IV. Interaction of Agriculture and Population

In the preceding sections we presented a broad overview of agricultural development and population growth in Lhasa District. An important fact is that varying tendencies, i.e., in crop production, numbers of livestock, population, and labour force, did exist in the period from 1958 to 1984. Identifying the relationship of these tendencies is the focus of this section.

Agricultural Production and Supply

The population is both the producer and the consumer. An increased population can provide a bigger labour force for production, but it also needs more products for consumption. Among the needs of the people, food is the most important. In Lhasa District, crop production plays the key role in the district economy. In the 1950s crop production provided the basic necessities for consumption, such as grain and cooking oil, to the local people. As the population continued to grow in the 1980s, crop production still served the same purpose even though the products improved a great deal. Because of the post and current limitations that persist in Lhasa District, e.g., those relating to transportation, it has always been necessary to maintain the food security level. Former experiences in crop production show that, despite the fact that grain crops account for more than 90 per cent of the croplands and in spite of a gradual improvement in productivity, grain production has not been sufficient to meet the basic food demands of the increasing population. The import of foodgrains has been necessary every year without exception in the past three decades.

Based on local government records and using a linear regression method, a chart on food production patterns from 1958 to 1984 has been constructed (Figure 9). From 1958 to 1984, the grain production in the district increased 2.7 times, with an annual increment of 1,679 tons (on a statistical basis). During the same period, the population of the district grew considerably at a growth rate of 2.1 per cent per annum. In relation to crop production and the population, the grain availability per capita over several time periods is indicated in Table 12. In fact, the shortage of grain has been one of the key issues in the district economy.

The World Bank estimated that, in China, in 1980, the per capita grain consumption in the rural areas was 257 kg per annum (unmilled grain) and in the urban areas it was equivalent to about 400 kg (unmilled grain) per annum in 1980 (World Bank 1983). In 1984 when the harvest was normal, the grain availability per capita was much lower in Lhasa District than the national level.

Table 12: Grain Availability[a] (1952-1984)

(kg per capita per annum)

	1952	1965	1970	1977	1979	1980	1984
China[b]	234	215	232	239	274	260	316
Tibet	94	149	151	228	185	218	201
Lhasa	116	168	147	211	161	204	194

a   Seed, feed, incremental reserves, and industrial uses are assumed to be 20% of gross production.

b   The data for China, from 1952 to 1980, are adapted from "The World Bank Country Study: China-Socialist Economic Development" Vol. II, p 62, 1983 and the data for 1984 are adapted from "Chinese Agricultural Yearbook", Agricultural Publishing House, 1985.

Figure 9: Grain Production and Its Incrementation in Lhasa District (1958-1984)

						1000 ton	
R	=	0.904 > 0.487 (α = 0.01)		1985	=	71.127	
Y	=	1.679 x - 71.614		1990	=	79.523	
S	=	6.436		1995	=	87.920	
				2000	=	96.316	
				2005	=	104.713	± 6.346
				2010	=	113.109	
				2015	=	121.506	
				2020	=	129.902	
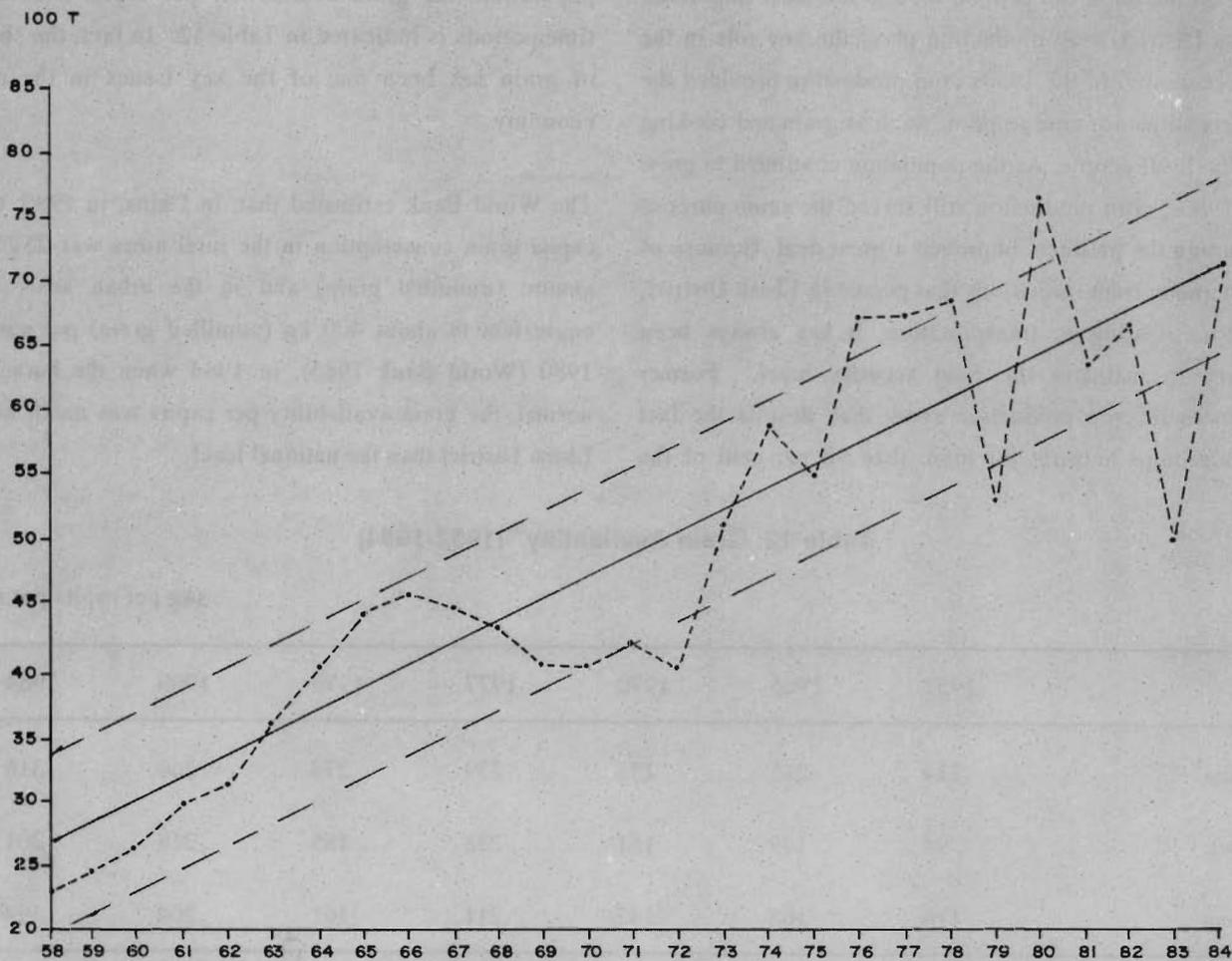
It needed grain imports of 33.12 thousand tons, accounting for 45 per cent of the gross crop production, to meet the mean national grain consumption level. In reality, Lhasa District imported about 19.7 thousand tons of foodgrain in 1984. The mean per capita grain availability was increased to 263 kg per annum (total population as a whole), but this was still beneath the national level in 1980.

Looking at the food security situation in Lhasa District, some typical aspects should be emphasised. Firstly, it is not a real rural area, owing to the high proportion of urban population. Almost one-third of the people are living in the city and need commercial grain supplies. Secondly, with the limitation of climatic conditions in the high mountains, productivity is not likely to increase significantly in the near future. And, lastly, in the case of the need for a better diet, certain cereal croplands will have to be transformed into horticultural lands.

Can crop production meet the population needs in the near future? Based on the regression shown in Figure 9, according to the tendencies of the annual increment in crop production and the tentative population growth (at a rate of 1.5% which is the local government target for the near

Table 13: **Estimation of Crop Production and Per Capita Grain Availability (1990-2020)**

Population	:	1000 persons	
Crop production	:	1000 tons	
Per capita grain availability	:	kg/person/year	

Year	Crop Output (+-6.4)	Population in Total		Rural Population	
		Population	Grain Per Capita	Population	Grain Per Capita
1984	69.4	285.6	194	179.8	309
1990	79.5	312.3	204	196.6	323
1995	87.9	336.4	209	211.8	332
2000	96.3	362.4	213	228.2	338
2005	104.7	390.4	215	245.8	341
2010	113.1	420.6	215	264.8	342
2015	121.5	453.1	215	285.3	341
2020	129.9	488.1	213	307.4	338

Note: Some assumptions implied by the figures in the table are listed below.

1. Crop production in Lhasa District will be more than sufficient for the needs of the rural population in the near future. Rural areas can provide surplus grain to urban areas.

2. Crop production will not be adequate to sustain the total population of Lhasa District in the near future if the present increments in crop yields continue. The import of grain products from other areas will be a necessity. The grain imported will be for the use of the urban population.

3. The grain supply level will improve before 2010 and decrease thereafter. This means that the pressure of cereal shortage in Lhasa District will be partially alleviated.

future), the output from crops and the per capita grain availability per annum in the coming three decades were estimated as indicated in Table 13. The estimation assumes that the arable land in Lhasa District will remain the same in future as it was in 1984 and the increase in crop production will rely mainly on productivity. Therefore, the productivity will have to increase from 2.46 tons per ha in 1984 to 4.58 tons per ha in 2020. This target is realistic because it is not so high as the former records (7.5-10 tons/ha). The estimation also assumes that the growth in population will slow down and that the urban-rural population ratio will be maintained, more or less, at the present level.

The need to provide basic minimum supplies of foodgrain for a growing population has dominated and will continue to dominate the agricultural strategy. At present, the import of foodgrain in Lhasa District depends upon subsidies from the Central Government. Thousands of trucks, travelling over one thousand kilometres, transport cereal grain from Sichuan or Qinghai Province. A recent survey by the author[*] revealed that the actual expenditure for transportation exceeds the real price of the foodgrain. A very big challenge will face the district economy, as well as its agricultural development, assuming that no subsidy will be provided in the future. To meet the foodgrain needs of the population, one option is to accelerate the development in crop production and the other is to continue importing. The former option depends upon the extent to which improved technology in crop and livestock production can be profitably mobilised. The latter option depends upon the ability to pay for these imports through exports or continued government subsidies.

In terms of the current situation in Lhasa District, food security is a key issue in the district economy. This issue can also be seen as a critical element in the land-food-population relationship .

In considering the land-food-population relationship, three elements are of basic importance: per capita land cultivated, land productivity, and degree of per capita crop production. Per capita land cultivated represents the availability of cultivated land to the rural population; productivity stands for the impact of integrated factors (e.g., climatic conditions, soil quality, improved technology, and management

efficiency); and the per capita crop production indicates the capacity of grain supply. These three elements link with, or cover, the other three elements as shown below.

Relationship of Elements
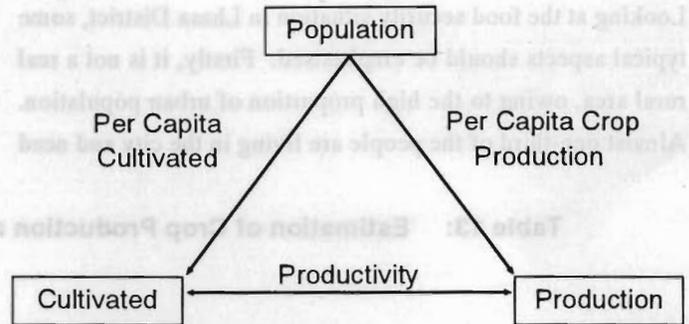
To identify the differences, the fuzzy matrix method is used to classify types of land-food-population interaction (see Annex). In doing so, the data for per capita land cultivated (land sown with oil seeds and vegetables) is not included, but per capita crop production and grain crop productivity (1984) for each county are used in the calculation. Damxung is treated as a typical category because there is no crop production. The basic data are shown in Table 14.

Lhasa, Quxu, Dagze, and Doilung are located along the lower reaches of Lhasa Valley where the climatic condition is suitable for crop production; the broad valley basin provides a large area of cultivable land. The management here is more intensive. These four counties could be defined as being more than self-sufficient in foodgrains, and they can provide surplus cereals to the market. According to a former survey (Gao Yixin et al. 1983), there are 2,500 ha of wasteland suitable for cultivation within the lower reaches of the Lhasa Valley. In future, the prospect of foodgrain supply will largely depend upon these four counties.

Maizho and Nyemo counties do not have any potential for increasing cultivated land. These two counties could, however, produce foodgrain for themselves and provide some surplus to the market when there is a good harvest. Future strategies should concentrate on improving productivity.

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[*] The expenditure for transportation (in 1986) was 0.7 *yuan* per kg, while the mean retail price of cereal was 0.45 *yuan* per kg.

Table 14: Land Cultivated Per Capita, Crop Production Per Capita, and Productivity

County		Land Cult. Per Capita (ha/person)	Crop Per Capita Production (kg/person)	Productivity (ton/ha)
Maizho	1	0.125	271	2.18
Dagze	2	0.216	648	3.07
Lhasa	3	0.195	731	3.75
Doilung	4	0.211	551	2.62
Quxu	5	0.179	547	3.41
Nyemo	6	0.122	338	2.78
Lunzhoub	7	0.118	127	1.08

Lunzhub County is not as yet self-sufficient in foodgrain because of the shortage of cropland and low productivity.

Damung County is not suitable for crop production. The supply of foodgrain in the future will also depend on the commercial cereal supply.

Animal husbandry products in Lhasa District mainly consist of meat, milk (including diary products), hides, and wool. Except for hides and wool, the products from animal husbandry are consumed locally. Meat and milk are the traditional components of the local people's diet. In rural areas red meat and dried meat are traditionally preferred, and diary products (e.g., butter for making yak tea) are used daily. The demand for meat and milk products in urban areas is high, but the supply capability is still below the current demand.

Not many data are available regarding the exact quantity of livestock products before 1983, because the local people were accustomed to the traditional manner of trade (material-barter trade) rather than commercial or market trade. In addition, the statistical system, before 1983, paid more attention to numbers of livestock rather than products. The only data available about the livestock products in 1984 were acquired by the author and are given in Table 15. Compared to the average level for Tibet, the per capita productivity level of animal husbandry in Lhasa District is low and it cannot meet the demands of the local people. The import of livestock products, e.g., meat and milk powder, is also a necessity in the area.

Meat and milk (dairy) are important components of the Tibetan diet. An increase in meat and milk production could mitigate the pressure on foodgrains. The livelihood of the people in future will depend partly on the development of animal husbandry.

The former policy, which was devised to encourage the increase of livestock, was inadequate. The most important immediate requirement is to match livestock numbers with carrying capacity through herd reduction and qualitative improvements. The policy objectives should shift from those of expanding animal numbers to increasing the output of animal products per unit of land area.

Animal husbandry production in Lhasa District is far from commercialised. Taking the figures for 1984, the dressing percentage (about 5.7% for cattle/yak and 12.5% for sheep or goats) was still very low. The reasons for the low rate are:

a. limitation of transportation and storage capabilities to accomodate a reasonable scale of slaughter,

b. high ratio of load-carrying livestock (15.7% of big livestock in 1984),

c. insufficient marketing channels to stimulate the output of animal products, and

d. the religious beliefs are against killing animals.

Traditionally, herdsmen used to butcher their animals at the beginning of the winter season. The number of animals to be slaughtered depended upon the herdsmen's judgement of their needs (red meat used during the cold season and dried meat used in the warm season) rather than the necessity to eliminate. Even at present, there is no fundamental move towards efficient collection and storage to facilitate slaughtering animals on a larger scale. The conflict between the short slaughtering period and daily demands is still a problem to be solved.

In addition to use as draught animals, livestock are also used for salt-grain exchange or other trade in the pastoral areas.

Table 15: Animal Husbandry Products (1984)

	Beef (ton)	Mutton or goat (ton)	Other meat (ton)	Milk (1000 ton)	Sheep wool (ton)	Goat wool (ton)	Cattle or yak wool (ton)	Sheep hide (x1000)	Goat hide (x1000)	Cattle or yak hide (x1000)
Production (1984)	3380	1236	168	14.25	292	103.4	176.3	70.5	45.5	35
Per capita of pastoral labourers (kg)	138	50	-	580	11.9	4.2	7.2	2.9	1.8	1.4
Per capita of rural population (kg)	18.8	6.8	0.9	79	1.6	0.6	1.0	0.4	0.24	0.19
Per capita of total population (kg)	-	16.8	49	1.0	0.4	0.6	0.24	0.16	0.12	-
Average level for Tibet (kg)	-	36.1	71	3.8	0.63	0.84	1.03	0.36	0.25	-
Average level* for China (kg) (1980)	-	12.3	1.4	-	-	-	-	-	-	-
Average level* for the United States (kg) (1980)	-	72.6 (red meat)	103.2	-	-	-	-	-	-	-

*   Adapted from "A World Bank Country Study-China", Annex 2, p 74, 1985

One cattle or yak	=	100 kg beef
One sheep or goat	=	10 kg mutton
One pig	=	40 kg p

Yaks, carrying about 50 kg, and sheep, carrying about 10 kg of goods, are driven 20 to 30 km each day. People are dependant on livestock for their livelihood. Whether or not the number of load - carrying animals can be reduced in the near future depends upon the development of the district economy.

The role of marketing was not fully understood in the past. The State purchasing system, with fixed low purchasing prices, did not encourage the sale of livestock products. After 1980, the quota - out quota - negotiation - market price system was introduced. However, as the marketing system was not yet established and marketing channels quite deficient, the herdsmen still wished to keep their animals provided they received satisfactory benefits.

Religious influences were quite strong until recently. Herdsmen were traditionally reluctant to butcher their animals as long as they could keep them. One or more free range animals, with red cloths tied around their heads, are kept in most pastoral households. These free range animals are kept alive (e.g., about 20 years for yaks) until their natural death.

Animal husbandry products are not merely an important source of income for farmers, they also meet a number of their basic needs. As argued earlier, we can conclude that livestock products have the potential for further development. Any substantial development in transforming traditional management into commercialised livestock production to meet the increasing needs of the population

requires efforts in several directions. Improving commercial channels and services could play a stimulating role.

To sum up, owing to the limitation of environmental conditions, the burden of urban population, and inadequate management, the agricultural production in Lhasa District could not meet the basic needs of the population. This situation might continue for a certain period in the future. To ameliorate the situation, improvement of crop production, exploitation of livestock potential, and identification and establishment of prospective export products should be part of the fundamental strategy over the long term.

Changes in Average Landholdings

Land is the fundamental agricultural resource and is used to sustain the growing population. The population size and the land available are closely linked and they determine the level of average landholdings. Under the law, land is the property of the whole nation rather than of any one individual, and collective groups or individuals can acquire the rights to use the land. As shown in Table 16, the average landholding pattern indicates that intensive and increasing pressures on the limited land base are the major elements in agricultural

change. The area of land per capita, in terms of both the rural population and the labour force, is declining. The term "average landholding" is broadly defined as the per capita mean landholding of the rural population or labour in the district or county.

The inconsistent increase in population, labour force, and arable land influenced the average holding of arable land. The rural population, at a growth rate of 1.6 per cent per annum, increased faster than the labour force (0.9% per annum). However, the increase in the labour force is greater than the increase in arable land (0.7% per annum). As a result, the land per capita cultivated by the rural population decreased by 32 per cent, and the land per labourer cultivated decreased by 9.9 per cent from 1958 to 1984. In addition, the ratio of farm labourers to the rural population increased from 1:2.27 to 1:2.71.

In future, decrease in labourers per amount of arable land and increase in the ratio of farm labourers to the rural population will be more or less unavoidable.

District-wise, the ratio of population to arable land (1984) was 10.2 persons per hectare in terms of the total population

Table 16: Average Landholding (1958 - 1984)

(ha/person)

Year	Land Cultivated		Grassland	
	Rural population	Labour[a]	Rural population	Labour[b]
1958	0.201	0.454	22.3	50.3
1960	0.206	0.443	21.1	45.4
1965	0.204	0.453	19.7	43.8
1970	0.193	0.430	17.9	39.8
1975	0.176	0.439	16.5	41.2
1980	0.167	0.431	15.6	40.3
1984	0.152	0.413	14.8	40.1
Growth rate per annum	1.2 %	- 0.4 %	- 1.6 %	- 0.9 %

a   Labour involved in crop production.

b   Labour involved in both crop production and animal husbandry.

to total arable land and 6.4 persons per hectare in terms of the rural population to total arable land. Compared to Tibet and China (Table 17), the situation in the context of arable land available per capita in Lhasa District was worse in terms of total population and better in terms of rural population.

Table 17: Ratio of Population to Arable Land (1984)

(person/ha)

	In terms of total population	In terms of rural population
China*	10.0	8.0
Tibet	9.2	8.0
Lhasa	10.2	6.6

*   The data for China are adapted from "China, Agricultural Yearbook, 1985" pages 93 and 114, Agricultural Publishing House, 1985

The ratio of rural population to arable land differs from county to county. Table 18 indicates the distributional patterns over several time periods. Among the counties involved in crop production, leaving aside Lhunzhub, the ratio of land to population is poor. The land-population ratio in Nyemo was the worst, not only because of the greater burden on land but also because the population has been increasing rapidly. In the counties along the lower reaches

Table 18: Rural Population - Arable Land Ratio (1958-1984)

(person/ha)

County	1958	1970	1984	Increase
Maizho	5.1	4.6	6.5	14
Dagze	3.7	3.7	4.5	0.8
Lhasa	3.5	4.8	4.5	1.0
Doilung	3.0	3.6	4.5	1.5
Quxu	4.0	4.7	5.6	1.6
Nyemo	5.6	6.9	8.2	2.6
Damxung	-	28.5	-	-
Lhunzhub	11.2	7.1	6.6	- 4.6

*   According to local experience one cattle/yak is equivalent to 5 sheep units, one horse/mule/donkey equals 3.6 sheep units, and one goat equals 0.7 sheep units. The calculation for total sheep units does not include swine.

of the Lhasa Valley, there is more arable land per capita, but the situation in Quxu was also not very encouraging.

A declining trend in the ratio of grasslands is also evident. Since the 1950s, the grassland per capita among the rural population has decreased by 50.7 per cent, at a rate of 1.6 per cent per annum, whereas, the labour/grassland ratio decreased by 25.4 per cent, at a rate of 0.9 per cent per annum. People have less and less grassland on which to rear their livestock. As a matter of fact, the population and the number of livestock were increasing but the area of grassland remained unchanged. As a consequence, heavier pressure was exerted on the grasslands.

In terms of sheep units[*], the ownership per capita of sheep among the rural population and the grassland available per sheep unit are shown in Table 19.

In the past, increasing the number of livestock seemed to be the only way to solve the conflict between environment and population. Natural resources were limited to the increase in the number of livestock in the traditional management system, defined as semi-nomadic with low-grain feeding. New techniques to improve the productivity of the grasslands (e.g., through irrigation, planting fodder) could hardly be implemented in the past or even currently. On the other hand, the growing population needed more livestock to maintain their standard of living and for employment as well. The growing numbers of livestock are, from certain aspects, critical in the light of the growing population. As a matter of fact, this results in increased pressure on the environment. The available evidence suggests that most grazing areas are already seriously overgrazed and are in danger of progressive and, perhaps, irreversible degradation (Zhang Rongzu et al. 1982). In addition, the living herds suffered during bad weather (e.g., drought, very cold winters, etc) owing to which the breeding rate became very low and the death rate very high during certain years. Therefore, fluctuation in the numbers of livestock occurred.

As the population continues to grow, the livestock per capita tends to decrease. Figure 10 indicates two distinct periods with regard to increase in the number of livestock and in

Table 19: Comparison of Livestock - Rural Population - Grassland (1958 - 1984)

	Total sheep units (million head)	Sheep units per capita (head/person)	Sheep units per/ha of grassland (ha/sheep unit)
1958	2.20	18.4	1.21
1960	2.41	19.1	1.10
1965	3.08	22.9	0.86
1970	3.18	21.4	0.83
1975	3.33	20.7	0.80
1980	3.41	20.0	0.78
1984	3.66	20.4	0.73
increase %	+ 66.36%	+ 10.87%	- 39.67%

Note:

1) As the average grassland per capita of the rural population declined, the space available for living animals decreased. The herds became more and more crowded and the burden on grazing land became heavier, creating difficulties for long-term sustainability.

2) The livestock per capita of the rural population has changed or reduced little since the mid-1960s, although livestock numbers increased by 66 per cent.

livestock per capita. In the first period (1958-1967), the livestock numbers (in sheep units) increased by 49.6 per cent, at a growth rate of 4.5 per cent per annum. Simultaneously, the rural population increased by 16 per cent, at a rate of 1.7 per cent per annum. This resulted in an increase in the strength of the labour force and an increasing tendency in terms of the livestock per capita. This period can be defined as a period of rapid improvement in animal husbandry, because of the large range of grasslands that were exploited step by step. In the second period (1968-1984), the increase in livestock numbers slowed down. Numbers increased (in sheep units) only by 14 per cent, at a rate of 0.83 per cent per annum. In the meantime, the population grew continuously; it increased by 28 per cent, at a rate of 1.55 per annum.

The second period can be defined as a fluctuating, or as a negatively balanced, period because the livestock per capita decreased notably. As the grassland was already fully used, the increase in the livestock numbers was restricted by the limited natural resources. Future prospects depend upon intensive management of grassland rather than its mere usage.
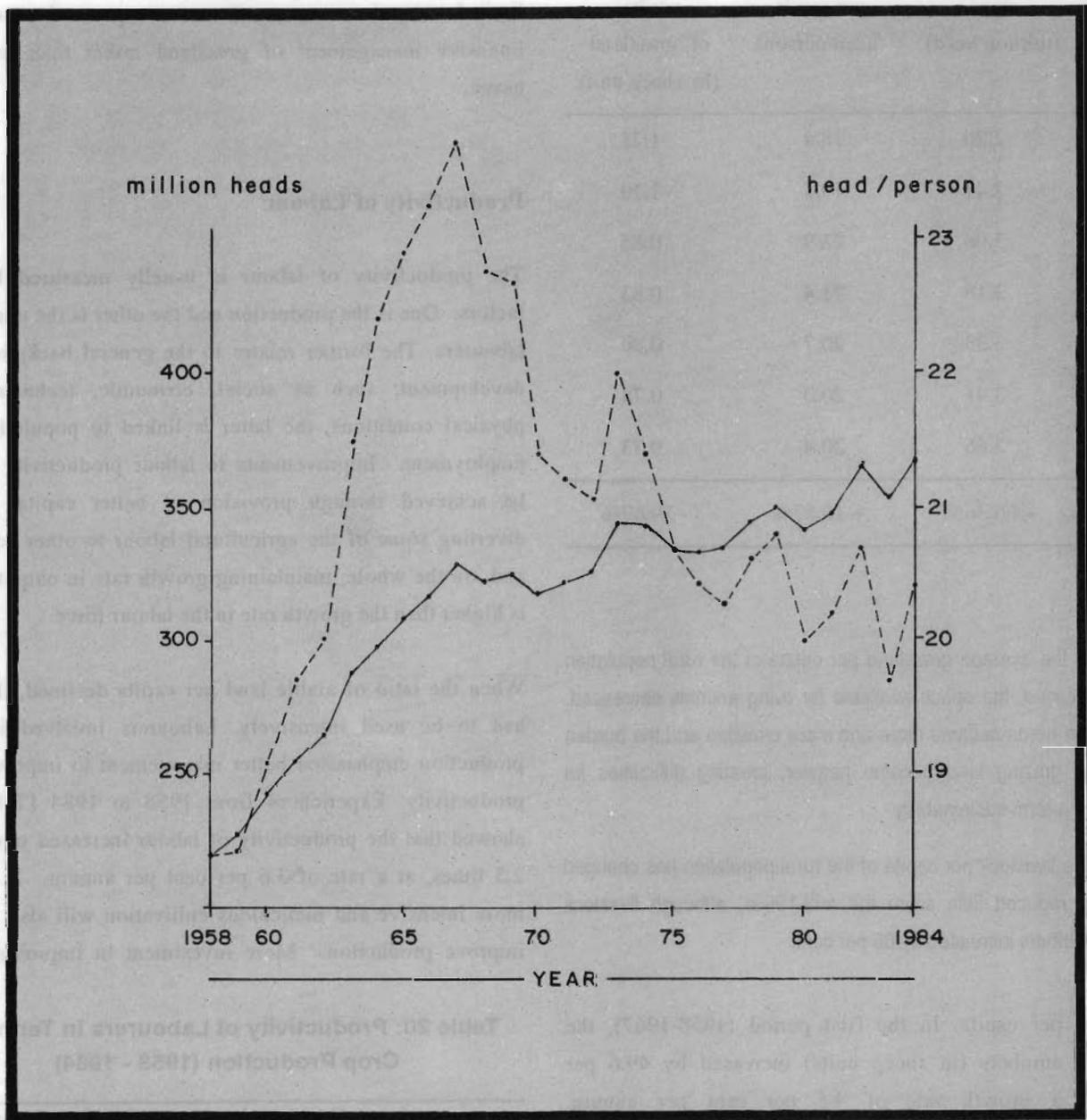
Productivity of Labour

The productivity of labour is usually measured by two factors. One is the production and the other is the number of labourers. The former relates to the general background of development, such as social, economic, technical, and physical conditions, the latter is linked to population and employment. Improvements in labour productivity should be achieved through provision of better capital inputs, diverting some of the agricultural labour to other activities and, on the whole, maintaining growth rate in output which is higher than the growth rate in the labour force.

When the ratio of arable land per capita declined, the land had to be used intensively. Labourers involved in crop production emphasised better management to improve their productivity. Experiences from 1958 to 1984 (Table 20) showed that the productivity of labour increased more than 2.5 times, at a rate of 3.6 per cent per annum. In future, more intensive and meticulous cultivation will also help to improve production. More investment in improving land

Table 20: Productivity of Labourers in Terms of Crop Production (1958 - 1984)

	Productivity kg/labourer/ per annum	Output value yuan/ labourer/per annum at 1980 constant prices
1958	413	183
1960	464	201
1970	595	269
1980	1110	461
1984	1059	458
Growth rate	+ 3.6%	+ 3.6%

Figure 10: Numbers of Livestock and Sheep Units Per Capita for the Rural Population (in Sheep Units)

Number of sheep units ....   Sheep units per capita _____

productivity will also help to improve the productivity of labour.

The increase in the labour force leads to a decline in the average grassland holding per capita. The fact that the labourers have to work on less land with more livestock was experienced from 1958 to 1984. The changing process of productivity, in terms of sheep units and output value per labourer, is shown in Table 21. Positive changes are recognised. The average output per labourer, in terms of rearing animals, increased by 25 per cent and the average productivity per labourer increased by 69 per cent. Should the future strategy for animal husbandry shift from raising the number of livestock to increasing the slaughtering rate (reaching 10 to 15% for cattle/yak, 15-20% for sheep/goats, instead of 5.7% and 12.5% respectively as of 1984), then the average output per labourer would change fundamentally.

Table 21: Productivity of Labourer* in Animal Husbandry (1958 - 1984)

	Sheep units/ labourer	Output value *yuan*/ labourer/per annum, at 1980 constant prices
1958	32.2	202
1960	32.2	206
1970	36.8	234
1980	38.6	297
1984	40.3	341
Increasing rate	+ 0.86%	+ 2.1%

*   The numbers calculated here are the total number of labourers involved in agriculture because labourers involved in crop production are also involved in livestock production.

'Sideline' activities are not direct land-based activities. But the development of 'sideline' activity-based production has become more and more important. At the beginning of the 1970s, the productive value per labourer from 'sideline' activities was about 30 *yuan* (at 1980 constant prices). It increased to about 60 *yuan* in 1980 and reached 175 *yuan* in 1984 (at 1980 constant prices). It is a sign that the workers are diversifying their occupations.

For maintaining/improving the productivity of labour, diversion of the labour force from limited land-based activities could be of significant importance. In doing so, the core issue is to set up a number of activities that can absorb the surplus labour force. Solving this issue is not an easy task but is an important strategy for environmentally- balanced development of the district economy.