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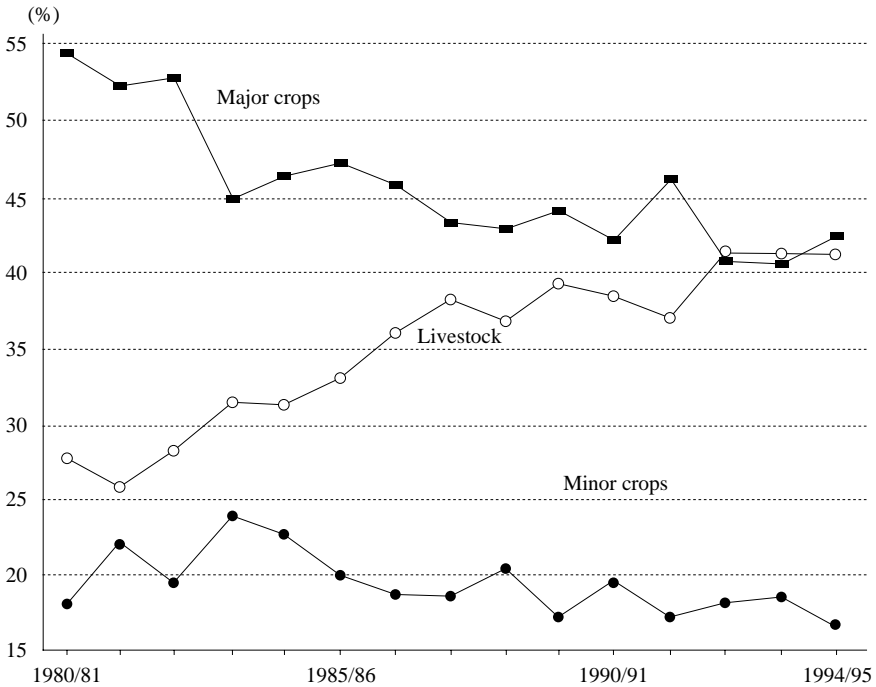
Study Area and Sample Households

This chapter gives description of the study area and sample households to which the empirical investigations in this study were applied. In the first section, recent developments in Pakistan's agriculture are briefly reviewed. It is shown that the study area witnessed a shift toward livestock production in agriculture during the 1980s. The second section gives a profile of villages and sample households that provide microeconomic data for this study. The procedure of data collection and the characteristics of sample households are discussed there.

I. Recent Developments in Pakistan's Agriculture

Agriculture is the most important sector of Pakistan's economy. It accounts for about one-fourth of the gross domestic product, earns about 60 per cent of export revenues in primary and processed forms, and provides employment for half of the country's rapidly increasing labor force (GOP [Pakistan, Government of], Economic Adviser's Wing 1996). Due to its highly developed irrigation network, the province of Punjab accounts for the largest share of most agricultural products in the country. In the early 1990s, the province produced more than 70 per cent of the country's wheat, 80 per cent of cotton, 50 per cent of sugarcane, and 40 per cent of rice, and raised more than 70 per cent of the country's buffaloes and 50 per cent of the cattle (GOP, Ministry of Food, Agriculture and Livestock 1994).

Fig. 2-1. Composition of Agricultural Value-Added, Pakistan



Source: Calculated from GOP, Economic Adviser's Wing (1996).

Note: The percentages are based on value-added data in current factor costs.

The annual growth rate of agricultural production averaged more than 4 per cent over the past twenty-five years, although the rate has decreased recently (Byerlee and Siddiq 1994). Major contribution to this substantial growth stemmed from the rapid expansion of irrigation facilities, introduction of high-yielding varieties (HYVs) and subsidized inputs, and public sector investment on rural infrastructures. The spread of HYVs was remarkable in wheat due to the country's well-developed irrigation system.

A recent phenomenon that deserves attention is the change in agricultural composition. In terms of national value-added from agriculture in current factor costs, the share of major crops declined from close to 55 per cent in the early 1980s to around 40 per cent in the early 1990s (Figure 2-1). The share of minor crops declined to less than 20 per cent during the same period. The livestock share increased from less than 30 per cent to more than 40 per cent. A recent estimate of gross and net farm income shows a similar pattern, both for Pakistan and for the Punjab province alone (Abbasi et al. 1993).

Fig. 2-2. Relative Prices of Milk and Cereals, Pakistan



Source: Calculated from GOP, Economic Adviser's Wing (1996).

Note: "Milk (W)" is an index of wholesale price of milk relative to wholesale price index (WPI). "Wheat & basmati (W)" is the average of indices of wholesale prices of wheat and basmati rice relative to WPI. "Wheat & basmati (S)" is the average of indices of government support prices of wheat and basmati rice relative to WPI.

The change in the value-added composition in favor of the livestock sector can be explained, at least partially, by relative prices. Cereal prices, whether wholesale prices or the government support prices,¹ did not rise as fast as milk prices during the period (Figure 2-2). Salam (1992) examined terms of trade between the agricultural and the manufacturing sectors. He reached a similar conclusion that both barter terms of trade and income terms of trade worsened for the crop subsector while those for the livestock subsector improved. This kind of change in relative prices is a phenomenon that reflects a rising demand for livestock products. Income elasticities of demand for these products are higher than those for other food commodities in Pakistan (Deaton and Grimand 1992; Azim and Shafiq-ur-Rehman 1992).

Livestock animals are an indispensable component in farm management in Pakistan. A traditional farm in the Indus basin has a pair of bullocks for draft

TABLE 2-1
BOVINE LIVESTOCK POPULATION IN PAKISTAN, 1976 AND 1986

	1976		1986		1986-76 Growth Rate ^a (%)
	Nos. (1,000)	Composi- tion (%)	Nos. (1,000)	Composi- tion (%)	
Cattle					
Male: for work	5,811	39.1	4,992	28.5	-1.52
Male: youngstock	2,239	15.1	2,864	16.3	2.46
Female: in-milk	2,436	16.4	4,075	23.2	5.15
Female: dry	1,828	12.3	2,165	12.3	1.69
Female: youngstock	1,942	13.1	2,504	14.3	2.54
Total	14,855	100.0	17,541	100.0	1.66
Buffaloes					
Male: for work	164	1.5	88	0.6	-6.22
Male: youngstock	1,575	14.8	2,371	15.1	4.09
Female: in-milk	3,582	33.8	5,725	36.5	4.69
Female: dry	1,710	16.1	2,338	14.9	3.13
Female: youngstock	2,799	26.4	4,157	26.5	3.96
Total	10,611	100.0	15,705	100.0	3.92

Sources: Calculated from data in GOP, Agricultural Census Organization (1989) and GOP, Ministry of Food, Agriculture and Co-operatives (1983).

^a The growth rate is a compound annual growth rate, defined as $\ln(Y_{1986}/Y_{1976})/10$.

power and several buffaloes for milk production. Despite the increased use of tractor power, livestock have remained important because milch animals such as cows and she-buffaloes have been substituted for draft animals. As shown in Table 2-1, the national population of bullocks for work declined from 5.8 million in 1976 to 5.0 million in 1986, at an average annual growth rate of -1.5 per cent. On the other hand, the number of cows and she-buffaloes in milk increased during the same period at 5.1 per cent and 4.7 per cent per annum, respectively.

Agricultural year in Pakistan comprises two cropping seasons: *kharif* (monsoon season) with harvest from October to December and *rabi* (non-monsoon season) whose crops are harvested from March to May. Major *kharif* crops consist of paddy, maize, cotton, and sugarcane; major *rabi* crops consist of wheat, rape and mustard, and pulses. In addition to these crops, fodder crops account for a large proportion of cropped land both in *kharif* and *rabi*. Most farmers in the Indus basin keep livestock animals and allocate a significant proportion of the cultivated land to fodder crops.

Nevertheless, very few empirical studies have investigated the micro-economic mechanism of supply side in this context. The scarcity in rigorous

research applies also to the Indian side of the Punjab region across the border. The Indian side experienced similar changes of increased importance of the livestock subsector in agriculture, mostly through increased numbers of cows and she-buffaloes (Mishra and Sharma 1990; Vaidyanathan 1988) and most of the dairy activities are carried out in the farm backyard (Grover and Mehta 1996). Studies using aggregate statistics are numerous, but rigorous microeconomic studies are scarce.²

II. Description of Sample Households

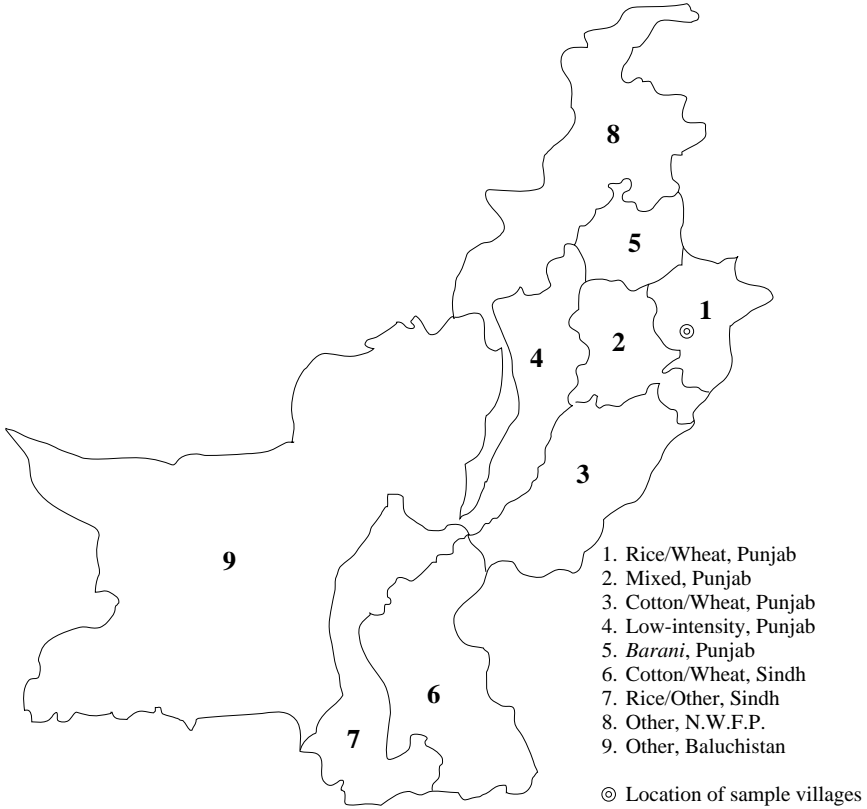
1. Village Selection and Data Collection

In selecting villages for microeconomic analysis of risk and household behavior under the above context, our first criterion was to control production technology and social structure as much as possible. On the other hand, observation of variation in production and household assets, market participation, and production and consumption patterns was needed to carry out a quantitative analysis. With these considerations in mind, five villages in the Sheikhpura district were selected, for which the Punjab Economic Research Institute (PERI), Lahore, conducted farm account surveys³ (Map 2-1). The district belongs to the rice-wheat zone in the Punjab province, where rice crops, especially the basmati variety of rice famous for its aroma, are the most important during *kharif* due to soil characteristics. The zone accounts for the largest share of rice production and a significant proportion of wheat in the province.⁴

Microeconomic data used in this study were collected by the PERI using enumerators, based on a repeated interviewing method for three agricultural years and six cropping seasons from 1988/89 to 1990/91.⁵ To supplement the data set with qualitative information, the author also surveyed the sample villages in 1992 and 1993. The original surveys conducted by the PERI covered all major agricultural zones in Punjab shown in Map 2-1, for which Haque and Saleem (1990), Cheema and Saleem (1993), and Saleem and Cheema (1993) give the aggregated results for the province each year with details of the overall sampling procedure. It is the author's great regret that this study cannot extend microeconomic analysis to other agricultural zones. The extension is left for future research.

The selection of these villages satisfied our criterion to some extent. Regarding the production technology, the selected villages were found to be ideal for the purpose of this study, which is to investigate the interrelation between crops and livestock, for two reasons. First, dairy livestock activities are an important source of household income. Dairy production carried out in the

Map 2-1. Map of Pakistan and the Site of the Study Area



Source: Adapted from Pinckney (1989a).

backyard of farms is a typical pattern in the Punjab agriculture, though its importance may be higher than in other agricultural zones of the Punjab. Second, as will be shown in Chapter 3, cropping patterns are relatively simple—the major competition for land involves fodder crops and cereal crops (wheat and basmati paddy). Therefore, the analysis will allow to focus on the issue of food-fodder land competition in the relationship with livestock.

At the same time, the choice of this zone has a limitation in a sense that large tradeoff among competing food and fiber crops, typical in the mixed-zone agriculture in Central Punjab (Gotsch et al. 1975) cannot be analyzed explicitly. Nevertheless, the author hopes that the net outcome will be significantly positive since the interrelation between crops and livestock has seldom been analyzed in the framework of agricultural household models under uncertainty (Chapter 1).

Another production factor that was controlled is irrigation. The tradeoff of food-grain and fodder crops would be more important in irrigated agriculture than in rain-fed one because of the higher crop intensity and smaller land area available for common grazing in the former. In all the selected villages irrigation was fully implemented. Map 2-2 depicts the location of the sample villages. Irrigation water comes from the Upper Gugera branch canal that receives water from the Lower Chenab main canal.⁶ Two major distributory canals irrigate the sample villages. Soils are characterized as moderately coarse to medium coarse and their quality is normal to slightly saline.

Before the construction of the Lower Chenab canal, most of the area was not irrigated. However, the soil was fertile and yielded good fodder crops when the amount of rainfall was sufficient (Punjab Government n.d.). The Lower Chenab canal was completed in 1892. It created a new irrigation opportunity and transformed the agricultural system in the area into a very intensive one (Punjab Government 1895). Hirashima (1978) estimated the benefit-cost ratio of the canal for the period from 1926/27 to 1976/77 at 3.60 and its internal rate of return at 52.9 per cent (p.27, Table 2). The two estimates are the highest among those for the ten canal-irrigation works completed in the colonial period.

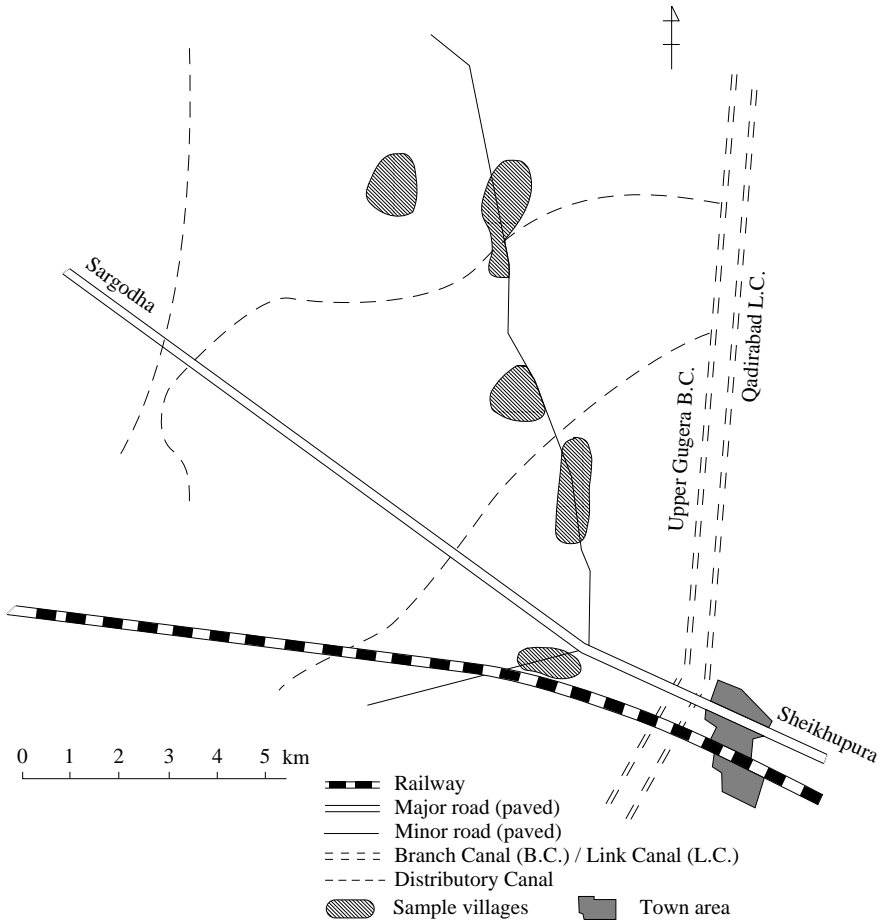
Regarding the social structure, the selected villages were found to be quite homogeneous in population, caste structure, and tenancy system.⁷ Each village was comprised of 200 to 300 households, of which about half operated agricultural land. The land-operating class was dominated by the Jat and Rajput castes. In all the villages, the majority of farm households were owner operators, followed by owner-cum-tenants. See the next subsection for details of the caste structure and the tenancy system.

Finally, as will be shown in the next subsection and following chapters, the sample set was characterized by a large variation in assets and economic choices. In addition, the distance from each village to a town market village differed substantially. As Map 2-2 shows, the five villages were scattered around the main road connecting two cities, Sheikhpura and Sargodha, and close to a town with a population of approximately fifteen thousand. The closest village was on the main road and only several kilometers from the town. To reach the most distant village, it took about a fifteen-kilometer drive on a paved (*pucca*), minor road, followed by an unpleasant journey of several kilometers on an unpaved (*kaccha*) road.

2. Sample Households

The data set used in this study includes nineteen-seven household observations for each year, among which fifty-nine households were surveyed con-

Map 2-2. Location of Sample Villages



Source: Prepared by the author.

tinuously with consistent information for all the three years (Table 2-2). Most of them operated an agricultural land area of less than 12.5 acres, a small size in the context of Pakistan’s agriculture.

Depending on the purposes, the set of all samples pooled together or a subset of samples from households that were surveyed continuously was used. Potentially, the use of the subset of fifty-nine continuously surveyed households might bring in a selection bias since the subset was drawn based on the criterion of being surveyed continuously, which may be correlated with the variables of interest. However, since the direction of the bias cannot be in-

TABLE 2-2
DISTRIBUTION OF SAMPLE HOUSEHOLDS

	1988 /89	1989 /90	1990 /91	All	(Nos.) Continuously Surveyed
By sample village					
Village 1	19	18	19	56	12
Village 2	22	22	20	64	13
Village 3	20	20	20	60	11
Village 4	15	15	17	47	9
Village 5	21	22	21	64	14
By farm size					
Small-A (farm area up to 6.25 acres)	37	37	37	111	24
Small-B (above 6.25 to 12.5 acres)	36	36	36	108	24
Medium (above 12.5 to 25.0 acres)	16	16	16	48	7
Large (above 25.0 acres)	8	8	8	24	4
All	97	97	97	291	59

Source: The author's calculation. The original information was collected by the Punjab Economic Research Institute. See the text for more details.

Note: In some of the continuously surveyed households, the size of operational land changed during the three-year period. The distribution given in the table refers to the average acreage if the household changed its operational size.

ferred a priori, this study proceeds as if the bias is negligible if sample distribution of the variables of interest from the continuously surveyed samples is not statistically different from that from the residual samples.

In the following tables in this chapter, statistics for the continuously surveyed samples are given first. This information is relevant for analyzing intertemporal changes. Then, similar statistics for all the observations are given, with *t*-statistics that test the null hypothesis that the two distinct groups of continuously and noncontinuously surveyed samples have the same mean under the assumption of normal distribution for the population. As shown below, most of the *t*-statistics are relatively small so that the null hypothesis is not rejected, justifying the arbitrary use of all the samples or the continuously surveyed samples.⁸

In Table 2-3, demographic information is summarized. The average family size was around 8.5 persons. Adult males accounted for 3.1 persons, adult females 2.9 persons, and the rest consisted of children up to ten years old. In terms of adult-male equivalent units (1.0 for adult male, 0.9 for adult female, and 0.52 for children up to ten years old),⁹ the average size of 8.5 persons is equivalent to about 7.0 units.

TABLE 2-3
NUMBER OF HOUSEHOLD MEMBERS OF SAMPLE HOUSEHOLDS

	1988/89		1989/90		1990/91	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Continuously surveyed households only (NOB=59)						
Male, adults	3.102	1.826	3.085	1.695	3.085	1.715
Female, adults	2.898	1.386	2.898	1.386	2.932	1.363
Male, children	1.254	1.321	1.203	1.387	1.186	1.266
Female, children	1.186	1.293	1.068	1.172	1.017	1.182
Total	8.441	3.640	8.254	3.412	8.220	3.312
All households (NOB=97)						
Male, adults	3.186	1.638	3.165	1.589	3.165	1.621
Female, adults	2.866	1.366	2.948	1.480	2.948	1.431
Male, children	1.371	1.356	1.381	1.562	1.309	1.438
Female, children	1.227	1.286	1.216	1.426	1.196	1.218
Total	8.649	3.466	8.711	4.169	8.619	3.693
Absolute value of <i>t</i> -statistics ^a						
Male, adults	0.625		0.616		0.604	
Female, adults	0.289		0.414		0.139	
Male, children	1.052		1.392		1.043	
Female, children	0.383		1.273		1.793*	
Total	0.735		1.339		1.317	

Source: Same as Table 2-2.

Note: NOB stands for the number of observations.

^a "Absolute value of *t*-statistics" shows *t*-statistics for the null hypothesis that the means of continuously and non-continuously surveyed samples are identical.

* The null is rejected at 10% (two-sided tests).

Table 2-4 gives information on operated/owned land. The average size of operated land was 10.2 acres for the continuously surveyed households, and 11.0 acres for all the households. However, the difference was not statistically significant. These numbers are comparable to the average sizes of operated holding in the district reported in Agricultural Census 1990 (GOP, Agricultural Census Organization 1994).

Tenancy arrangements are becoming less important in the province in general and in the rice-wheat zone in particular (GOP, Agricultural Census Organization 1994). Traditionally, the dominant form of tenancy was sharecropping with a 50–50 output sharing rule. However, lease contracts with fixed cash rent have become popular in the Punjab, especially among large farms that rent in additional land. In the sample households of this study, both forms were commonly observed (Table 2-4). For example, in 1988/89, the continuously surveyed households rented in 0.8 acres of land on a lease contract, on

TABLE 2-4
ACREAGE OF AGRICULTURAL LAND OPERATED/OWNED BY SAMPLE HOUSEHOLD

	(Acres)					
	1988/89		1989/90		1990/91	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Continuously surveyed households only (NOB=59)						
Total operated land	10.203	8.155	10.110	7.744	10.233	8.288
Total owned land	8.691	7.641	8.653	7.680	8.597	7.665
Land rented-in, lease	0.797	3.448	0.742	3.338	0.432	1.979
Land rented-in, sharecropping	1.004	2.254	0.809	2.027	1.271	3.001
Land rented-out, lease	0.169	1.302	0.034	0.260	0.034	0.260
Land rented-out, sharecropping	0.119	0.536	0.059	0.295	0.034	0.183

All households (NOB=97)						
Total operated land	10.951	8.522	11.348	9.444	11.198	9.363
Total owned land	9.036	7.650	9.384	9.496	9.036	8.724
Land rented-in, lease	1.046	3.792	1.126	3.734	0.763	2.888
Land rented-in, sharecropping	1.312	3.001	1.260	3.106	1.554	3.329
Land rented-out, lease	0.188	1.183	0.129	0.862	0.082	0.637
Land rented-out, sharecropping	0.255	1.370	0.294	1.842	0.072	0.523

Absolute value of <i>t</i> -statistics ^a						
Total operated land	1.071		1.600		1.259	
Total owned land	0.551		0.940		0.614	
Land rented-in	0.804		1.258		1.398	
Land rented-in, sharecropping	1.252		1.773*		1.037	
Land rented-out	0.193		1.345		0.931	
Land rented-out, sharecropping	1.216		1.554		0.893	

Source : Same as Table 2-2.

Notes : (Total operated land) = (Total owned land) + (Land rented-in, lease)
+ (Land rented-in, sharecropping) - (Land rented-out, lease)
- (Land rented-out, sharecropping).

^a See Table 2-3.

* See Table 2-3.

average. The average acreage of land that was rented in on a sharecropping base was 1.0 acres. Thus, rented-in land occupied about 18 per cent of operated land. Households rented out 0.2 acres of land on a lease contact and 0.1 acres on a sharecropping contract. The rented-out acreage accounted for about 3 per cent of the land owned by these households. The relative importance of land under tenancy was similar for the other subset of sample households.

Table 2-5 sheds light on tenancy from a different angle. The number of households who participated in land-tenancy arrangements shows that tenancy transactions were more important than indicated by the area-based statistics in Table 2-4. About 10 to 15 per cent of sample households rented in land on lease and about 20 per cent rented in land on a sharecropping contract. Some households rented in land on both contracts. Pure owner-cultivator households, who neither rented-in nor rented-out any land, accounted for about 60 per cent of sample households.

The educational status of household heads is shown in Table 2-6 in terms of the number of years of completed formal education. On average, sample household heads went to school for only two to three years. The mean and variance might conceal the true picture. More than 60 per cent of sample household heads obtained no education at all. Among those with any years of completed education, the average was about seven years. This implies that most household heads, if they had an opportunity to go to school, finished primary level (normally five years in Pakistan). These household-based figures are consistent with the macro figures of Pakistan's poor achievement in human resource development, especially in education. Nowadays, these households send their children to schools as long as they can afford. School enrollment by female children is still low in the study villages. Since the effect of education on farm management efficiency has been emphasized on the literature on human capital (Schultz 1961; Lockheed, Jamison, and Lau 1980; Jamison and Lau 1982), this variable will be included as an explanatory variable that determines crop yields (Chapter 3) and households' willingness to bear risk (Chapter 6).

The caste composition of sample households is given in Table 2-7. Since the survey aimed at agricultural households and did not cover all villagers, sample households were dominated by "agricultural castes" defined by the colonial administrators in the 1881 Census of India.¹⁰ The majority of households belonged to subcastes of Jat, known as the most diligent farmers in the Punjab, such as Wirk, Chabbal, etc., or subcastes of Rajput.

Numerically, Jat households were followed by those classified as "minor land-owning and agricultural (MLOA) castes" in the 1881 Census, such as Arain, Awaan, and Gujjar. These castes used to be specialized in agriculture-related activities in a traditional village. For instance, the Arains were known for their vegetable-growing activities and the Gujjars were famous for their dairy activities. They supplemented their crop income from their small land area by selling these agricultural products. In the study villages, this tradition still prevails today, although the specialization has weakened significantly. Most Jat households are currently eager to grow vegetables for markets once they are convinced that the crops are profitable. Milk production and milk

TABLE 2-5
NUMBER OF HOUSEHOLDS PARTICIPATING IN LAND TENANCY MARKETS

	1988/89		1989/90		1990/91	
	Nos.	%	Nos.	%	Nos.	%
Continuously surveyed households only (NOB=59)						
Households who owned land	59	(100.0)	59	(100.0)	59	(100.0)
Households who rented-in land on lease	8	(13.6)	9	(15.3)	5	(8.5)
Households who rented-in land on sharecropping	11	(18.6)	10	(16.9)	14	(23.7)
Household who rented-out land on lease	1	(1.7)	1	(1.7)	1	(1.7)
Households who rented-out land on sharecropping.	4	(6.8)	3	(5.1)	2	(3.4)
Households who rented-in no land	42	(71.2)	41	(69.5)	41	(69.5)
Households who did not participate	38	(64.4)	38	(64.4)	38	(64.4)

All Households (NOB=97)						
Households who owned land	95	(97.9)	92	(94.8)	94	(96.9)
Households who rented-in land on lease	14	(14.4)	18	(18.6)	11	(11.3)
Households who rented-in land on sharecropping	20	(20.6)	21	(21.6)	27	(27.8)
Households who rented-out land on lease	3	(3.1)	3	(3.1)	2	(2.1)
Households who rented-out land on sharecropping	7	(7.2)	5	(5.2)	3	(3.1)
Households who rented-in no land	65	(67.0)	61	(62.9)	62	(63.9)
Households who did not participate	57	(58.8)	54	(55.7)	57	(58.8)

Source: Same as Table 2-2.

Note: Percentage in the parenthesis refers to the total number of households who operated any land in corresponding years.

sales are important for all agricultural households regardless of their castes. Nevertheless, the milk sector is relatively more important for Gujjar households, and milk marketing in the villages is mostly carried out by the Gujjars.

3. Household Income Sources

Table 2-8 shows statistics for household income by major sources: crop income, livestock income, and off-farm income. The first two represent agricultural enterprises and their sum is the farm income.

Crop income is defined as gross crop income minus gross crop cost. Gross

TABLE 2-6
YEARS OF COMPLETED EDUCATION OF HOUSEHOLD HEADS, 1990/91

	Mean	Standard Deviation	Minimum	Maximum
Continuously surveyed households only (NOB=59)				
All households in this category (NOB = 59)	2.288	3.596	0	10
Households with any years of completed education (NOB = 19)	7.105	2.355	3	10

All households (NOB=97)				
All households in this category (NOB=97)	2.588	3.603	0	10
Households with any years of completed education (NOB=38)	6.605	2.555	1	10

Absolute value of <i>t</i> -statistics ^a				
All households in this category	1.015			
Households with any years of completed education	1.190			

Source: Same as Table 2-2.

^a See Table 2-3.

TABLE 2-7
CASTE COMPOSITION OF SAMPLE HOUSEHOLDS

Caste Group	Subcastes	Continuously Surveyed Households	All Households		
			1988/89	1989/90	1990/91
Jat	Wirk	15	22	23	24
	Chabbal	10	16	16	16
	Other Jat	3	6	6	7

Rajput	Rajput	0	1	2	1
	Bhatti	12	21	20	18

Pathan	Pathan	2	3	5	3
	Khan	0	1	0	1

MLOA ^a	Dogar	6	9	8	8
	Arain	4	9	8	10
	Gujjar	3	3	3	3
	Awaan	2	2	2	2
	Chanbaa	1	1	1	1

Others		1	3	3	3

Total		59	97	97	97

Source: Same as Table 2-2.

^a "Minor land-owning and agricultural" castes according to the 1881 Census of India. See the explanations in the text.

TABLE 2-8
HOUSEHOLD INCOME BY SOURCES

	(Nominal Rs.)					
	1988/89		1989/90		1990/91	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Continuously surveyed households only (NOB=59)						
Livestock income	8,907	7,094	8,793	6,414	16,978	10,751
Crop income	30,499	28,888	25,957	21,458	24,978	20,493
Farm income	39,406	27,954	34,750	23,240	41,957	24,903
Off-farm income	6,290	3,281	6,265	3,706	8,122	3,514
Total household income	45,696	27,347	41,015	21,172	50,079	23,034
All households (NOB=97)						
Livestock income	9,801	7,501	9,014	7,310	17,118	11,565
Crop income	33,027	30,004	28,292	23,420	27,601	21,655
Farm income	42,828	29,716	37,306	26,619	44,719	26,309
Off-farm income	6,361	3,131	5,847	3,919	7,856	3,406
Total household income	49,189	29,243	43,153	24,540	52,575	25,053
Absolute value of <i>t</i> -statistics ^a						
Livestock income	1.455		0.369		0.148	
Crop income	1.028		1.217		1.478	
Farm income	1.406		1.172		1.282	
Off-farm income	0.277		1.303		0.954	
Total household income	1.458		1.064		1.216	

Source: Same as Table 2-2.

Note: Pakistan rupee in nominal value: US\$1.00 = Rs.19,215, 21,445, 2,423 in each respective year.

^a See Table 2-3.

crop income is the sum of revenues from crop harvests, their by-products, and fodder outputs. Gross crop cost includes fertilizer and pesticide costs, maintenance costs of draft animals, maintenance costs (in case of an owner) or paid expenditure (in case of a nonowner) on tractor and tubewell services,¹¹ all the wages paid to hired labor, and land revenues including canal water charges paid to the government. Economic meaning of the crop income is, therefore, the sum of profits from crop management, imputed wage for family labor, and imputed rent for owned land and owned agricultural machinery.

Livestock income is the sum of milk income and livestock-sales income. Milk income is the gross value of milk products minus total costs that include the paid or imputed costs of green fodder, dry fodder, and concentrates fed to milch animals, and other maintenance costs. Livestock-sale income represents the value of animals sold during the year minus maintenance costs.

These definitions of farm accounting reflect the observations in the study area. First, since no bullock rental was observed in the sample households and this study was focused on the income fluctuations expressed in market prices, the maintenance costs of draft animals were subtracted from crop income instead of adding their imputed contribution to livestock income. Second, since market transactions of fodder were observed in the area and a number of sample households purchased the deficit or sold the surplus of fodder (Chapter 4), all revenues from dry fodder and green fodder were evaluated at the market price and included in the crop income. Then the values of fodder fed to the animals were treated as costs in the livestock sector, regardless of whether the fodder was harvested from the farmers' own field or purchased from the market.

Finally, off-farm income was defined to include agricultural wage income received on other farms, nonagricultural wage and salary, explicit rent income, and received remittances. However, the information was less reliable than that from farm enterprises.

On average, crop income was the most important among the three major sources of household income, accounting for about two-thirds. The livestock share in farm income was about 30 per cent on average. However, it was higher last year due to the increased livestock-sale income and the increased size of milch livestock herd, when the harvests of both wheat and basmati crops were poor.

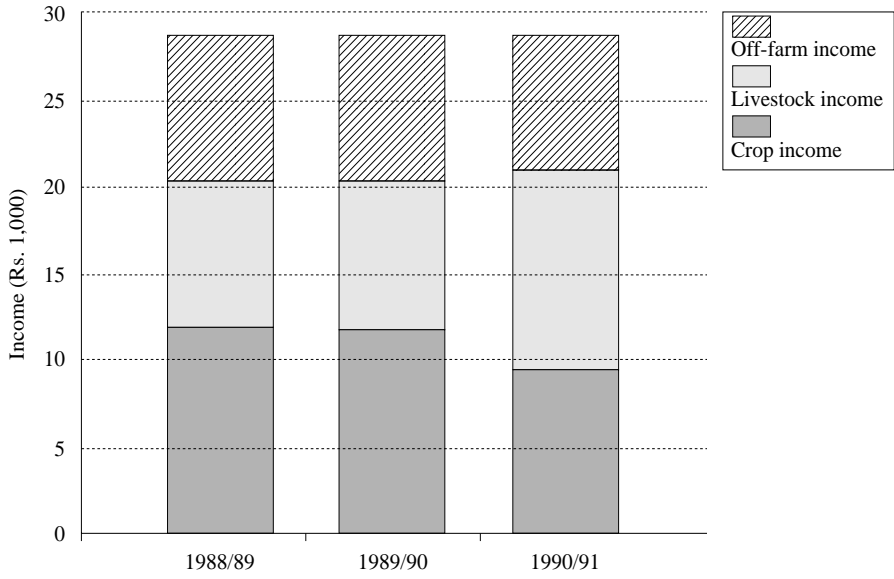
The composition of the three income sources varied among households. Figure 2-3 depicts three-year fluctuations for the four groups classified by the operated farm size (continuously surveyed households only). Numbers in the figure are converted into real 1988/89 rupees using consumer price index for the rural area. Smaller farms depend more on livestock income and off-farm income; larger farms' income depends mostly on crop production. An important implication of this finding is that large households' income fluctuates a great deal with the fluctuation of crop income. On the other hand, smaller households' major income sources, i.e., livestock and off-farm income, might be less correlated with the fluctuation of crop income.

III. Risk and Household Production Decisions: A Working Hypothesis

This study is based on microeconomic household data collected over a period of three years from the rice-wheat zone in Pakistan's Punjab. Sample households combined crops and livestock activities on their farms to earn farm income, which was supplemented by off-farm income. A casual look at income movement over the three-year survey period showed that livestock and

Fig. 2-3. Income Sources by Size of Operational Land

A. Marginal farms (up to 6.25 acres)



B. Small farms (6.25–12.5 acres)

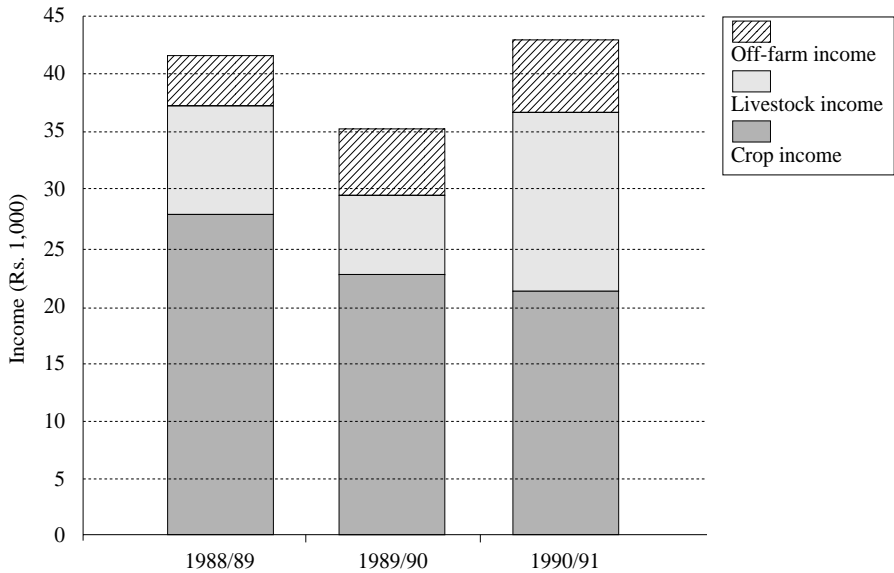
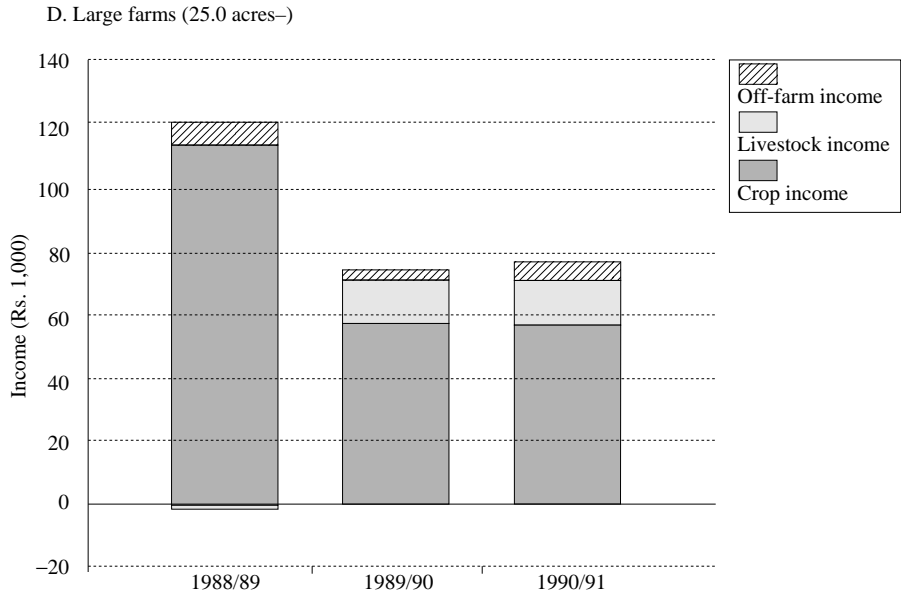
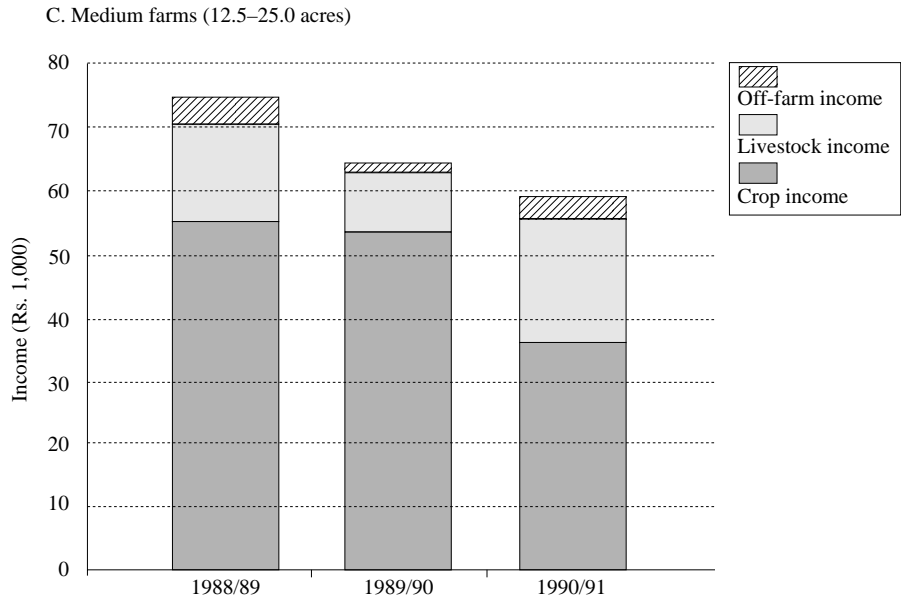


Fig. 2-3. (continued)



Source: Same as Table 2-2.

Note: Units are expressed in 1988/89 real Rs. Livestock income of large farms in 1988/89 was negative. Only observations from the continuously surveyed households are used.

off-farm income was relatively more important as an income source for farms with a smaller land area. It should be noted that the survey period was characterized by a macroeconomic shift toward livestock production in Pakistan's agriculture.

Based on these observations, a working hypothesis of this study was derived—sample households in Pakistan, especially poor households with a small land-asset base, attempt to stabilize their consumption by combining crop and livestock sectors. A corollary of this hypothesis is that households' preference characteristics with respect to risk and individual consumption items should affect production choices in crops and livestock. In the following chapters, this hypothesis will be investigated empirically from different angles.

Notes

- 1 See the first section of Chapter 4 for agricultural price policies in Pakistan.
- 2 See papers reported in a symposium on livestock economy at the Annual Meeting of Indian Agricultural Economics Association, 1995, published in *Indian Journal of Agricultural Economics* 50, no. 3 (1995), especially, Mishra (1995).
- 3 Thanks are due to Dr. Muhammad Jameel Khan, Director, the PERI for access to the data and the villages. Without his help, this study would have been impossible.
- 4 See Byerlee and Husain (1992) and references therein for the details of the farming systems and recent agricultural developments in the rice-wheat zone.
- 5 An agricultural year corresponds to the period from July to June and includes two cropping seasons, *kharif* and *rabi*, in this order.
- 6 The canal system in the Punjab consists of (i) main canal, (ii) branch canal, (iii) major distributory, (iv) minor distributory, (v) watercourse, and (vi) field channel. The management of the first four is under the jurisdiction of the provincial irrigation department.
- 7 Unfortunately, it is not possible to relate those social parameters of the villages to the provincial or national figures, since the original PERI survey did not collect population information on the social structure of each village in the field. The PERI survey would be more useful if this information were also collected in a systematic way.
- 8 Similar tests were conducted for higher moments also. Since their conclusions were similar, the results were omitted to save space.
- 9 This normalization will be used in Chapter 7 to investigate per capita household income.
- 10 This census is considered to be the most useful official document for nationwide information on castes in the Indian Subcontinent. The particular edition referred

to is that of Ibbetson ([1916] 1994) that reprinted the chapter on “The Races, Castes and Tribes of the People” in the report of *The Census of the Panjab 1881*, originally published in 1883.

11 See Chapter 3 for market transactions of tractor and tubewell water services.