CHAPTER 2

North Arcot and the Green Revolution

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The North Arcot Economy

NORTH ARCOT DISTRICT, which embraces the study region, lies in the northwest of Tamil Nadu state. It is a relatively densely populated region; in 1981 the population density was 357 persons per square kilometer of land. It is also a relatively poor region within India. For example, in 1980/81 the district's net domestic product (NDP) at factor cost was Rs 3,285 million, or Rs 750 (US$95) per capita. This compared with a national average in 1983 of US$260 per capita (World Bank 1986).

Agriculture is the predominant activity in the region, accounting for 40 percent of NDP (Table 2.1). Within the agricultural sector, paddy, groundnuts, and sugarcane are the predominant sources of income. These crops also support a downstream agroprocessing industry that is an important part of the manufacturing sector. In 1981 there were 1,825 paddy hullers, 542 groundnut decorticators, 850 oil mills, and three major sugar factories in the district. Milk production is also important, and a sizable herd of milk and draft animals helps support about 300 tanneries in the district, as well as numerous butchers and dairy-processing and retail shops.

Manufacturing accounts for 20 percent of the region's NDP (Table 2.1). Apart from agroprocessing and tanneries, the main manufacturing activities are silk and cotton textiles, an array of cottage industries, and chemical and metal manufacturing.

According to the 1981 census, the agricultural sector employed 1.16 million full-time workers, or 68 percent of the region's work force. Of these, 606,000 were cultivators and 552,000 were agricultural laborers. A further 111,000 workers were employed in household industry, and 437,000 were employed in other activities. The largest formal employer is the government. In 1981, the combined employment of central, state,

TABLE 2.1
Structure of Regional Production, North Arcot District, 1980/81

Sector	*Net Domestic Product (million Rs)*	*Percent of Total NDP*
Agriculture & allied activities	1,329.8	40.5
Manufacturing	649.2	19.8
Trade, hotels, & restaurants	406.4	12.4
Construction	188.7	5.7
Transport & storage (other than railways)	151.0	4.6
Real estate	86.2	2.6
Banking & insurance	69.5	2.1
Public administration	64.7	2.0
Electricity, gas, & water	41.1	1.3
Communications	36.5	1.1
Railways	25.2	0.8
Mining & quarrying	19.1	0.6
All other sectors	217.5	6.6
Total	3,284.9	100.0

Source: Assistant director of statistics, Vellore.

and district government, quasi-government organizations, municipalities, and block development offices was 73,000 jobs, or 5 percent of the region's full-time work force.

There are about 23 urban centers in the district with populations of 8,000 or more, and 13 of these are *taluk* headquarters. Vellore is the district capital and has a population of about 250,000. Of a total population of 4.4 million people in North Arcot district, only 1.0 million, or 23 percent, live in urban areas. The urban population increased at an average rate of 2.6 percent per year between 1971 and 1981, compared with a 1.3 percent growth rate for the rural population.

The district is blessed with a relatively good infrastructure. A dense network of roads extending over 8,800 kilometers connects all 2,049 rural villages in the district. A railway line also passes through the district and connects all the important towns. There are about 1,037 post offices and 126 telegraph offices. Almost all the villages have electricity.

Every village with a population of 300 or more has a primary school, and a high school is generally available within a radius of five miles. There are 536 hospitals, 18 blood banks, and about 300 child welfare centers. There is also a wide network of banking facilities, with 281 commercial bank branches servicing the district.

Agriculture

Paddy and groundnuts are the major crops, and these are grown primarily in the eastern part of the district. They each account for about one-third of the total cultivated area in the district. The western part of North Arcot is more diversified and produces sugarcane, bananas, horticultural crops, and coconut. Cattle provide the main source of draft power for crop production and also by-products such as milk, calves, and manure.

The district enjoys two monsoons: the southwest monsoon from June to September and the northeast monsoon from October to December. The northeast monsoon is the most important and provides about 60 percent of the total annual rainfall of 972 millimeters. In harmony with these rainfall patterns, paddy has traditionally been grown in three well-defined seasons, namely *samba*, *navarai*, and *sornavari*. The *samba* crop is the main rainy-season crop. It is sown in July or August and harvested in December or January. The *navarai* crop coincides with the dry season and depends entirely on irrigation. It stretches from December or January to May. The *sornavari* crop extends from May or June to September and encompasses the light, southwest monsoon.

Millets and sorghum are grown as rainfed crops from June–July to October–November, and as irrigated crops from February–March to June–July. The main cropping season for pulses (red gram, black gram, and green gram) is from June–July to December–January. For groundnuts, the rainfed season is from June–July to September–October, and the irrigated crop is grown between December–January and March–April. Sugarcane and bananas are planted in January and harvested in December.

Of a total gross area of about 690,000 hectares planted to crops in the district each year, 400,000 hectares (58 percent) are irrigated. The net irrigated area is about 250,000 hectares. Water is supplied by canals (7 percent of the net irrigated area), tanks (33 percent), and wells (60 percent). Unlike tubewells, the wells in North Arcot are large, open wells sunk in the regolith to tap groundwater supplies in the crystalline rock beneath. There are about 290,000 irrigation wells in the district, or one for every 1.81 hectares of net sown area. This is the highest ratio of all the districts in the state of Tamil Nadu. Rural electrification has had a strong influence on the expansion of well irrigation; of a total of 160,000 pumpsets in 1982/83, 140,000 were electric and only 20,000 were diesel powered.

Irrigation allows almost continuous cropping of the land throughout

TABLE 2.2
Annual Rainfall and Area, Yield, and Production of Paddy and Groundnuts, North Arcot District

Year	Paddy			Groundnuts			Annual Rainfall (mm)
	Area (thous ha)	Yield (kg/ha)	Production (thous t)	Area (thous ha)	Yield (kg/ha)	Production (thous t)	
1961/62	259	1,493	387	185	1,232	228	1,045
1962/63	279	1,440	402	206	1,189	245	1,351
1963/64	293	1,438	422	201	1,214	244	1,198
1964/65	305	1,570	480	198	1,020	202	993
1965/66	275	1,397	384	200	715	143	1,131
1966/67	301	1,320	397	202	960	194	1,239
1967/68	278	1,180	329	220	805	177	745
1968/69	170	1,224	208	201	796	160	741
1969/70	251	1,540	387	189	825	156	1,033
1970/71	294	2,143	631	181	1,122	203	811
1971/72	274	2,064	566	227	1,044	237	1,075
1972/73	290	1,906	554	223	812	181	1,034
1973/74	269	1,858	500	246	1,024	252	732
1974/75	233	1,729	404	228	908	207	896
1975/76	241	2,116	511	229	1,131	259	997
1976/77	276	2,073	572	226	823	186	1,283
1977/78	316	2,335	737	222	1,243	276	1,472
1978/79	295	2,179	642	210	814	171	1,192
1979/80	307	2,182	671	212	1,052	223	1,048
1980/81	136	1,844	250	200	650	130	570
1981/82	167	2,345	391	265	1,264	335	1,062
1982/83	118	2,452	290	230	1,291	297	751
1983/84	265	2,615	693	305	1,000	305	1,272
1984/85	255	2,694	687	208	1,076	224	1,076
Growth rate (%)	−1.47	2.94	1.47	0.96	0.07	1.04	n.a.
Coefficient of variation (%)	19.79	11.37	28.58	10.12	18.83	22.52	21.58
Average:							
1963/64–1965/66	291	1,468	429	200	983	196	1,107
1977/78–1979/80	306	2,232	683	215	1,036	223	1,237
Percent change	5.2	52.0	59.2	7.5	5.4	13.8	11.7

Note: The coefficients of variation were calculated after removing trend.

the year. However, since tanks and wells need adequate rain to replenish water reserves each year, they provide only limited insurance against drought. This is particularly troublesome because the region experiences wide variations in annual rainfall; coefficients of variation range from 18 to 31 percent among the 13 *taluks* in the district. During a severe drought in 1982/83, for example, the gross paddy area planted fell 40 percent below trend (Table 2.2).

Paddy production is particularly affected by variations in annual rainfall; the coefficient of variation (cv) around trend was 29 percent during the period 1961/62 to 1984/85 (Table 2.2). Yields are less affected by rainfall (cv = 11 percent) than the area planted (cv = 20 percent), suggesting that farmers adjust the area of paddy grown to fit available water reserves each year.

Groundnut production is slightly less variable than paddy; the cv around trend was 23 percent during 1961/62 to 1984/85. Unlike paddy, groundnut yields are less stable than the area planted. This is because only part of the crop is irrigated.

Small farmers are prevalent in North Arcot. In 1979 there were 574,000 holdings and the average size was 1 hectare. About 68 percent of the farms were 1 hectare or less, and about 86 percent were 2 hectares or less.

North Arcot is also dominated by owner-operated farms. Pure tenant farms are scarce, and most land-leasing arrangements involve farmers who already own some land of their own. Rents are paid in cash or kind, but they usually involve fixed rents. Sharecropping is rare.

The Green Revolution in North Arcot

Growth in Agricultural Output

Paddy and groundnuts are not only the predominant crops in the region's agriculture; they have also been the major sources of growth in agricultural output in recent decades. However, as shown in Table 2.2, to designate this growth as a revolution appears, at least at first blush, to be a bit of a misnomer; the average annual growth rates of paddy and groundnut production over the period 1961/62 to 1984/85 were only 1.47 and 1.04 percent, respectively.

This growth was obtained almost entirely from area expansion in the case of groundnuts, and while expansion can be partly attributed to increased investments in irrigation, there was very little change in groundnut technology. Indeed, the predominant varieties, TMV2 and

TMV7, which are of the bunch type, were grown throughout the period of study.

In contrast, the growth in paddy production was technologically driven; yields increased by nearly 3 percent per year between 1961/62 and 1984/85, while the area grown actually declined (by 1.5 percent per year). Most of this yield increase has occurred since the late 1960s (Figure 2.1) and can be attributed to green revolution inputs such as the high-yielding varieties (HYVs) and fertilizers (see Appendix A). But average growth rates do not adequately capture the discontinuities associated with abrupt changes. Comparison of three-year average yields for 1963/64–1965/66 and 1977/78–1979/80 (periods of relatively normal rainfall) shows that paddy yields jumped about 50 percent between these periods (Table 2.2). Paddy production also increased, by 60 percent, while the paddy area remained virtually constant. These changes are more impressive in size and, given their technological origin, can be labeled a green revolution within the spirit of the widespread usage of this term.

Changes in Paddy Technology

An analysis of the sources of growth (Appendix A) shows that nearly all the growth in the region's paddy production since 1950/51 can be attributed to varietal improvement and the more intensive use of nitrogen and irrigation water. Other changes in the region's paddy technology involved the mechanization of water lifting and the use of power sprayers and threshers.

VARIETIES. One of the reasons that the green revolution did not have a more dramatic impact in North Arcot is that there had been a long and successful tradition of improving paddy varieties at local research stations, and some of the features of HYVs that account for their higher productivity had already been incorporated into improved local varieties. For example, TKM6, which was later to become one of the parents of IR20, was developed and released in the region as far back as 1952. This variety is photoperiod insensitive and can be grown all year round. It is also a short-duration variety, with a growing period of only 110–15 days.

The first HYV, Taichung Native 1, was introduced in North Arcot in 1965 from Taiwan. As with all subsequent HYVs, the main advantages over existing improved local varieties lay in their short stiff-straw and their higher responsiveness to nitrogen, especially during the dry *navarai* season.

The early HYVs proved susceptible to major rice pests and diseases

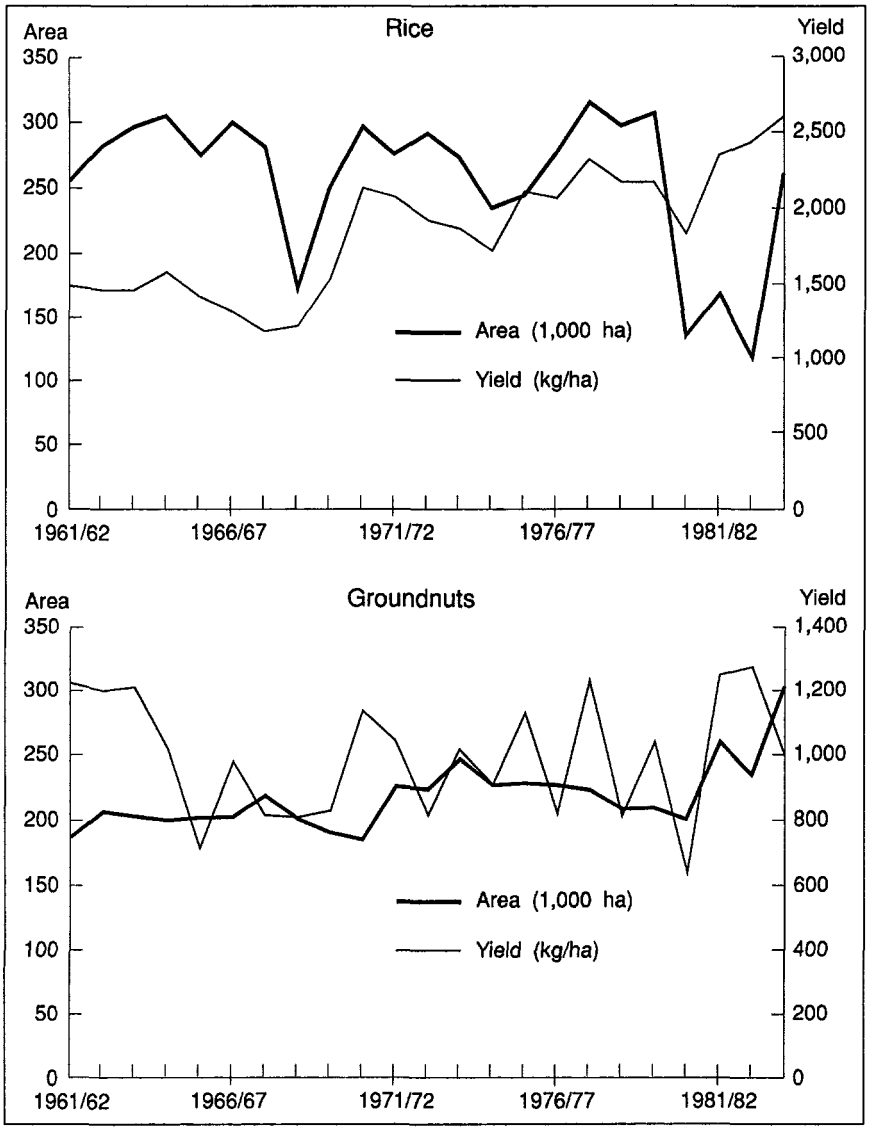

Fig. 2.1. Area and yield of rice and groundnuts.

and were not widely accepted by farmers. The major break came with the release of IR8 (developed by the International Rice Research Institute, IRRI) in the late 1960s. This was widely adopted (Table 2.3) but was subsequently displaced by other IRRI varieties such as IR20, IR36, and IR50 that were better suited to local growing conditions.

TABLE 2.3
Area Under HYV Paddy, North Arcot District

Year	*Area under Paddy (ha)*	*Area under HYVs (ha)*	*Percent of Paddy Area under HYVs*
1950/51	117,387	—	—
1960/61	251,766	—	—
1966/67	301,107	10,268	3.41
1970/71	294,428	60,917	20.69
1975/76	241,298	112,541	46.64
1980/81	135,825	121,482	89.44
1982/83	118,280	108,297	91.56
1983/84	265,015	247,206	93.28

Source: Joint director of agriculture, Vellore.

During the 1970s, national and state programs began to release HYVs of their own, many of which were based on crosses using IRRI plant material. Of the 38 paddy varieties developed and released in Tamil Nadu during the decade beginning in the mid–1970s, 23 of them had IRRI varieties in their parentage.

IRRIGATION. The adoption of HYVs coincided with a rapid expansion in the number of irrigation wells in the region, from 179,232 in 1965/66 to 301,116 in 1983/84. This increase facilitated the year-round growing of paddy and freed up land during the main rainy season (*samba*) to enable an expansion in the area of groundnuts grown (Table 2.2). The number of mechanized wells—electric and oil pumpsets—also doubled over this period, and by the early 1980s over half the wells were mechanized.

FERTILIZER. The consumption of chemical fertilizer within the region increased sixfold between 1965/66 and 1984/85, from 5,177 to 30,024 metric tons of nutrients (Fertilizer Association of India, various issues). Nitrogen consumption increased from 3,198 to 17,032 metric tons.

Data from the Cost of Cultivation of Principal Crops (CCPC) surveys conducted by TNAU for the Ministry of Agriculture show that fertilizer is used more intensively on HYVs than on improved local varieties (Tables 2.4 and 2.5). It is also used most intensively during the irrigated *navarai* season.

Nearly all paddy receives an application of basal fertilizer at transplanting, but subsequent nitrogen applications (topdressings) are done sequentially, and depend on the health of the crop, the availability of

TABLE 2.4
Costs and Returns from Improved Local Varieties of Paddy (1973/74 prices)

	1972/73	*1973/74*	*1974/75*	*1975/76*	*1976/77*	*1977/78*	*1978/79*	*1979/80*	*1980/81*	*1981/82*	*1982/83*
Yield (kg/ha)	2,042	2,267	2,941	2,763	3,148	2,537	2,364	2,793	2,368	3,364	3,009
Price (Rs/kg)	1.05	0.95	1.22	0.89	1.01	0.95	0.97	0.91	1.07	0.82	0.90
Value output (Rs/ha)	2,148	2,158	3,592	2,467	3,172	2,406	2,281	2,527	2,529	2,767	2,722
Variable costs (Rs/ha)	948	582	723	769	1,175	787	1,024	811	902	1,138	664
Seed	119	84	124	145	148	103	127	122	93	216	132
Manures	64	56	33	43	219	83	55	8	66	25	14
Fertilizers	126	99	169	233	261	159	233	157	210	325	163
Pesticides	4	—	3	8	12	13	17	—	6	13	10
Hired labor	400	297	349	290	439	358	446	464	487	389	316
Hired bullocks	46	21	21	28	44	37	38	47	21	41	17
Hired machines	168	1	11	2	11	6	92	—	3	122	11
Other	21	24	13	20	41	28	16	13	16	7	1
Gross margin (Rs/ha)	1,200	1,576	2,869	1,698	1,997	1,619	1,257	1,716	1,627	1,629	2,058
Total labor (hours/ha)	1,824	2,129	2,081	2,046	2,263	1,507	1,703	1,973	1,676	1,820	1,557

Source: Cost of Cultivation of Principal Crops data, TNAU.
Note: Costs and returns based on planted area and averaged over seasons.

TABLE 2.5
Costs and Returns from HYV Paddy (1973/74 prices)

	1972/73	*1973/74*	*1974/75*	*1975/76*	*1976/77*	*1977/78*	*1978/79*	*1979/80*	*1980/81*	*1981/82*	*1982/83*
Yield (kg/ha)	2,588	2,747	3,637	3,239	3,746	3,022	2,772	2,835	3,234	3,249	3,035
Price (Rs/kg)	1.02	0.94	1.21	1.02	1.02	1.02	1.06	0.99	1.07	0.90	1.04
Value output (Rs/ha)	2,647	2,581	4,389	3,292	3,805	3,101	2,941	2,805	3,453	2,908	3,168
Variable costs (Rs/ha)	1,179	817	845	1,067	1,986	1,175	1,240	969	1,114	1,246	1,068
Seed	113	90	103	126	203	118	133	114	89	138	139
Manures	73	66	38	88	153	116	104	90	85	50	31
Fertilizers	242	184	219	340	600	284	325	199	347	463	384
Pesticides	14	12	15	29	55	22	24	15	23	33	7
Hired labor	483	401	409	417	578	486	447	451	506	399	460
Hired bullocks	52	25	37	40	43	41	34	36	25	10	30
Hired machines	182	15	8	9	318	85	157	50	19	149	14
Other	20	24	16	18	36	23	16	14	20	4	3
Gross margin (Rs/ha)	1,468	1,764	3,544	2,225	1,819	1,926	1,701	1,836	2,339	1,662	2,100
Total labor (hours/ha)	1,969	2,338	1,955	2,226	2,295	1,891	1,816	2,092	1,787	1,692	1,899

Source: Cost of Cultivation of Principal Crops data, TNAU.
Note: Costs and returns based on planted area, and averaged over seasons.

water, and so on. For this reason there is a noticeable variation in the amounts of nitrogen used from year to year (Tables 2.4 and 2.5).

MECHANIZATION. In addition to an increase in the mechanization of water lifting, the use of power sprayers and power-operated threshers has also expanded. There were, respectively, 925 and 228 such machines in 1982, compared with zero in 1966. A new set of entrepreneurs who own these machines has emerged in the region, and they hire out their services at fixed rates.

Land preparation is, with few exceptions, still performed with labor and bullock power. However, there were 529 four-wheel tractors in the study region in 1982, compared with 114 in 1966. Their continued spread does not seem likely, given the predominance of small-scale farmers.

Mechanization has led to a modest trend decline in total labor use per hectare of paddy, for both HYVs and improved local varieties (Tables 2.4 and 2.5). But on average, HYVs use about 5 to 10 percent more labor per hectare.

Changes in the Profitability of Paddy Production

The changes that took place in paddy technology have potentially broader implications for farm incomes than the ensuing changes in per hectare costs and returns. For example, the combination of increased irrigation and the availability of quicker-maturing varieties enabled farmers to crop a larger gross area, the increase in which was not all necessarily devoted to paddy. In this section we shall be concerned only with per hectare profitability; the larger issues of changes in total farm production and incomes are taken up in Chapter 3.

YIELDS. As we saw earlier, the region's average paddy yield has grown at about 3 percent per year since the early 1960s, with a sharp jump in the 1970s (Figure 2.1). The CCPC data in Tables 2.4 and 2.5 show that the HYVs were distinctly higher yielding than the improved local varieties when first widely adopted in the early 1970s (about 20 percent higher), but their yields have not increased much since then. Moreover, the yield differential between HYVs and improved local varieties diminished over the years as local research stations incorporated additional features of the HYVs into their own genetic material.

COSTS. HYVs are more input intensive than local varieties, with total variable costs averaging about 20 to 25 percent higher per hectare (Tables 2.4 and 2.5). These higher costs are attributable to the more intensive use of fertilizers, pesticides, and hired labor. Total variable

costs in constant prices show a modest trend increase over the years for both HYVs and improved local varieties.

GROSS MARGINS. While there is considerable variation between years, paddy gross margins (gross revenue less variable costs) show little trend over the years when measured in constant prices (Figure 2.2). Paddy prices barely kept pace with inflation, and the costs of production, particularly fertilizer, increased sufficiently to offset the gains from increased yields (Tables 2.4 and 2.5). The HYVs have generally proved more profitable than the improved local varieties on a per hectare basis (Figure 2.2).

Primary Data Sources

The research in this study is predominantly based on household and firm-level surveys undertaken at different points in time. In this section

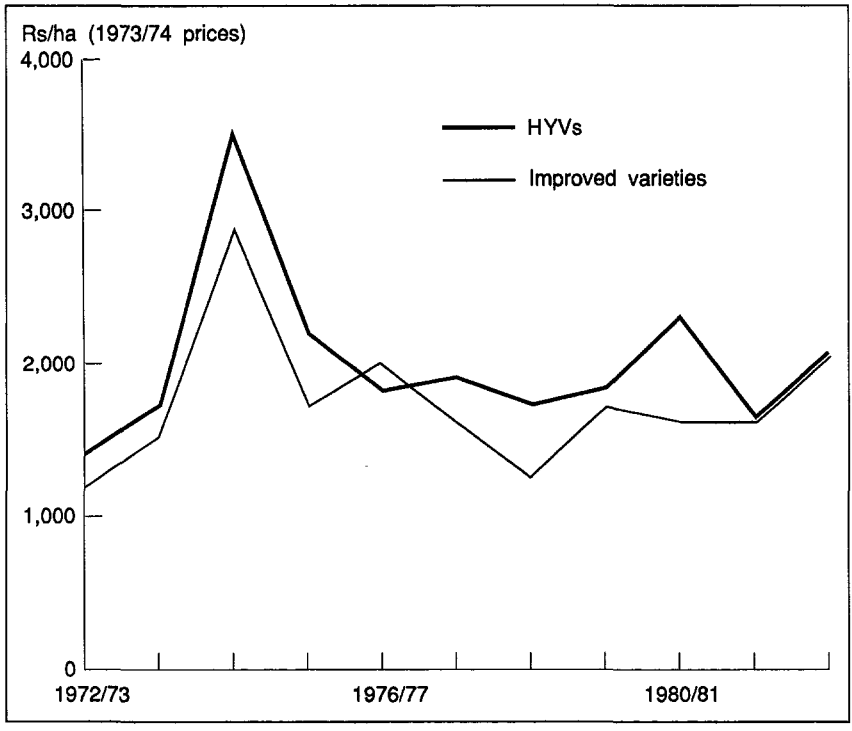

Fig. 2.2. Gross margins per hectare of paddy.
Source: Cost of Cultivation of Principal Crops data, TNAU.

we briefly review the scope of these surveys, in terms of both their geographical coverage and the kinds of variables that were monitored. Additional details about the surveys are to be found in Appendix B.

The Study Region

The study region adopted in our research is identical to the one defined by the earlier team from Cambridge and Madras universities (Farmer 1977). It consists of a contiguous area of six eastern *taluks* (Arkonam, Cheyyar, Wandiwash, Arni, Polur, and Tiruvannamalai) that lie east of the Javadi hills and south of the sandy belt along the Palar River (Figure 2.3). This area produces about three-quarters of North Arcot district's total paddy production; hence in terms of studying the impact of the green revolution, the chosen study region facilitated the efficient concentration of survey resources.

A potential drawback is that the district's headquarter town of Vellore is not included in the study region. Given that Vellore is the largest urban center in the district with a population of 250,000, its inclusion might seem essential for any analysis that purports to trace the growth linkages from agriculture. However, it turns out that the study region is well serviced by a hierarchy of smaller towns and urban villages, and the trading links with Vellore are concentrated on relatively few, higher-order goods and services (e.g., automobile repair, selected durables, and hospital treatment) that are not widely available elsewhere (Chapter 10). In essence, the study region encompasses most of the places where the day-to-day transactions of the region's households are undertaken, and as such it defines the kind of economic watershed required from a growth linkages analysis (Bell, Hazell, and Slade 1982; Hazell and Röell 1983).

Agriculturally, the study region is more specialized than North Arcot district as a whole. It is primarily a rice- and groundnut-growing area with relatively small amounts of millets, sorghum, and pulses. Its manufacturing base is also more specialized into agroprocessing and textiles. A detailed analysis of the region's economy is to be found in Chapter 7.

The Surveys

The first set of survey data available was collected by a team from Cambridge and Madras universities in 1973/74. Despite expectations, the team found that only about 13 percent of the paddy area was planted to HYVs at the time, so the survey really approximated a pre– or early–green revolution situation. A second team from IFPRI and TNAU

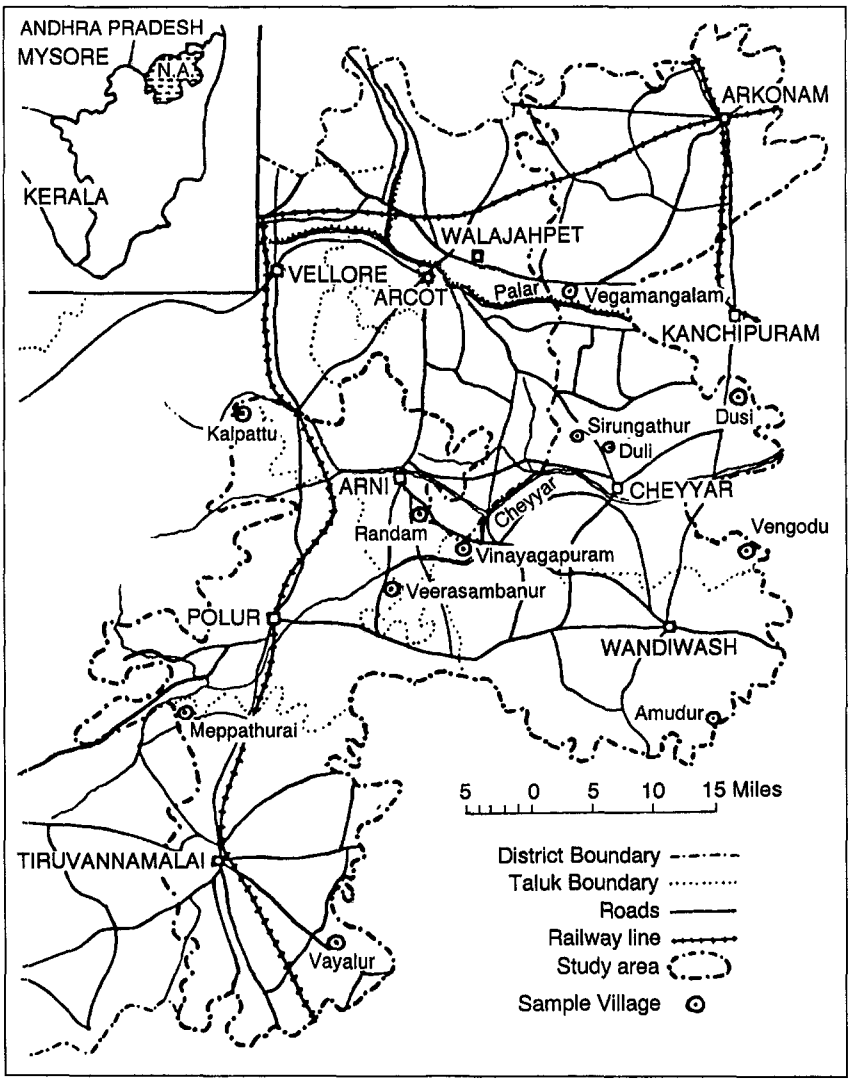

Fig. 2.3. *Study villages and towns.*
Source: B. H. Farmer, *Green Revolution?*, p. 8. © 1977 by The Macmillan Press Ltd.

undertook similar surveys in 1982/83, by which time over 90 percent of the paddy area was planted to HYVs. This was clearly a post–green revolution situation.

Both surveys included a representative sample of all rural households (farmers, landless farm workers, and nonagriculturalists) living in the same 11 villages. The villages were selected through sampling

procedures to be representative of all the rural villages (those with populations of less than 5,000 people) in the study region (see Appendix B). These villages are Vegamangalam, Sirungathur, Duli, Vengodu, Vinayagapuram, Amudhur, Nesal (or Randam, as John Harriss prefers to call it in Chapters 4 and 6), Kalpattu, Veerasambanur, Meppathurai, and Vayalur.[1] Their locations are shown in Figure 2.3.

The Cambridge-Madras universities survey in the 11 villages had several components, each involving different samples and questionnaires (see Chambers et al. 1977). But the data used in this study were taken almost exclusively from two components. The first was a sample of 161 paddy-farm households that participated in a detailed farm management survey for three consecutive seasons ending with the 1974 *sornavari* crop. The second component was a household sample of 57 paddy farmers, 3 nonpaddy farmers, and 77 noncultivators who participated in a monthly income and expenditure survey between April 1973 and May 1974. The 57 paddy-farm households were a subsample of the 161 paddy farmers included in the farm management survey. Between them these surveys provided detailed information on most aspects of farm management, employment, sources of income, households assets, food consumption, and household expenditure patterns.

The IFPRI-TNAU survey in the rural villages covered a sample of 345 households that participated in a monthly income, expenditure, and farm management survey from March 1982 to April 1983. The sample contained 160 paddy cultivators, 25 nonpaddy cultivators, and 160 noncultivating households (of which about three-quarters were landless laborers). While the survey was conducted in the same 11 villages as the Cambridge-Madras survey, it was not possible to use the same sample of households without losing representation in the post–green revolution situation.

To enhance the comparability of the rural household data between the two surveys, the same household and variable definitions were used wherever possible. For example, a cultivator was defined as a farmer operating more than one-fourth acre and a paddy farm as a holding of one-fourth acre or larger on which paddy *was* or *could be* grown. Parts of the 1973/74 questionnaires were also used in 1982/83, although they were precoded to take advantage of interim advances in data-processing technology. Members of the earlier Cambridge-Madras universities team also provided advice and visited several of the villages while the 1982/83 survey was ongoing.

1. The Cambridge-Madras team surveyed an additional village, Dusi, which was selected purposively and not as part of the random sample. Apart from chapters 4 and 6, the Dusi data were not used in this study, and they are excluded from the description of the survey procedures and sample sizes.

A potential hazard with repeat surveys of this kind is that weather conditions, which remain largely unknown until after a survey has begun, may not prove comparable between years. If they are not, then serious problems can arise in determining how much of the observed changes in the survey data are attributable to the green revolution and how much is simply the effect of different weather conditions.

As shown in Table 2.2, annual rainfall was only 732 millimeters in 1973/74, or 35 percent below average. But because rainfall in the preceding two years had been quite normal, there were sufficient tank and groundwater reserves that aggregate paddy area and production declined only marginally. At 751 millimeters, annual rainfall was almost identical in 1982/83. However, this time the region was still recovering from the effects of a severe drought in 1980/81 and below-average rainfall in 1981/82, which together had depleted the water reserves available at the beginning of the 1982/83 agricultural year. As a result, paddy area and production fell to nearly half their normal levels in 1982/83, and the region entered a state of economic distress. In fact the situation deteriorated sufficiently that government relief schemes, such as the National Employment Program, were activated in the region during the period of survey.

Given the obvious difficulties in comparing survey data between 1973/74 and 1982/83, an additional survey was undertaken in 1983/84. This proved to be an above-average year for rainfall (1,272 mm), and paddy area and production recovered to more normal levels (Table 2.2). But available resources for the 1983/84 survey were very limited, and it proved necessary to limit the survey to those villages surveyed in the previous year that had been most affected by the drought. These villages are Duli, Vayalur, Veerasambanur, Meppathurai, and Amudhur. Not surprisingly, they are the villages with the poorest and least reliable supplies of irrigation water (see next section and Chapter 6). Within these villages, half of the 1982/83 sample of paddy cultivators and landless laborers were selected at random for resurvey, and all of the 1982/83 sample of nonpaddy cultivators and nonagriculturalists. The same monthly questionnaire was used as in 1982/83, spanning the period September 1983 to June 1984. In order to obtain information for the complete agricultural year, households were also asked to recall information for July and August when first interviewed in September.

The Cambridge-Madras universities study was less focused on agricultural growth linkages than the present study and, apart from a survey of small businesses in the single town of Arni (see Chapter 9), surveys of the nonrural economy were not undertaken in 1973/74. In contrast, a major effort to study the nonfarm economy was undertaken in 1982/83 that included a monthly income and expenditure survey of

320 urban households, a survey of 1,500 nonfarm businesses located in urban areas, and a survey of the patterns of service provision and use in all the villages in the study region that had populations of more than 750 persons (see Appendix B and Chapter 10 for details). Additionally, the monthly questionnaire for the rural household survey included details about any nonfarm business activities that the sample households undertook, and a repeat survey of small businesses in Arni was undertaken (see Chapter 9).

Characteristics of the Sampled Rural Villages

There are considerable differences among the 11 sampled villages, particularly with respect to population, land and water resources, economic activities, infrastructure, labor, and social relations in production. A detailed analysis of the intervillage variations is offered by John Harriss in Chapter 6. This section presents a very brief account of the major features of the 11 villages.

In 1982/83, the 11 villages had an average population of 959, ranging from 538 in Duli to 1,487 in Nesal. Nesal, Kalpattu, Vengodu, Vegamangalam, and Sirungathur are the largest villages, with populations in excess of 1,000. The major castes are Vanniyas, Pillai, Naidus, Mudaliars, Yadavas, and Harijans.

All the villages have a primary school, and Amudhur has a high school. Unlike the other villages, Meppathurai and Vinayagapuram do not have a bus service, but one is available within three kilometers. All the villages have electricity and, apart from Vinayagapuram, are connected by surfaced roads. A detailed account of the infrastructure facilities available in each village is to be found in Chapter 10.

As in the region generally, tanks and wells are the principal sources of irrigation in the study villages (Table 2.6). Kalpattu and Vegamangalam are unique in not having tanks. Kalpattu is surrounded by hills that recharge its wells with groundwater all year round. Because of this feature, the village is able to grow crops continuously and its cropping pattern is the most diversified; it includes paddy, banana, turmeric, sugarcane, groundnut, and horticultural crops. Vegamangalam village is supplied with water from a natural spring and also enjoys year-round irrigation. Because of good irrigation resources, Kalpattu, Vegamangalam, and Nesal are comparatively prosperous villages and are less prone to drought. Duli, Vayalur, Veerasambanur, Meppathurai, and Amudhur have the least reliable sources of irrigation water, and they were severely affected by drought in 1982/83.

The sample villages use labor from both within and outside the village. Sirungathur, Veerasambanur, Vengodu, and Amudhur are

TABLE 2.6
Irrigation Facilities in Rural Study Villages, 1982

Village	*No. of Tanks*	*No. of Wells*[a]	*No. of Pumpsets*[b]	*Average Depth of Wells*[c] *(meters)*	*Percent of Households with Access to Irrigation Wells*
Kalpattu	0	194	124	15.67	100.0
Meppathurai	1	159	69	11.00	95.0
Vayalur	1	87	37	12.18	100.0
Veerasambanur	3	130	41	12.18	82.0
Vinayagapuram	2	109	73	15.84	100.0
Nesal	3	227	161	14.21	73.7
Amudhur	2	86	59	9.32	87.5
Vengodu	3	134	75	12.81	94.1
Duli	1	38	23	12.54	58.3
Sirungathur	2	98	75	12.75	100.0
Vegamangalam	0	69	60	10.21	50.0

Source: Information collected from village-level development workers and village administrative officers.

[a]Some wells were not in use at the time of the survey.

[b]Wells without pumpsets generally have poor water supplies and the water is lifted by *mhote*.

[c]Depth of wells was determined from a random sample of nine wells in each of the villages.

labor-surplus villages, whereas Kalpattu, Nesal, and Vegamangalam are labor-deficit villages. Some sharecropping is found in Vinayagapuram and Vegamangalam, but it is unimportant in the other villages.

All the study villages have cooperative credit societies that provide crop loans. The sample villages also benefit from the presence of government-run fair-price shops, which provide rice, vegetable oils, sugar, and kerosene at subsidized prices.

Various state-run developmental programs also benefit the study villages, for example, the Noon Meal Scheme, Integrated Rural Development Programs, and Training and Visit Extension. Village *panchayats* are responsible for local water supply, road maintenance, and health programs. Milk producers' cooperative societies also function in the study villages.