2
	14	Vaskar	CIMMYT	1983		x	2
	15	Nepal 297		1985		x	

Sources: Nepal, Department of Agriculture, *The Integration of Research and Extension in Farmers' Fields: The Terminal Report of the Integrated Cereals Project* (Kathmandu: Ministry of Agriculture, 1985), p. 49; and Food and Agriculture Organization of the United Nations, *Seed Status Survey Report* (Rome: FAO, 1981).

[a] According to the FAO *Seed Status Survey Report*, the importance or popularity of varieties is categorized as follows: 1 very important, 2 important, 3 less important, 0 grown occasionally or not at all.

Table 40—Foreign-aided projects that partly support agricultural research activities in Nepal, 1982

Project	Financing Agency
Agricultural Research and Extension	International Development Association/World Bank (IDA/WB)
Cash Crop Development (sugarcane, tobacco, oilseed, ginger, sericulture)	IDA/WB
Narajani Zone Irrigation Development, Stage II	IDA/WB
Sunsari and Morang Irrigation and Drainage Development, Stage I	IDA/WB
Rasuwa-Nuwakot, Integrated Rural Development Project (IRD)	IDA/WB
Chitawan Irrigation Project	Asian Development Bank (ADB)
Kankai Irrigation Project	ADB
Sagarmatha IRD Project	ADB
Livestock Development Project	ADB
Aquaculture Development	ADB
Hill Agriculture Development	ADB
Aquaculture Development	United Nations Development Programme (UNDP)
Vegetable Seed Production	Food and Agriculture Organization of the United Nations (FAO)
Integrated Cereals Project	U.S. Agency for International Development (USAID)
Resource Conservation and Utilization	USAID
Institutional Capacity Building (to develop social-science research capability)	USAID, Agriculture Development Council, International Development Research Centre, Federal Republic of Germany
Lumle Agriculture Center	United Kingdom (UK)
Pakhribas Agriculture Center	UK
Silvicultural Research Project	UK
Tea Development	UK and ADB
National Potato Development	Switzerland
Tinau Watershed Management	Switzerland and Federal Republic of Germany
Livestock Development at Pukhara	Federal Republic of Germany
Janakpur Agricultural Development	Japan
Horticulture Development	Japan
Sericulture Development	Republic of Korea
Karnali/Bheri Integrated Rural Development (projects to collect basic data surveys and resource assessments)	Canadian International Development Agency (CIDA)
Agriculture Resource Inventory	USAID
Land Resource Mapping Project	CIDA
Water and Power Resources Development (surveys and resource assessments)	CIDA
National Farm Management Survey	FAO/UNDP

Source: Unpublished data from the Foreign Aid Division, Ministry of Finance, Nepal.

Table 41—Crop research budget expenditures, 1970/71-1980/81

Project	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
						(1972/73 Rs 1,000)					
Technical section											
Agricultural botany	670	675	630	210	271	342	314	260	289	260	251
Entomology	457	409	325	618	436	295	334	299	534	309	280
Plant pathology	323	441	340	357	379	262	261	289	320	291	280
Entomology (Khopasi)	n.a.	n.a	n.a.	n.a.	441	295	388	227	288	220	815
Agricultural stations and farms											
Parwanipur - crops	457	1,081	865	654	627	447	423	376	339	284	287
Tarhara - crops	305	404	698	587	333	299	347	353	267	244	235
Rampur - crops	663	765	671	502	539	283	315	316	328	265	286
Bhairahwa	780	827	281	495	198	442	311	293	300	271	270
Nepalganj	512	437	461	778	1,025	653	1,021	535	408	341	323
Jumla	217	125	75	184	121	144	131	145	143	126	105
Tikapur	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	15	32	24	25
Surkhet	n.a.	n.a.	n.a.	37	45	72	434	196	445	169	173
Doti	109	89	70	76	94	127	115	79	99	91	101
Jobari	n.a.	n.a.	n.a.	n.a.	n.a.	136	120	127	170	114	69
Janakpur	875	708	1,126	395	263	258	243	233	231	175	82
Khumaltar	237	304	249	288	257	186	163	213	217	241	200
Jiri	19	211	n.a.	n.a.	n.a.	155	171	158	225	146	30
Parwanipur - paddy	n.a.	n.a.	n.a.	n.a.	n.a.	245	670	782	770	767	659
Parwanipur - sugarcane	n.a.	n.a.	n.a.	n.a.	n.a.	214	211	190	254	142	141
Rampur - maize	n.a.	n.a.	n.a.	n.a.	n.a.	578	625	1,109	1,508	1,111	1,032
Bhairahwa - wheat	n.a.	n.a.	n.a.	n.a.	n.a.	378	430	526	978	411	789
Cotton research	n.a.	n.a.	n.a.	n.a.	n.a.	172	n.a.	180	198	n.a.	n.a.
Oilseed crop	n.a.	n.a.	n.a.	n.a.	n.a.	164	434	153	316	205	127
Cardamom development	n.a.	n.a.	n.a.	n.a.	112	67	75	133	181	82	89
Ginger development	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	19	18	29	28
Total	5,624	6,476	5,791	5,181	5,141	6,214	7,536	7,206	8,858	6,318	6,678

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).

Notes: n.a. means data are not available or project was not yet in existence. Nepal's consumer price indexes (1972/73 = 100), used to convert current rupees expenditure into real expenditure, are as follows: 1970/71 = 88.8; 1971/72 = 90.0; 1972/73 = 100.0; 1973/74 = 114.6; 1974/75 = 134.0; 1975/76 = 141.1; 1976/77 = 141.5; 1977/78 = 155.9; 1978/79 = 161.1; 1979/80 = 177.6; 1980/81 = 201.4.

Table 42—Livestock development budget expenditures, 1970/71-1980/81

Project	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
						(1972/73 Rs 1,000)					
Livestock development farm											
Tarhara	503	243	303	421	432	318	317	287	297	248	353
Rampur	267	372	355	387	346	303	285	244	n.a.	n.a.	n.a.
Pokhara	240	199	337	518	281	380	300	697	874	2,848	1,876
Nepalganj	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	88	8	94	20	18
Solukhumbu	n.a.	n.a.	n.a.	297	189	208	204	183	175	157	128
Khumal	1,639	1,124	857	538	586	340	405	391	435	360	376
Jiri	264	211	254	241	243	230	253	252	229	198	187
Disease investigation and parasite control											
Tripuraswar	n.a.	n.a.	n.a.	235	348	358	642	532	423	381	350
Sheep farm											
Chitlang	53	89	78	69	125	89	115	97	121	81	78
Karnali	515	222	343	n.a.	n.a.	n.a.	n.a.	155	159	162	234
Tibrikot	n.a.	n.a.	n.a.	277	221	161	173	n.a.	n.a.	n.a.	n.a.
Panchasayakhola	88	174	99	153	175	149	105	115	104	103	89
Pasture development											
Rasuwa	35	36	36	48	81	74	57	54	57	57	56
Khumal	26	35	74	n.a.	n.a.	40	57	51	109	59	49
Yak farm											
Dolpa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	35	51	123	78	53
Goat farm											
Bandipur	n.a.	n.a.	n.a.	n.a.	n.a.	142	n.a.	125	165	111	131
Sheep and goat development	n.a.	n.a.	n.a.	29	101	418	23	133	131	100	n.a.
Central hatchery											
Balaju	248	83	69	93	87	71	82	81	99	91	84
Parwanipur	246	233	326	286	314	272	299	275	358	200	197
Khumal[a]	145	108	91	155	118	117	339	230	202	211	160
Brooder and hatchery farm											
Nepalganj	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	104	148	62	76	113
Total	4,269	3,129	3,222	3,747	3,647	3,670	3,883	4,109	4,217	5,541	4,532

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).
Note: n.a. means data are not available or station was not yet in existence.
[a] Includes central hatcheries in Kathmandu and Jawalakhel.

Table 43—Horticultural farm budget expenditures, 1970/71-1980/81

Project	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
					(1972/73 Rs 1,000)						
Horticultural farm											
Janakpur	69	70	53	57	67	141	90	72	89	82	79
Panchekhel	n.a.	n.a.	150	94	84	133	179	92	86	82	88
Yagyapuri	135	229	187	235	167	150	211	158	181	175	154
Trisuli	34	58	51	84	84	71	170	78	60	46	56
Tarhara	125	84	122	113	133	205	146	79	71	57	62
Parwanipur	116	67	87	113	70	92	96	92	94	67	69
Helambu	72	42	53	56	56	62	75	273	127	78	85
Dhunibesi	30	58	48	52	67	53	50	60	60	47	54
Sarlahi	n.a.	n.a.	n.a.	n.a.	455	712	452	454	611	364	378
Kirtipur	169	201	274	257	288	269	210	216	308	207	200
Daman	75	124	135	155	143	167	143	142	199	115	114
Solukhumbu	n.a.	n.a.	n.a.	n.a.	n.a.	71	n.a.	65	137	66	154
Baitadi	44	77	64	54	138	88	101	83	87	90	80
Humla	n.a.	30	69	66	60	63	49	62	101	64	59
Jumla	21	20	44	184	171	81	135	143	173	131	92
Rasuwa	36	32	63	89	131	102	89	82	85	73	51
Dailekh	n.a.	n.a.	n.a.	11	17	28	43	262	142	87	144
Nepalganj	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	94	56	53	55
Pokhara	105	133	218	357	540	176	251	194	274	226	172
Godowari	51	180	160	157	169	159	186	214	238	212	191
Jiri	n.a.	n.a.	72	157	188	30	44	53	45	44	40
Kakani	75	101	94	188	146	137	231	173	162	226	149
Mustang	76	n.a.	110	68	161	509	549	428	322	369	320
Pulpa	44	58	47	91	74	216	140	75	88	64	59
Dhankuta	135	160	146	288	396	353	494	472	388	329	300
Potato											
Khumal	215	265	151	120	132	206	285	361	128	235	117
Potato nucleus farm											
Jiri	n.a.	n.a.	n.a.	n.a.	n.a.	60	121	144	55	38	38
Vegetable development and seed production											
Khumal	n.a.	n.a.	200	329	190	315	199	226	188	127	130
Rukum	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	37	88	124	69
Total	1,627	1,989	2,598	3,345	4,127	4,649	4,739	4,884	4,713	3,878	3,559

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).
Note: n.a. means data are not available or station was not yet in existence.

Table 44—Fisheries development budget expenditures, 1970/71-1980/81

Project	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
						(1972/73 Rs 1,000)					
Fisheries development center											
Tarhara	55	76	63	72	59	65	77	72	65	36	49
Pokhara	103	105	97	103	97	911	500	260	237	209	243
Bhairahwa	120	80	90	72	80	187	379	337	369	237	239
Kailali	n.a.	n.a.	n.a.	n.a.	n.a.	61	196	162	213	259	129
Trisuli	330	185	64	50	60	115	81	53	98	49	55
Janakpur	150	152	121	215	213	177	155	115	160	165	135
Godawari	117	77	55	103	149	107	117	98	98	78	83
Parwanipur	90	58	71	38	58	94	87	74	56	63	64
Fatepur	n.a.	96	113	219	151	298	78	61	102	77	59
Hatauda	267	145	226	177	182	173	193	192	192	188	232
Total	1,232	974	900	1,049	1,049	2,188	1,863	1,424	1,590	1,361	1,288

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).
Note: n.a. means data are not available or project was not in existence.

Table 45—Food and agricultural input research budget expenditures, 1970/71-1980/81

Project	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
						(1972/73 Rs 1,000)					
Food research projects											
Food research	446	292	543	121	139	142	203	190	386	324	282
Quality control	n.a.	n.a.	n.a.	246	169	212	295	295	277	247	269
Food testing in Hatauda	110	41	120	336	131	132	136	124	80	66	81
Nutritional research	n.a.	200	251	479	224	326	99	196	151	154	151
Total	556	533	914	1,182	663	812	733	805	894	791	783
Input research projects											
Agricultural engineering	456	592	296	409	306	240	304	334	412	420	238
Soil section	422	400	380	643	472	375	454	486	439	354	300
Total	878	992	676	1,052	778	615	758	820	851	774	538

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).
Note: n.a. means data are not available or project was not in existence.

Table 46—Socioeconomic and marketing research budget expenditures, 1975/76-1980/81

Project	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
			(1972/73 Rs 1,000)			
Food, agricultural, and marketing services	164	202	227	225	195	188
Agricultural marketing research and development	117	124	125	140	131	164
Food situation analysis	31	48	60	52	54	50
Agricultural price analysis and marketing extension	71	93	118	127	87	83
Special studies economic analysis	161	187	247	148	221	219
Total	544	654	777	692	688	704

Sources: Nepal, Auditor General's Office, *Auditor General Annual Report*, various issues (Kathmandu: AGO, various years).

Note: Socioeconomic and marketing research expenditures, 1975/76-1980/81, annual growth rate = 5.31 percent (t-statistic = 1.79).

Table 47—Classification of budget expenditures

Budget Code	Type of Expenditure
1	Salary and wages
2	Allowances
3	Travel allowance and daily allowance
4	Services: printing and binding, postage, telephone, telex, bank service charges, advertising, transportation and freight charges for moving property
5	Rent
6	Repair and maintenance
7	Expendable goods (with life less than one year)
7.1	Office stationery
7.2	Books, newspapers, and magazines
7.3	Fuel
7.4	Clothes and foodgrains for junior staff
7.5	Other expendable goods
8	Grants-in-aid, contributions, and rewards
9	Unforeseen
10	Durable goods (with life less than one year)
10.1	Furniture
10.2	Transport devices
10.3	Tools and machinery
11	Purchase of land and buildings
11.1	Purchase of land
11.2	Purchase of buildings
12	Construction and improvements
12.1	Building construction and improvements
12.2	Other construction and improvements

Source: Nepal, Ministry of Finance, *Income-Expenditure Estimated Budget, 1982/83* (Kathmandu: MOF, 1982).

Table 48—Trained personnel in agriculture, by institution, 1983

Institution	Ph.D.	M.S.	B.S. or Equivalent	Total
Ministry of Agriculture Secretariat	5	25	0	30
Department of Agriculture	9	137	400	546
Department of Livestock and Animal Health	3	26	91	120
Department of Food and Agricultural Marketing Services	4	32	3	39
Central Food Research Laboratory	2	30	0	32
Agriculture Development Bank	1	16	53	70
Agriculture Inputs Corporation	0	4	21	25
Agricultural Projects Services Centre	5	70	2	77
Institute of Agriculture and Animal Science	5	63	20	88
Dairy Development Corporation	0	11	14	25
Total	34	414	604	1,052

Source: A survey of personnel in agriculture by the author, 1983.

Table 49—Trained personnel in the Ministry of Agriculture and its parastatals, by discipline, 1983

Discipline	Ph.D.	M.S.	B.S. or Equivalent	Total
Agronomy	3	23	55	81
Botany	3	16	10	29
Horticulture	1	25	40	66
Animal husbandry	1	13	37	51
Veterinary science	2	15	55	72
Agricultural economics	9	104	0	113
Agricultural extension	1	29	100	130
Rural sociology	0	5	0	5
Entomology	2	14	7	23
Plant pathology	1	15	21	37
Soil science	0	14	15	29
Fisheries	0	14	8	22
Agricultural engineering	0	11	27	38
Agricultural statistics and mathematics	2	17	3	22
Food technology	0	13	0	13
Nutrition	2	3	0	5
Business administration	0	4	0	4
Geography	1	0	0	1
Chemistry	1	10	6	17
Home science	0	2	1	3
General agriculture	0	0	188	188
Dairy technology	0	4	11	15
Total	29	351	584	964

Source: A survey of personnel in agriculture by the author, 1983.

APPENDIX 2: METHODOLOGY FOR DETERMINING GROWTH RATES AND DECOMPOSITION OF GROWTH TRENDS

Growth Rates

In order to compute annual growth rates, the exponential curve $Y = ab^t$, which represents a trend with constant rate of increase or decrease, is estimated. In logarithmic form it becomes

$$\log Y = \log a + t \log b,$$

where y = the value of the variable in year t, and t = time; 1970/71 = 1, 1971/72 = 2 .... Anti-log of log b gives the value of b and the growth rate $G = (b - 1) \times 100$, expressed in percentage.

Decomposition of Growth Trends

The decomposition of agricultural growth trends was analyzed employing multiplicative schemes developed by Minhas:

$$A_t\sum_c a_{ct}Y_{ct}P_c/A_0\sum_c a_{c0}Y_{c0}P_c = (A_t/A_0)(\sum_c a_{c0}Y_{ct}P_c/\sum_c a_{c0}Y_{c0}P_c)(\sum_c a_{ct}Y_{c0}P_c/\sum_c a_{c0}Y_{c0}P_c)$$
$$(\sum_c a_{ct}Y_{ct}P_c/\sum_c a_{ct}Y_{c0}P_c \times \sum_c a_{c0}Y_{c0}P_c/\sum_c a_{c0}Y_{ct}P_c),$$

where

A_t = gross cropped area during period t,

a_{ct} = (A_{ct}/A_t) = proportion of area under crop c (A_{ct}) to the gross cropped area during period t,

Y_{ct} = physical output per hectare of crop c during period t, and

P_c = the constant price weights (1975/76) assigned to each crop.

This formulation expresses the index number of output as a multiple, respectively, of the index number of area, change in crop yields, change in cropping patterns, and a residual component that is the interaction between cropping pattern and yield components.

Fitting an exponential time-trend to each series of index numbers produces an additive scheme for growth,

$$G = G_A + G_Y + G_a + G_{ay},$$

where

G = growth rates of gross agricultural output,

G_A = growth rates of gross cropped area,

G_Y = growth rates of contribution of the yield effect,

G_a = growth rates of contribution of the cropping pattern effect, and

G_{ay} = residual components, such as growth rates of contribution of interaction between cropping pattern and yield components.

The residual component, G_{ay}, is obtained by subtracting $(G_A + G_Y + G_a)$ from G.

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