ANALYSIS OF MAJOR TYPES OF OFF-FARM EMPLOYMENT

As mentioned in Chapter Three, development of off-farm occupations in Western Sichuan is still in the primary stages. Mining and logging are prominent off-farm activities and diversification, such as agricultural and sideline production, provides potential off-farm activities, specifically in horticultural development and food processing. For mining, logging, horticultural development, and food processing, some further analyses are given below.

Rural Mining Industries

Environmental and Resource Base

The region is one of the most mineral rich districts in China. The minerals include iron, vanadium, titanium, gold, silver, lead, zinc, copper, manganese, and lithium. Also it is a rich source of non-metallic minerals such as mica, asbestos, gypsum, marble, granite, limestone, and peat. These resources provide a substantial base for the development of rural mining industries. Current activities include the mining of gold, lead, zinc ore, copper ore, and iron ore and the quarrying of marble, granite, and other building materials. Rural mining industries have developed rapidly since 1978 and have become a predominant off-farm sector. In Aba and Ganzi prefectures, rural mining constitutes about 85 per cent of the total mining enterprises, and the output of some major products increased rapidly between 1978 and 1987 (see Table 5.1).

Table 5.1: Main Products in Rural Mining Industries in Aba and Ganzi Prefectures, 1978-1987

	1978	1980	1985	1987
Gold (Kg)	8	80	90	216
Lead and Zinc Ore (ton)	300	2,476	607	4,249
Copper Ore (ton)	0	0	0	9,947
Manganese Ore (ton)	0	0	4,800	1,700
Coal (ton)	4,801	7,001	14,686	18,240

Source: Liu Zhougong, Chen Guojie, et al. 1990.

In general, rural mining industries operate on a small scale. Yet mining and quarrying have affected the environment in a number of ways. To a certain extent, this is due to carelessness and the absence of proper techniques and appropriate equipment. Because of the quarrying of marble, granite, and other building stones near roads and streams, for example, plant covers are destroyed severely, often causing flood, debris flow, and landslides. In addition, solid waste, waste water, and dust from rural mining industries (such as lead and zinc mines and copper mines) have polluted the mountain environment and caused some damage to miners' health.

In Aba and Ganzi prefectures, 19 projects have been planned. By the end of this century an investment of 29.5 million *yuan* will produce annually 209.37 kilogrammes of gold; 73,000 tons of copper ore; 50,000 tons of manganese ore; 100 tons of chromite copper ore; 3,000 cubic metres of granite; 3,000 cubic metres of marble; 700 tons of mica flakes; and 2,000 tons of carbide. The total of annual returns is in the range of 7 million *yuan*. At the same time, rural mining industries must be planned and managed well. The local governments should take proper measures for conservation of the environment and resources.

Demographic and Spatial Implications

The region is the most sparsely populated area in Sichuan Province. Most rural mining industries are developed in areas where the mineral resources are rich but where the population density is small. During Spring and Summer, there is a significant conflict in the demand for labour between farm work and mining activities. A majority of the labourers cease mining activities to do farm work. Because of insufficient labour it is difficult to develop rural mining industries on a large scale. Except for gold mining, for which tens of thousands of new settlers came from outside the region, other rural mining activities have not been affected by migration and population redistribution.

In the region, backward communication and transportation systems are the main constraints to development in rural mining industries. Except for Panzhihua City, Xichang City, and a few counties in Liangshan Prefecture lying near the Cheng-Kun railway, all other counties are accessible only by road. In Aba and Ganzi prefectures, the road density per 100 is only 4.7 and about 18 per cent of the towns and villages are located away from the road. In addition, the roads are of poor quality and are often blocked by floods, debris flows, landslides, and bad weather (such as snow, rain, and fog). The major markets for the products are in Chengdu City, Chongqing City, Panzhihua City and other cities. Apart from some counties in Liangshan Prefecture near Panzhihua City, the distance from the market is too far.

The infrastructure for electric power does not fully meet the need of rural mining industries, specifically during the low flow period of mountain streams. In Aba Prefecture, where electric power stations have been developed more rapidly than in other prefectures, the developed power capacity (0.124 million kilowatts) is only 1.7 per cent of the total potential. Power demand is greater than supply in all the counties except Lixian and Wenchuan. This restricts the development of rural mining industries, metallurgical industries, and even the primary processing of mineral products.

Employment Implications and Development Considerations

The rural mining industry, one of the main sources of off-farm employment and income, accounts for one-fourth of the total output value and the total employment within rural industries. In Aba and Ganzi prefectures, the output value of rural mining industries increased from 2.64 million *yuan* to 25.79 million

yuan between 1978 and 1987. Table 5.2 shows the distribution of output value in Aba and Ganzi prefectures between 1978 and 1987. In Aba and Ganzi prefectures, it is projected that the output value of rural mining industries will increase by about 11.6 per cent each year during the period from 1990-2000. In the past 10 years, it increased by more than 25 per cent each year. This is not sustainable. According to the development plan, employment in rural mining industries in Western Sichuan should increase by 5-7 per cent each year during the same period.

Table 5.2: The Output Value of Rural Mining Industries in Aba and Ganzi Prefectures between 1978 and 1987

Unit: Million *Yuan*

Year	1978	1987
Mining and Smelting of Metals	0.31	13.30
Coal Mining	0.30	0.84
Building Materials	2.03	11.65
Total	2.64	25.79

Source: Liu Zhougong, Chen Guojie et al. 1990.

There are some locational considerations regarding the development of rural mining industries. In areas near Panzhihua City and Xichang City, as well as along the valley of the Anninghe River, there is a great demand for such items as building materials, coal, and for the primary processing of mineral products. In other areas of Liangshan Prefecture, products having comparative advantage and development potential include iron ore, lead and zinc ore, copper ore, mineral coal, and building materials (e.g., cement, bricks, and tiles). Secondly, in Aba and Ganzi prefectures, important consideration should be given to the primary processing of mineral products in the southeastern area and mining of metallic and non-metallic minerals in the Middle and the Northwestern parts. The main products having a comparative advantage and development potential include gold, copper ore, lead and zinc ore, lithium ore, and building stones (e.g., marble and granite). Some reasonable plans for Aba and Ganzi prefectures are described below.

(1) Gold Mining. The main potential regions include Baiyu, Litang, Seda, Daofu, Ganzi, Kangding, and Songpan counties where the annual yield of gold can increase by about 6.7 per cent each year and to about 500 kilogrammes in 2000.

(2) Other Metallic Minerals. The important development items include copper mining in Jiulong County; lithium mining in Jinchuan, Maerkang, and Kangding counties; and manganese mining in Heishui County. The annual total output value of these metal minerals could increase by about 11.6 per cent each year and to about 75 million *yuan* in 2000.

(3) Quarrying of Building Stones. The important areas include granite quarrying in Luding County and marble quarrying in Danbar, Xiaojin, and Lixian counties. The annual total output value of these building stones could increase by about 19.6 per cent each year and to 30 million *yuan* in 2000.

Rural Logging Industries

Environmental and Resource Base

The forest area in the region is one of the three largest in China. It is the largest base for timber production in Sichuan Province. The forest resources are mainly concentrated in the alpine regions of Aba and Ganzi prefectures with a small portion in Liangshan Prefecture. There are 7.88 million hectares of land under forest and, in 2.85 million hectares of this, logging operations can be carried out to produce 795.67 million cubic metres of timber. More details are shown in Table 5.3.

Table 5.3: The Forest Resources in the Alpine Regions of Western Sichuan

	Logging Area (million hectares)	Total volume of Timber (million cubic metres)
Young Forest	0.16	4.63
Mature Forest	0.36	41.90
Overmature Forest	2.33	749.14
Total	2.85	795.67

Source: Liu Qingquan, Gao Yutian et al. 1985.

The alpine forests in Western Sichuan are not only rich in tree species but also important for preserving water and soil. The main vegetation here is the dark coniferous type consisting of such species as *Abies*, *Picea*, *Tsuga*, *Pseudotsuga*, and *Keteleeria*. There are 11 species of *Picea*, 10 of *Abies*, 3 of *Tsuga*, 2 of *Keteleeria*, and 1 of *Pseudotsuga*. In this region, most of the forests are located in the upper valleys of the Mingjiang River, the Yalongjing River, and the Jinshajiang River. Because of steep mountains, deep valleys, and rapid water flows in this region, the forest plays an important role in preventing soil erosion. The forests are situated in the transitional zone of the southeastern moist area and the northwestern arid region and are even more significant for ecological protection. These alpine forests are also the key to maintaining the water balance in Sichuan Province and in the middle and lower valleys of the Yangtze River further downstream.

How to properly utilise the alpine forests in Western Sichuan is a matter of vital concern. The natural regeneration of the forests has to be balanced against the extraction of trees. Between 1980-1987, the output of timber in rural logging industries was up by 2.1 times. The annual forest felling now is about 40 per cent higher than the annual growth rates. As a result, the forest resources and the ecosystem are being damaged. In Aba and Ganzi prefectures, forest cover was reduced from 25 per cent in 1949 to 11.32 per cent in 1987. The endangered species of animals and plants amount to 10-20 per cent of the total species. At the current rate, forest resources in the region might be exhausted by the end of this century. The rapid decrease of the forest resources is evidenced by a number of indicators such as (a) decrease in the water conservation function, (b) rapid expansion of meadows and shrubs, (c) change of microclimates, and (d) increase of natural hazards. The area affected by loss of water and soil erosion is over 60 per cent of the total in Aba Prefecture and 63 per cent of the total in Liangshan Prefecture. Natural hazards, such as debris flow and landslides, have spread to over 36 counties and 2 cities. Therefore, the logging industries must be well planned and properly managed. The Water Conservation Regulations on the Upper Valleys of the Yangtze River (carried out by the Government) must be implemented strictly. The felling area must be limited to below 40 per cent of the total forest area. The annual yield of timber production must be reduced by half to two thirds and forestry, logging, and wood processing should be integrated.

Wood processing has great potential. In the region, only about 30-40 per cent of the forest resources are used and only 0.5 per cent of the wastes in logging are utilised. A variety of new products from wood processing can be developed. For example, processing one cubic metre of log into small-sized lumber can give a value added of 100-140 *yuan*. In addition, tree branches and other wastes caused by forest felling (which constitute about 15-20 per cent of the volume of the log), and excelsiors from wood processing (which amount to 30 per cent of the volume of the log) can be used to produce glued wood board, laminated fibre board, wood pulp and paper, ethanol, wood alcohol, wood tar, glucose, and glutamate. Development of these new products can not only generate additional income but also reduce the demand for timber.

Demographic and Spatial Implications and Linkages with the Farming System

Rural logging is usually a seasonal off-farm activity. During busy farming seasons, there is a conflict in demand for labour between farm work and forest felling. The remote alpine regions contain overmature forests that have not been logged because of labour shortages. Backward communication and transportation networks are other constraints. In Aba and Ganzi prefectures, the export of timber takes up most of the road transportation facilities. In Liangshan Prefecture, floating logs are also transported by rivers.

Improper development of rural logging activities has caused some negative effects on forestry, farming, and livestock. In the early 1980s, rural logging activities were not managed well in many counties. The returns from investment were low; cutting and felling exceeded the planting rate, thereby causing a problem of sustainability; the cutting area was not extended to other districts and instead immature forests were cut. The ecosystemic balance was destroyed and this had adverse effects on agriculture and livestock. Now, the land with a slope of over 25 degrees is no longer used for cultivation and replanting has been initiated in such areas. In Liangshan, Aba, and Ganzi prefectures, between 1978-1985, the area annually increased 2 times, from 527 thousand *mu* to 1,077 thousand *mu*.

Employment Implications and Development Considerations

At present, the rural logging industry is still one of the main sources of off-farm employment and income. It contributes about one sixth of the total output value and total employment in rural industries. In Aba and Ganzi prefectures, between 1980-1987, the output value of rural logging industries (including wood processing) increased from about 3 million *yuan* to 19.07 million *yuan*, and the output of timber increased from 77,508 cubic metres to 165,997 cubic metres. But this is not sustainable. In order to conserve forest resources and the ecosystem, as mentioned earlier, the annnual timber production must be reduced by a half to two-thirds. In Aba and Ganzi prefectures, it is proposed that the total annual output from rural logging and wood-processing industries be increased by only about 9.6 per cent (which is about a half of the current rate of 19.3%). Two comprehensive wood-processing factories are being established in Maerkang and Rangtang counties. This would need 2.3 million *yuan* of investment to produce per annum 8,000 cubic metres of processed timber and obtain per annum 3 million *yuan* of output value and 0.6 million *yuan* of profit. Such processing activities should be further encouraged.

Horticultural Development

Environmental and Resource Base

Western Sichuan has distinct bioclimatic variations. Conditions change from subtropical at low elevations to tundra with permanent snow at higher elevations. There are generally 1,500-2,000 hours of sunshine per year and the heat distribution decreases from the low river valleys to the high mountains. The daily range of temperature is great and the annual range small, and this creates better conditions for photosynthesis. The small annual range promotes the stability of stenothermic species. In general, most of the land is cultivable and natural conditions are favourable.

Abundance and diversity of these natural resources provide a good basis for development of horticulture, including fruits, flowers, and vegetables. For example, *Michelia alba,* mangoes, grapes, *Tamarindus indica*, and mulberry for breeding silkworms cultivated in the subtropical valleys of the Jinshajiang River and the Anninghe River. Oranges, peaches, cherries, and bamboo (*Sinocalamus affinis*) are cultivated in Luding of the Daduhe River Valley. Apples, walnuts, and wild peppers (*Zanthoxylum simulans*) are cultivated in the middle or upper reaches of the Daduhe River and the Mingjiang River. The apples produced in Maoxian, Wenchuan, and Yuexi counties and the pears produced in Jinchuan County have won State and Provincial prizes. The mulberry plant flourishes throughout the river valleys of the subtropical zone, sustaining fresh leaf growth throughout the winter. As many as four or five generations of silkworm are bred every year, twice as many as in the Yangtze River Basin. The quality of silk is also very fine because of the excellent natural resources and conditions.

Linkages with Traditional Agriculture and Market(s)

For a long time, the self-sufficient subsistence economy was the traditional pattern in the region. The cultivation of cereal crops was the main agricultural activity and horticultural development was at a low level, meant only for self-consumption. Since 1978, transition from a self-sufficient subsistence economy to one based on commodity production and marketing has become apparent. Traditional agriculture and land use patterns have undergone change. First, barren hills and wastelands have been used for growing apples, pears, vegetables, wild pepper, mulberry, *Michelia alba*, and other flowers. In addition, even cultivated areas, except for the ones kept for maintaining a specified level of cereal production are being

increasingly used for horticultural purposes and cash crop production. For example, in Aba Prefecture about 100 thousand *mu* of cultivated mountain slopes have been switched to horticultural production during the eight year period from 1980 to 1988. The growth in horticultural production between 1970 and 1985 production is given in detail in Table 5.4. The corresponding decrease in cereal crops, especially after 1980, is apparent from Table 5.5.

Table 5.4: Horticultural Area in Liangshan, Aba, and Ganzi Prefectures, 1970-1985

Unit: '000 ha

Year	Total	Mulberry	Tea	Fruits	Apples	Pears
1970	2.73	0.20	0.88	1.65	0.95	0.35
1975	5.99	0.05	1.07	4.87	3.38	0.77
1980	9.75	0.67	1.29	7.78	6.41	1.03
1985	12.45	1.84	1.84	8.77	6.80	1.23

Note: The area does not include those where only a few trees were planted.
Source: Statistics of the Rural Economy of Sichuan, 1987.

Table 5.5: Area Under Various Crops in Liangshan, Aba, and Ganzi Prefectures, 1970-1985

Unit: '000 ha

Year	Total	Cereal Crops	Cash Crops	Other Crops
1970	589.9	552.1	17.8	20.0
1975	627.7	575.9	22.7	29.1
1980	618.9	568.6	19.7	30.7
1985	597.1	522.5	30.5	44.1

Source: Statistics of the Rural Economy of Sichuan, 1987.

Although the production of cereals is still a predominant activity in agriculture, the prominence gained by horticulture and other crops (including cash crops) is evident from the change in the ratios from 1970 to 1985 as indicated in Table 5.6.

Table 5.6: Ratios between the Areas under All Crops, Horticulture, Cereals and Other Crops, 1970-1985

Year	All Crops : Horticulture	Cereal Crops : Other Crops
1970	216.4 : 1	14.6 : 1
1975	104.9 : 1	11.1 : 1
1980	63.5 : 1	11.3 : 1
1985	48.0 : 1	7.0 : 1

Source: Statistics of the Rural Economy of Sichuan, 1987.

Similarly, in Liangshan Prefecture, between 1978-1988, the sugarcane area increased from 50,000 *mu* to 83,000 *mu*, the tobacco area increased from 22,300 *mu* to 99,200 *mu*, and the area under fruits and other trees increased by 7.51 million *mu*. Moreover, although the area under cereal crops decreased, the actual output of cereal crops increased by 3 per cent per year and met the basic demands of the Prefecture. The change in output of various crops between 1978 and 1988 in Liangshan Prefecture is illustrated in Table 5.7.

Table 5.7: The Output of Cereal Crops and Principal Cash Crops in Liangshan Prefecture, 1978 and 1988

	Output in 1978 (tons)	Output in 1988 (tons)	Change 1978-1988 (%)	Average Annual Change (%)
All Cereal Crops	990.900	1,288,600	30	2.7
Roasted Tobacco	2,560	9,110	256	13.5
Sugarcane	144,100	377,800	162	10.1
Fresh Fruits	10,820	57,860	435	18.3
Dry Fruits	1,350	3,900	189	11.2
Cocoons	69	1,297	1,780	34.1

Source: Statistics of the Rural Economy of Sichuan, 1987.

Another case in point is the production of apples in Liangshan Prefecture. There was hardly any apple production on a large scale before 1980. Now there are large amounts of apples sold in Chengdu, Chongqing, and other cities. Table 5.8 shows the production of apples since 1970 in selected of Liangshan Prefecture.

Table 5.8: The Production of Apples in Selected Counties of Liangshan Prefecture, 1970-1985

Unit : tons

Year	Butuo	Puge	Xide	Yuexi	Yanyuan
1970	0.1	0.4	0.0	0.6	15.0
1975	177.5	5.2	8.4	212.5	174.9
1980	9.5	28.8	152.5	477.9	560.3
1983	475.8	154.9	273.2	1,323.0	1,805.3
1985	423.6	298.2	788.2	2,215.8	2,252.9

Source: Statistics of the Rural Economy of Sichuan, 1987.

Similarly, sericulture has comparative advantages in some counties of Liangshan Prefecture (see Table 5.9). In Ningnan County, the production of cocoons reached 800 tons in 1989, and a silk filature mill, with an output of 70 tons per year and 600 employees, has been built.

Table 5.9: The Yield of Cocoons in Selected Counties of Liangshan Prefecture, 1970-1985

Unit: tons

Year	Xichang	Huidong	Mianning	Ningnan
1970	0.3	1.3	24.6	0.3
1975	3.5	3.0	34.8	4.7
1980	10.6	10.5	43.6	76.2
1983	40.5	65.8	94.6	240.6
1085	79.5	119.3	94.4	405.9

Source: Statistics of Rural Economy of Sichuan, 1987.

Wild pepper is a famous native product in Western Sichuan. For a long time, it was collected in a traditional fashion. After 1980, wild pepper bushes were planted widely in the three prefectures of Liangshan, Aba, and Ganzi. Table 5.10 shows the increase in production of wild pepper in these three prefectures.

Table 5.10: The Production of Wild Pepper in Liangshan, Aba, and Ganzi Prefectures, 1965-1985

Unit: tons

Year	Liangshan	Aba	Ganzi
1965	156.2	101.4	63.6
1970	48.8	172.1	91.6
1975	68.2	151.9	83.7
1980	271.6	125.9	99.1
1985	844.5	271.0	208.4

Source: Statistics of the Rural Economy of Sichuan, 1987.

The market is very important for the development of horticulture. Most horticultural products in West Sichuan are of good quality and are very competitive in the market. For example, large amounts of apples, pears, and peppers sell well in the provincial market because of their good quality. Apples produced in Yanyuan and Yeuxi counties are sold even in Hongkong and Macao. Some early-maturing and special vegetables find markets in Chengdu and even Northern China. At present, except for the marketing of cocoons, which is still controlled by State-owned commercial departments, all horticultural products can be marketed through different channels (including State-owned, collectively-owned, and individually-run business organisations). The fluctuation in market prices is, however, severe and quite frequent. The dissemination of market information is slow and information is difficult to come by. Incomes from horticulture are heavily affected by this process.

In addition, the major markets are too far away. Easily perishable goods such as apples, pears, bananas, grapes, and other fresh fruits and fresh vegetables are difficult and expensive to transport. In order to ease these shortcomings, the backward and forward linkages of horticulture, such as production and processing, packing, transportation, and marketing, must be developed in a more integrated fashion.

Employment Implications and Development Considerations

Although complete information on the employment implications of horticultural development in Western Sichuan is lacking, some cases show that horticulture has become an important source of off-farm employment and income within agriculture. In Maoxian County, in 1989, three horticulture-based enterprises generated 800 thousand *yuan* in outputs and employed 420 labourers, accounting for 72 per cent and 65 per cent respectively of the total due to agriculture-based enterprises. In Western Sichuan, there are about 600 households specialising in horticulture in 1988. Throughout the river valleys in the southern part of this region, almost every farming family grows bananas. The average annual income per family is 200-300 *yuan*, but in some families it is as much as 1,000 yuan. In Ningnan County, every family plants three trees or more of *Michelia alba*. After three years of growth, the trees yield more than 10 thousand flowers a year and bring in an income of over 200 *yuan*. After five years of growth, each tree yields 20 thousand flowers a year and brings an income of 400 *yuan*. In Luding and Maoxian counties, each family earns over 400 *yuan* on an average and some as much as 700-800 *yuan*, from wild pepper. Apples are now the most significant source of income for many peasants. In 1989, in Jinzhou Village of Maoxian County, two families which represented the higher and lower income groups in the village earned respectively 4,800 *yuan* and 2,500 *yuan* from apples accounting for 59.1 per cent and 48.2 per cent of the total income of the families. In the valleys of Ningnan and Miyi counties, the breeding of silkworms and the planting of *Michelia alba* and mango in the home garden fetch per family as much as 600-1,000 *yuan* annually. This is about 25-40 per cent of the total earnings from agriculture. Indeed horticulture is profitable and suitable for almost all families, especially for the poor or marginalised groups and women.

Horticulture has developed well and become very popular in Liangshan Prefecture and Panzhihua City. In Aba and Ganzi prefectures, production of apples, pears, wild peppers, and vegetables has even greater potential. Some important development targets for 1990-2000 are described in Table 5.11. It shows that apple production is expected to increase substantially (annual average increase of about 29 per cent and 44 per cent in Aba and Ganzi respectively). The corresponding increase in area coverage is, however, significantly lower, indicating that the yields per ha and per tree are to be increased by a significant amount by introducing improved techniques. The table also indicates a large increase in the production of pears and pepper but at a relatively smaller rate than apples.

Vegetable production is also being promoted. In 5 counties of Aba Prefecture (Wenchuan, Lixian, Maoxian, Jinchuan, and Maerkang), the area under vegetables in 1988 amounted to 1,490 ha (62% of the vegetable land in the Prefecture). By 1995, this will have increased to 2,330 ha yielding 12,150 tons and by 2000 to 3,330 ha and 18,100 tons.

In the marginalised or poor regions, the local governments are also offering support to develop and popularise horticulture by making funds available and by introducing new technological skills. For example, in the piedmont area of the Erlang Mountain in Tianguan County, the local government has taken the following successful measures to develop vegetable fern.

(1) A professional body of 100 members was formed by the County's "Native Product Company" to be responsible for the production of vegetable fern.

(2) A production plan, which assigned duties to every team member, was decided upon by the villagers before the plants were gathered.

Table 5.11: Horticultural Development Targets for the Year 2000

	Area to be covered			No. of trees to be planted			Expected Annual		
	'000 ha	Increase over 1990 level (%)	Average annual increase (%)	Million	Increase over 1990 level (%)	Average annual increase (%)	'000 tons	Increase over 1990 level (%)	Average annual increase (%)
Apples									
Aba[1]	13.3	25	2.3	10	49	4.1	125	1,150	28.8
Ganzi[2]	6.7	247	13.2	4.9	215	12.2	132	3,660	43.7
Pears									
Aba[3]	2.0	20	1.9	0.8	30	2.7	20	100	7.2
Ganzi[4]	NA	NA	NA	NA	NA	NA	20.5	430	18.2
Pepper									
Aba[5]	17.3	57	4.6	21	30	2.7	1.6	360	16.5
Ganzi[6]	1.3	230	12.7	NA	NA	NA	0.6	700	23.1

Notes:

(1) Areas with potential include 9 counties: Maoxian, Wenchuan, Lixian, Xiaojin, Jinchuan, Maerkang, Lanping, Songpan, and Heishui.
(2) Areas with potential include 4 counties: Batang, Xiangcheng, Danba, and Daofu.
(3) Areas with potential include Jinchuan and Xiaojin counties.
(4) Danba County is the potential area.
(5) Potential areas include 6 counties: Wenchuan, Lixian, Maoxian, Heishui, Jinchuan, and Xiaojin.
(6) Potential areas include Jiulong County, the lower valleys of the Jiulong River, and the Luding Area of Daduhe River.

(3) Information about the project was disseminated to every household.

(4) A training course in the techniques of gathering and processing, including demonstrations in the field, was organised. As a result of these measures, the "Native Product Company" was able to buy 30 tons of vegetable fern within a very short time. To give another example, the local government in Mianning County encouraged silkworm breeding by paying compensation for cocoon yields of less than 25 kilogrammes per sheet and engaging a technical advisor to instruct the *Yi* ethnic group in silkworm breeding. Lianhe Village of Mianning County had over 10,000 wild mulberry bushes that were not used to breed silkworms. The leaves were instead gathered to feed the pigs. After the government measures, there were 60 households that bred more than 40 sheets of silkworms. On an average the earning per household increased to 200 *yuan*. The other measures taken by the government of Mianning County were:

(a) planting more mulberry bushes on barren and waste land under the guidance of the Agricultural Bureau to let every family have more than two sheets of silkworms; and

(b) building a silk filature mill to derive maximum economic benefits and increase off-farm employment.

The above examples indicate that strong support from the local government is very important in horticultural development and in the establishment of backward and forward linkages.

Rural Food-processing Industries

Environmental and Resource Base

In Western Sichuan, food processing industries are very prominent. They are mainly concentrated in processing of livestock products, grains and other cereal crops, sugarcane and other cash crops, fruits, edible mushrooms, and vegetables. Among them, the processing of livestock products is the most important. Also the processing of edible mushrooms has a comparative advantage.

The region is one of the five largest livestock-raising areas in China. There are 14.5 million ha of available grassland, or somewhat more than 73.8 per cent of the provincial total. Ganzi and Aba prefectures are especially important livestock areas. About 60 per cent of the counties in these two prefectures are primarily engaged in the livestock sector. In 1985, in Ganzi and Aba prefectures, there were 3.93 million head of cattle and 2.98 million head of sheep which accounted for 41 per cent and 30 per cent of the provincial total respectively. The annual yield of beef and mutton was 19,200 tons, about 30 per cent of the provincial total; and the annual yield of cow's milk was 153,750 tons, about 71 per cent of the provincial total. At present, the approach to livestock raising is backward and unsatisfactory Overgrazed pasture land constitutes over 30 per cent of the total area. Similarly, degraded pastures amount to 20-30 per cent of the total area. Table 5.12 gives detailed information about the state of livestock overcrowding in Western Sichuan. Given the overcrowding situation, one alternative is to promote the processing of livestock products currently being carried out on a relatively small scale. This way, labourers engaged in livestock raising may be transferred to processing industries and the number of livestock may be reduced.

In the region, there is a rich variety of wild and domesticated mushrooms. Some well-known and rare species include glossy ganoderma (*Ganoderma lucidum*), black mushrooms (*Tremella fuciformis*), golden mushrooms (*Tremella mesenterica*), fragrant mushroom (*Lentinus edodes*), pine mushroom (*Tricholoma matsutake*), and morel (*Morchella esculenta*). Among them, species such as *Auricularia auricula, Tremella fuciformis*, and *lentinus edodes* can be cultivated. Farmers have already had a lot of experience in cultivating *Ganoderma lucidum*. Wild mushrooms, such as *Lentinus edodes* and *Tricholoma matsutake*, are an important resource throughout the three prefectures. In 1988, *Tricholoma matsutake* brought in a revenue of 80 million *yuan* in Ganzi Prefecture, and this averaged out at 100 *yuan* per capita. Because of the abundance of oak (*Quercus spp.*) and Yunnan pine forest, (*Pinus yunanensis*) which are symbiotic with *Tricholoma matsutake*, the earnings per capita in Xiangcheng, Daocheng, Yajiang, and

Table 5.12: The Livestock Resources in Western Sichuan

	Ganzi	Aba	Liangshan
Usable Grassland (million ha)	8.32	3.86	1.99
Usable Fresh Grass Yield			
Total (million tons)	28.3	14.5	7.2
Yield (tons/ha)	3.40	3.76	3.62
Livestock Load (million of cattle)			
Theoretical Capability	2.98	1.53	0.76
Actual Number (in 1985)	3.00	1.87	1.62
Extent of Overcrowding (thousands of cattle)	21	344	857

Source: Zhou Shourong et al. 1989.

Jiulong counties were as high as 10,000 to 20,000 *yuan*. The processing of these mushrooms is also profitable and must be promoted because fresh mushrooms are more difficult to transport, store, and sell at a higher price.

In addition, a variety of good quality fruits, such as apples and pears, can be processed. Although, at present, fruit production has not fully met the market demand for fresh fruits, it is necessary to initiate gradually some rural industries for fruit processing in conjunction with the promotion of fruit production as mentioned in the previous section.

In Liangshan Prefecture, sugarcane, tobacco, and other fruits besides apples and pears (such as mangoes, bananas, grapes, peaches, plums, strawberries, and cherries) are cultivated. It would be advisable to develop industries for their processing.

Constraints in the Development of Rural Food-processing Industries

Although rural food processing industries developed rapidly in the last decade in Western Sichuan, some constraints, such as their economies of scale, market risk, and levels of technology, should be specifically considered. Some small food-processing industries were developed without considering the economy of scale. Consequently, their productivities and economic benefits were usually lower. They cannot compete against the large State-owned industries. On the other hand, some were developed on too large a scale and they could not operate at full capacity because agricultural production in the area was not sufficient to meet the requirements. For example, in Liangshan Prefecture, although the annual production of sugarcane increased by about 3.6 times between 1978 and 1988, it was still not enough to run the local sugar refineries at full capacity. In addition, the seasonality in fruit production is also a big constraint in the development of food-processing industries. Secondly, the necessary capital and advanced techniques for rural food-processing are lacking, and the abundant resources alone have not generated a dynamic economy. In Aba and Ganzi prefectures, because of the shortage of capital, some planned factories, such as the one for fruit processing in Maoxian County, livestock products in Ruoergai and Hongyuan counties, and starch and alcohol in Heishui County, had to be delayed. Due to the lack of advanced techniques, new products could not be developed and poor quality products could not be improved upon. In Ganzi Prefecture, for example, mushrooms other than *Tricholoma matsutake*, which abound in the area, could not be processed and stored because a suitable technology was not available. In another case, the Wenchuan Tinned Fruit Factory had to be closed down recently because of the poor quality of products and inappropriate technology.

Also, intense competition and fluctuations of the food market, especially in drinks and fruit products, make these industries very risky. The dissemination of market information in the region, as mentioned earlier, is slow and information is difficult to get. This makes food-processing industries in Western Sichuan quite challenging.

Development Considerations

During the last decade, rural food industries developed more rapidly than other industries. In 1989, they contributed about four-fifths of the total output value and the total employment in rural agro-based industries and about one-fifth in rural industries. In Aba and Ganzi prefectures, between 1978-1987, the output value of rural food processing industries increased from 50 thousand *yuan* to 13.73 million *yuan*, and the share of the total output value of rural agro-based industries increased from 62.5 per cent to 80.5 per cent (see Table 5.13).

In Aba and Ganzi prefectures, the output value of rural food-processing industries increased by 86.6 per cent each year between 1978-1987. During 1990-2000, this rate of growth could not be sustained. It is expected that the rate will be about 16.6 per cent each year during this period. Some important development features between 1990-2000 in Aba and Ganzi prefectures are described below.

(1) Livestock Products. Important development items include the processing of beef and mutton and the processing of cow's milk. Within the planned period, two new meat-packing plants will be built in Ruoergai and Hongyuan counties. By 2000, the annual yield of meat-products will increase 8.1 times in comparison with 1985 and will reach 10 thousand tons.

Table 5.13: The Output Value of Prominent Agro-based Industries in Aba and Ganzi Prefectures

Unit: million yuan

Sub-sectors	1978	1987
Food processing	0.05	13.73
Textile and Leather	0.03	1.66
Paper Products		0.001.66
Total	0.08	17.05

Source: Liu, Zhougong, Chen Guojie et al. 1990.

(2) Starches. In these two prefectures, white potatoes, maize, and a variety of beans of high quality have been cultivated on a large scale. They can provide a substantial basis for the development of starch-and vermicelli-processing. Important items include white, potato-based starch-processing in Heishui County, broad bean-based starch- processing in Xiaojin County, and starch-processing in Kangding County. The annual yield of starches will reach 1,500 tons. Meanwhile, the production of alcohol and animal feed will also be developed.

(3) Mushroom and Fruit Processing. The region is rich in *Tricholoma matsutake* and other edible mushrooms. *Tricholoma matsutake* is widely distributed in over 60 counties (Kangding, Yajiang, Daocheng, Xiangcheng, Derong, Batang, Jiulong, Xiaojin, and others). The annual production of salted *Tricholoma matsutake* was more than 1,100 tons in 1988 in Ganzi Prefecture and the total output value was 100 million *yuan*. Within the planned period, a factory producting new salted *Tricholoma matsutake* in Kangding County, and fully-equipped fruit-processing factories, in Xiaojin, Jinchuan and Wenchuan counties, will be built.