

Beyond Market Failures:
Irrigation, the State, and Non-traditional Agriculture in Northeast Brazil

by

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Submitted to the Department of Urban Studies and Planning
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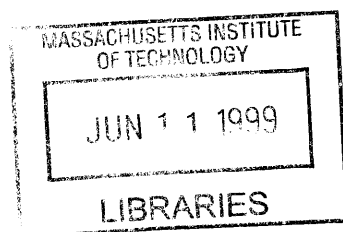
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ABSTRACT

This dissertation analyzes the role of the state in the economic transformation of three regions of irrigated agriculture in the São Francisco River Basin in Northeast Brazil. It focuses on understanding the reasons why only one of these three regions (Petrolina-Juazeiro) successfully turned into a modern agricultural economy based on high quality, non-traditional export crops, at the same time that wages and labor standards among rural wage workers increased without compromising the access of producers to export markets, and in spite of all three regions having received similar heavy government investments in large-scale irrigation infrastructure.

Findings show that the economic transformation of Petrolina-Juazeiro does not relate to market-friendly policies, nor can it be fully explained by government investments in public goods (irrigation infrastructure) or the influence of “good leadership” at the local level. The key role of the state consisted of federal government agencies applying innovative practices in three major areas: 1) the management of large-scale irrigation investments, including the type of beneficiaries selected, the management of subsidies to irrigation, and the pressures on growers who received subsidies to perform well; 2) the relationship with growers’ associations to solve collective action problems associated with exporting; 3) the introduction of high-value crops and new technologies among small tenants in government-sponsored irrigation schemes; and 4) wage negotiations between growers and rural wage workers.

In addition, research results show that the globalization of food markets and the growth of non-traditional export crops can be accompanied by positive effects on rural employment, wages, and labor standards. These positive outcomes relate to: 1) the type of crops involved and their demand for skilled workers to meet high quality demands from consumers; 2) the supply of skilled workers in the region involved; 3) the presence and previous experience of rural unions; 4) the consumer concerns for the labor conditions of production; and 5) how rural unions and consumer concerns affect the balance of power between growers and rural wage workers and their respective organizations.

Thesis Supervisor: Judith Tandler
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**Beyond Market Failures:
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CHAPTER ONE

INTRODUCTION

Most of the recent literature analyzing the role of the state in economic development has focused on manufacturing and on late industrialization, attempting to understand the nature and sequence of government interventions that led to a dynamic, export-oriented industrialization.¹ In contrast, the development literature has paid substantially less attention to the role of the state in promoting a dynamic, export-oriented agricultural growth. This is surprising because rural poverty remains to be a major problem in most of the developing world, a reason why governments of developing countries and international donors have been implementing different types of programs to create employment, redistribute land, and promote the modernization of agriculture among small farmers. Equally important, many developing countries, such as Argentina, Chile, Costa Rica, and Guatemala, among others, have been able to create dynamic agricultural export sectors, frequently based on non-traditional crops, which represent a high proportion of their exports.² What has been the role of the state in cases of agricultural-based growth? How can governments influence the effects on rural poverty of agricultural-based growth?

This dissertation focuses on the role of the state in the economic transformation of Petrolina-Juazeiro—a 53,000 km² (the size of Netherlands and Belgium combined) and 510,000 inhabitants area in the states of Bahia and Pernambuco that is part of the São

¹ See Amsden (1989 & 1994), Collier (1979), Johnson (1987), and Wade (1990 & 1994).

² Non-traditional export crops (NTECs) include crops that used not to be exported, even though farmers frequently grew them for selling in the domestic market. In contrast to traditional export crops like wheat and corn, NTECs include crops like fruits and vegetables characterized by their high value and quality. For example, Chile has turned into a successful exporter of fresh and processed food products, such as grapes, wines, and apples. Costa Rica and Guatemala have developed their production of tropical fruits for exports, selling products like mangoes and pineapples to Europe and the United States.

Francisco River Basin in Northeast Brazil.³ I compare the case of Petrolina-Juazeiro with two other regions of irrigated agriculture in the São Francisco River Basin: the *Baixo São Francisco* and the North of Minas Gerais (see maps 1 to 3). In contrast to the Northeast of Brazil, a 1.5 million km² region (18% of the country's area) with poor soils, semiarid climate, and periodic droughts that has long viewed as Brazil's foremost "problem area," Petrolina-Juazeiro is a great contrast of dynamic irrigated agriculture, agro-processing industries (tomato and fruit-processing) and services (mainly input supplying, banking, and consulting), well-known in Brazil as the most important producer and exporter of high quality fruits and vegetables in the country. In the late 1960s, the Petrolina-Juazeiro region was no different than most of the rural areas in Northeast Brazil. Characterized by the same poor natural resources and low standards of living as the Northeast, the economy of Petrolina-Juazeiro was based on a backward agriculture, dominated by the production of cotton, livestock, and subsistence crops (mainly corn and beans). While sharecroppers cultivated cotton usually interplanted with corn and beans, landowners grew cattle in natural pastures and in the cotton leftovers from the harvest.⁴ In the early 1990s, Petrolina-Juazeiro had turned into a producer of a wide range of irrigated high-value crops, including table grapes and mango that are sold fresh to Europe and the United States, and other crops for the domestic market, including banana, coconut, guava, passion fruit, melon, industrial tomato,

³ The Petrolina-Juazeiro region defined here includes the municipalities of Petrolina, Santa Maria da Boa Vista, and Lagoa Grande of the state of Pernambuco and Juazeiro, Casa Nova, and Curaçá of the state of Bahia.

⁴ Among others, see Hirschman (1963), Robock (1957), Kutcher & Scandizzo (1981), and Barreira (1992) for a revision of economic and social features of agricultural production in Northeast Brazil. For analysis of its land tenure problems, see Barros et al (1977), Bursztyn (1984), Carvalho (1988), Cline (1970), Hall (1990), Hoffman (1987), Kutcher and Scandizzo (1981), Leite (1994), and Sampaio (1985 & 1988). See Johnson (1971) for an excellent study of the sharecropping relationship in the Northeast, and Barros et al (1977), Goodman (1990), Martine (1987), Martine & Beskow (1987), Melo (1980), Robock (1957), Sampaio et al (1987), Silva & Medeiros (1982), Schuh (1970), Smith (1969), and World Bank (1994) for analysis of the agricultural sector. See Camarano (1986 & 1987), Martine and Camargo (1984) and Moura and de Freitas (1986) for analysis of the population dynamics. See Tendler (1982 and 1991) for analyses of World Bank rural development programs, and Tendler (1997) for a study of successful state government interventions. For analysis of poverty in Brazil's Northeast, see Barros et al (1977), Fox and Morley (1990), Hoffman (1987), Knight and Moran (1983).

watermelon, and onion, among others.⁵

The success of irrigated agriculture in Petrolina-Juazeiro relates partly to heavy investments of the federal government in irrigation infrastructure. Since the late 1960s, CODEVASF—a federal government agency created to promote the economic development of the São Francisco River Basin—built large-scale irrigation schemes to irrigate 35,000 hectares of land. These government-sponsored irrigation projects have been successful in introducing new crops and technologies, which were first adopted by growers in irrigation schemes and later disseminated among producers outside them. The total irrigated area in Petrolina-Juazeiro reached 80,000 hectares in 1997, 23% of the Northeast's, for an area and a population that represented only 3.2% and 1.1% of the Northeast's. In this area, growers in Petrolina-Juazeiro produce 90% of the country's exports of mango and 30% of table grapes, having displaced the much more technologically developed states of São Paulo and Rio Grande do Sul as the most important exporters of these products.⁶ This is surprising because most government-sponsored programs of irrigation and land settlements in Brazil and elsewhere like the ones in Petrolina-Juazeiro have often been unsuccessful, showing a predominance of subsistence crops and lack of adoption of new technologies among their beneficiaries. In addition, they have often been criticized for their high costs because they have been too centralized and over-directed, as government agencies often remained

⁵ The term high value refers to their high prices in relation to volume if compared to other traditional and non-traditional agricultural products like wheat, corn, soybean, cotton, sugar, and coffee. While world prices for wheat and corn in recent years have been between \$ 75 to \$ 175 per metric ton, those of fruits and vegetables range from \$ 200 to \$ 1,600. The price of Brazilian grapes, for example, oscillated between \$ 900 and \$ 1,500 per ton between 1991 and 1996. In the same period, prices varied between \$ 600 and \$ 995 in mango and between \$ 333 and \$ 597 in melon.

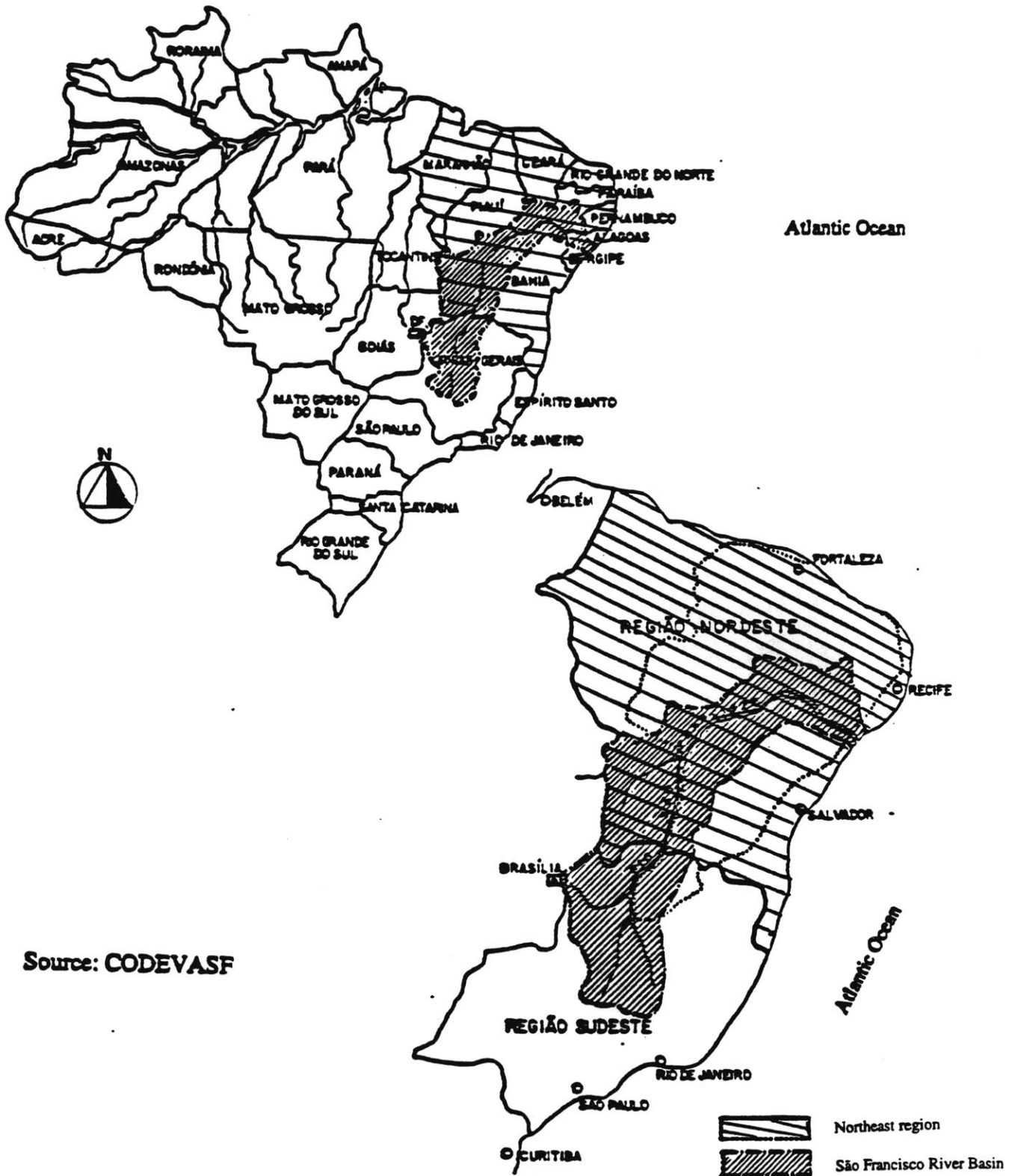
⁶ For additional information on irrigation in Northeast Brazil, see (BNB 1990a) and CODEVASF (1991). The remaining exports of table grapes and mango originate from the south of the country, mainly from the states of São Paulo and Rio Grande do Sul.

Map No. 1. SÃO FRANCISCO RIVER BASIN

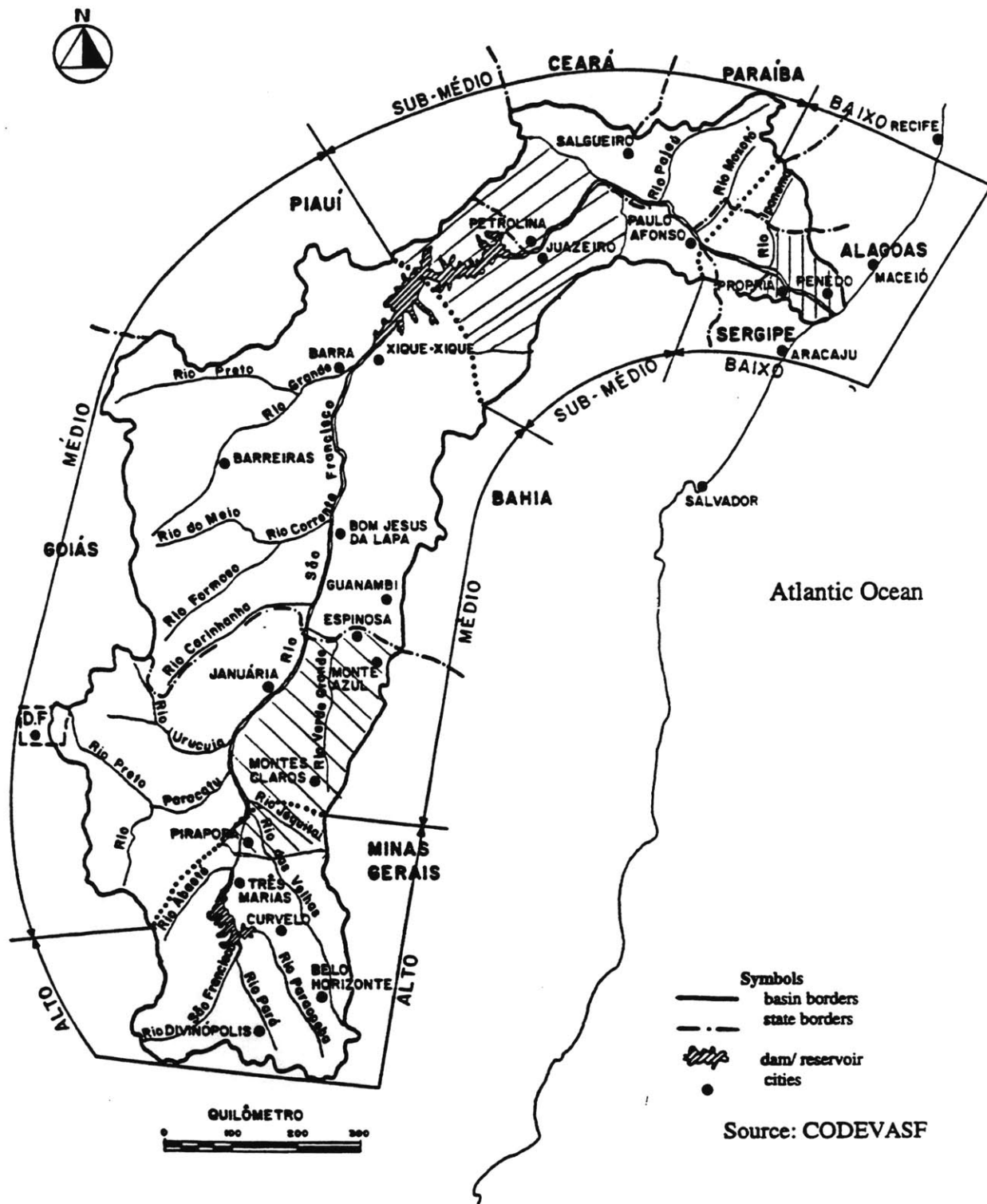


Source: CODEVASF

Map No. 2. The São Francisco River Basin and Brazil's Northeast region



Map No. 3. Petrolina-Juazeiro, North of Minas Gerais, and *Baixo São Francisco* in the São Francisco River Basin



Source: CODEVASF

operating and maintaining irrigation facilities and providing other services (like agricultural extension) to growers.

In addition, the studies on cases of agroexport booms similar to Petrolina-Juazeiro have often stressed their exclusionary nature—meaning that land distribution and access of the rural poor to stable employment often fell.⁷ I myself expected that small tenants in CODEVASF's irrigation projects in Petrolina-Juazeiro would grow mainly traditional crops like beans and corn and that they would not be able to grow high value crops like fruits and vegetables. To my surprise, I found that small tenants not only grew a wide range of high-value crops, but also they had been increasingly focusing on high-value, perennial crops and decreasing their areas with annual crops. In addition, the growth of irrigated agriculture in Petrolina-Juazeiro was accompanied by widespread positive effects on the creation of jobs, the increase in wages, and the improvement of labor standards, including the enforcement of prohibitions on child labor and better safety and health standards. By 1996, irrigated agriculture in Petrolina-Juazeiro employed nearly 40,000 wage workers (30% of the rural labor force in the region), out of which 29,000 (72%) worked in the two main non-traditional export crops (NTECs), namely table grapes and mango. An unusually high proportion of 60% of the labor force directly involved in agricultural production was permanent and 40% of it comprised women. These rural workers (both in crops for export and the domestic market) received wages substantially higher than the legal minimum wage in Brazil (21.7% higher by January 1998) and than the average wage of most Northeast rural workers. In addition, most workers received higher wages for overtime and night

⁷ Several authors have argued that the growth of NTECs have led to negative distributive effects. Among others, see Carter & Mesbah (1993), Conroy et al (1994), Schurman (1993), Stanley (1994), and Twomey & Helwege (1991). For analyses of the Brazilian case, see Ferreira Irmão (1984), Martine (1987), and Martine & Beskow (1987).

work (50% and 80% respectively) and, in contrast to most Northeast rural workers, were registered and received fringe benefits (social security and medical insurance) that represented about 50% on top of the wage.⁸ Two thirds of the workers were trained in a variety of skills, including managing irrigation equipment, fruit packing, pruning trees, among other tasks, and they receive premiums for productivity. Lastly, rural wage workers in Petrolina-Juazeiro had gained a number of important improvements in labor conditions, such as the right to have bathroom facilities and clean drinking water in the workplace and transportation within the farm and from the workplace to their homes. For reasons that I will explain later, improvements in wages and labor conditions neither led growers to mechanize their crops, nor jeopardized their capacity to compete in the domestic and export markets, suggesting that returns to these costs in terms of increased production were greater than costs. Such favorable conditions in employment, wages, and labor conditions have attracted workers from all over the Northeast of Brazil to Petrolina-Juazeiro, turning it into one of the few regions in the Northeast that has a net rate of in-migration rather than out-migration.⁹

Finally, other regions of commercial agriculture often face problems of social actors involving in antagonistic or simply distant relations with each other--large farmers with small farmers, firms with wage workers, large agro-industrial customer firms with small farmers suppliers, outside customer firms with local producers. In contrast, Petrolina-Juazeiro has been mostly characterized by a long-standing working-together of these actors,

⁸ Rural workers' unions in Petrolina-Juazeiro have been able to negotiate wage increases that have been raising their minimum wage above the Brazil's legal minimum every year since 1994, year in which they obtained a minimum wage 10 percent higher than the legal minimum.

⁹ While the population of Petrolina-Juazeiro more than doubled between 1970 and 1990, it increased by 50.1% in the states of Pernambuco and Bahia as a whole.

who have created several institutions for negotiating among them when conflicts arise and for collaborating in various tasks, such as marketing in foreign markets and research on new agricultural technologies.

Petrolina-Juazeiro is not the only case of dynamic agriculture in Brazil's semiarid Northeast. Other major cases include: a) the production of melon for export in Mossoró/Vale Açú (state of Rio Grande do Norte); and b) pockets of dynamism in many Northeast states (mainly Ceará, Bahia, Rio Grande do Norte, Sergipe, Piauí) related to irrigated agriculture (fruits and vegetables) and dairy, mainly for the domestic market. Although these cases have contributed to the development of the Northeast, Petrolina-Juazeiro is the most interesting to study for many reasons. First, it is the most significant case of agricultural transformation in the semiarid part of the Northeast region, comprising much larger areas of irrigated crops and larger production and exports than any of the other cases. Second, it is the case with the largest area of irrigated agriculture in the Northeast region and the most significant in terms of production and exports—with approximately 60% of all exports of fresh fruits from Northeast Brazil—to analyze the role of government in promoting the cultivation of high-value crops and the adoption of new technologies among small farmers. While small tenants in Petrolina-Juazeiro have been able to transform their agricultural production, having introduced export crops and obtained similar yields than firms, the other regions are mostly led by a few large firms with no substantial linkages with small farmers (like in irrigated melon in Mossoró/Vale Açú). Third, irrigated agriculture in Petrolina-Juazeiro has generated substantially more jobs and higher wages than in any of the other regions.

This dissertation analyzes the government interventions that led to the transformation of Petrolina-Juazeiro from a backward agriculture into a modern agricultural economy, increasing wages and labor standards without compromising the access of producers to export markets. Surprisingly, although Petrolina-Juazeiro has become a well-known success in Brazil since the early 1990s, the literature analyzing the economic transformation of Petrolina-Juazeiro has been extremely limited. Also, the explanations from Brazilian analysts and the conventional wisdom in Brazil about the transformation of Petrolina-Juazeiro have varied greatly, from giving a key role to the state to arguing that it relates mainly to private sector initiative. The most popular explanations are the following:

1) Many authors view the transformation of Petrolina-Juazeiro as a result of heavy investments of the federal government in infrastructure (roads, electrification, and mainly irrigation).¹⁰ As I will explain in detail in chapter 2, the federal government has long created many agencies to deal with problems of drought and poverty and to promote the development of the Northeast.¹¹ Through these agencies, the federal government made heavy investments in roads, electrification, and irrigation infrastructure in the São Francisco

¹⁰ See Banco do Nordeste do Brasil (1990a, b, & c), Carvalho (1988), Galvão (1990), Maffei & Ramos de Souza (1986), and Lima & Katz (1993) and Ramos de Souza (1990).

¹¹ The most important federal government agencies in Petrolina-Juazeiro were: a) the Sao Francisco Hydroelectric Agency (*Companhia Hidro-Elétrica do Sao Francisco*, CHESF), created in 1945 to provide electric power infrastructure along the Sao Francisco River; b) the Sao Francisco Valley Commission (*Comissao do Vale do Sao Francisco*, CVSF), established in 1948 to provide basic infrastructure (distribution of electric power, hospitals, schools, water supply, roads, and irrigation) within the Sao Francisco River Basin—later transformed into the Sao Francisco Valley Superintendency (*Superintendencia do Vale do Sao Francisco*, SUVALE) in 1967 and into the Sao Francisco Valley Development Agency (*Companhia de Desenvolvimento do Vale do Sao Francisco*, CODEVASF) in 1974; c) the Bank of Northeast Brazil (*Banco do Nordeste do Brasil*), established in 1952 to provide credit for investment and working capital to all economic activities; and d) the Superintendency for the Development of the Northeast (*Superintendencia para o Desenvolvimento do Nordeste*, SUDENE), created in 1959 to program and coordinate development interventions in the Northeast. Apart from these agencies, the federal government had created the Federal Inspectorial Agency Against the Drought (*Inspectoria Federal do Obras Contra as Secas*, IFOCS) in 1909. This agency, which had relatively little presence in Petrolina-Juazeiro, provided water infrastructure—mainly dams for public drinking. In 1945, the federal government transformed IFOCS into the National Department of Works Against the Drought (*Departamento Nacional de Obras Contra as Secas*, DNOCS).

River Basin. CODEVASF was the agency that carried out the construction of large-scale irrigation projects to irrigate a total of 80,000 hectares in the São Francisco River Basin.¹² The agency built large-scale dams and delivery canals and constructed “irrigation perimeters”, each of which had between 3,000 and 20,000 hectares of lands appropriate for irrigation. In each of these irrigation perimeters, CODEVASF expropriated the land, divided it into plots, selected producers (including, as I will explain later, both landless and agricultural firms) and distributed the plots among them, built farm-level infrastructure, and constructed connecting roads and social infrastructure (electrification, schools, and health posts) of general use. In addition, CODEVASF carried out all operation and maintenance tasks, including the distribution of water, collection of water fees, and maintenance of irrigation infrastructure and roads.

2) In contrast to these authors, other analysts tend to view negatively the role of government intervention, explaining the transformation of Petrolina-Juazeiro as a result of private sector investments rather than of federal government investments in irrigation infrastructure. These views criticize government investments in irrigation for different reasons. World Bank evaluations have argued that government agencies implementing irrigation projects were frequently paternalistic and too slow in transferring operation and maintenance of irrigation infrastructure to user associations.¹³ An important portion of the Brazilian literature analyzing government irrigation policies has also been very critical, arguing that government-sponsored projects were too expensive and that most of them had little impacts on improving the living standards of the rural population because they were

¹² This area corresponds to December 1996. At that time, CODEVASF was completing the implementation of other irrigation projects that would increase the irrigated area to 100,000 in the next four years.

¹³ See World Bank (1990 & 1993a).

poorly managed and focused on traditional crops (corn and beans) rather than high-value crops.¹⁴ Furthermore, many of these analyses argue that firms located outside government irrigation projects (what they call as “private irrigation”) have been the main ones responsible for introducing new crops and technologies and have been far more efficient in producing them.¹⁵

3) Brazilian policymakers and economists in government positions have recently emphasized the positive role played by the implementation of “market friendly” policies, mainly stabilization measures, in providing an appropriate environment for private firms to invest and innovate.¹⁶ These measures, which the federal government implemented since 1994, may have lowered costs for private firms in Petrolina-Juazeiro and other regions of Brazil and increased their possibilities to compete in the international market.

4) While a few analysts have focused on the politics of Petrolina-Juazeiro, the conventional wisdom in Brazil gives a key role in the success of the region to the presence of a strong local and “progressive” leadership (the Coelho family).¹⁷ According to this interpretation, members of the Coelho family who occupied key positions at the municipal, state, and federal level were able to attract both heavy federal investments in irrigation and private firms to the region. In contrast, other regions in the Northeast lacked this kind of “progressive” leaders; instead, local elites usually struggled to get the benefits from government support and were associated with clientelistic practices in the use of public funds.

¹⁴ Among others, see Assirati (1994), Barros (1987), Coelho (1975 & 1982), FAO/World Bank CP (1983 & 1984), Hall (1978a & b, and 1983), Mavignier and Pereira (1990), MINTER/SUDENE/BNB (1985), Noronha (1980), de Oliveira (1981), Sampaio et al (1979).

¹⁵ FAO/World Bank CP (1983 & 1984), Mavignier and Pereira (1990), World Bank (1990).

¹⁶ Multilateral and bilateral donors have widely promoted the application of “market friendly” policy packages since the middle 1980s in order to revitalize the economies of developing countries and promote exports. For arguments favoring these policies, see Stiglitz (1989) and World Bank (1993b & 1996). For arguments that relate the emergence of NTAEs to the application of these policies, see Jaffee (1993). For the Brazilian case, see Loiola and Uderman (1993).

5) Finally, some analysts have viewed the transformation of Petrolina-Juazeiro into a producer of non-traditional export crops as a natural result of the globalization process. The change in consumers' patterns in the developed world towards an increasing consumption of fresh fruits and vegetables, and the comparative advantages of Petrolina-Juazeiro to produce them in the US and European counterseason, are the driving forces of the economic transformation of the region. These authors have also focused on the effects of the increasing weight in export crops on the rural poor, most of them arguing that it has led to the exclusion of the small farmers and settlers (*colonos*) in government-sponsored irrigation projects from growing these crops, the worsening of working conditions, and to negative effects on the environment, namely desertification and higher risks of pests, diseases, and salinisation of soils.¹⁸

I argue that the successful outcomes of Petrolina-Juazeiro neither relate to market-friendly policies, nor can they be fully explained by government investments in public goods (mainly large-scale irrigation infrastructure) or by the influence of "good leadership" at the local level. Trade liberalization policies in Brazil started only in 1989 and successful stabilization policies (the "*Real Plan*") that brought inflation down to one digit figures only began in 1994. While these measures had important positive effects in the growth of cultivated areas in Petrolina-Juazeiro, its emergence as a successful producer of fresh fruits and vegetables of high quality both for export and the domestic market started before--in the late 1980s, in the midst of a long period of inflation and after a number of failed stabilization programs.¹⁹

¹⁷ See Chilcote (1990) for a careful historical study of the local elites in Petrolina-Juazeiro.

¹⁸ See Marsden et al (1996) and Salet (1997).

¹⁹ For analyses of stabilization programs implemented in Brazil during the 1980s, see Cardoso (1991), Cardoso and Dornbusch (1987), Kiguel and Liviatan (1991), and Modiano (1988).

With respect to the argument that gives a key role to the transformation of Petrolina-Juazeiro to government-sponsored investments in irrigation infrastructure, I will show in chapters 2 and 3 that while they were in fact very important in making possible the growth of irrigated agriculture, federal government agencies (mainly CODEVASF and DNOCS) also made these same investments in other regions in the São Francisco River Valley, the North of Minas Gerais and the *Baixo São Francisco*, without these regions showing its successful economic transformation.

In contrast to the above-mentioned interpretations, and based on the comparison of Petrolina-Juazeiro with the North of Minas Gerais and the *Baixo São Francisco* (see map 3 for their location), I argue that the key role of the state consisted of federal government agencies applying innovative practices (explained below) in three major areas: 1) the management of large-scale irrigation investments, including the type of beneficiaries selected, the management of subsidies to irrigation, and the pressures on growers who received subsidies to perform well; 2) the relationship with growers' associations to solve collective action problems associated with exporting; 3) the introduction of high-value crops and new technologies among *colonos* in irrigation projects; and 4) wage negotiations between growers and rural wage workers.

The management of large-scale irrigation investments

Government agencies in charge of irrigation investments applied innovative principles in the management of these large-scale irrigation investments:

- a) Mixing medium-size firms and small farmers in irrigation projects. In contrast to other government agencies working with land settlements in Brazil and in other countries,

which provided land only to landless poor farmers, CODEVASF established in its irrigation projects in Petrolina-Juazeiro a mix of former landless (*colonos*) and medium-size agricultural firms. These firms usually grew between 100 and 200 hectares of irrigated lands, in contrast to the large agricultural firms (known in Brazil as “anchor” firms) that usually grow between 1,000 and 2,500 hectares of irrigated crops dominant in other zones of Northeast Brazil (e.g., the melon growers in Mossoró-Vale Açú). While CODEVASF did this extensively in Petrolina-Juazeiro, it did it much less in the North of Minas Gerais, and it did not do it at all in the *Baixo São Francisco*, for reasons explained in detail in chapter 3.

b) Picking winners. Similarly to what several East Asian governments did when promoting industrialization, and in contrast to the usual practice in Brazil and to what CODEVASF itself was doing with landless farmers, CODEVASF did not provide across-the-board subsidies to firms. Instead, it selected firms from outside Petrolina-Juazeiro—mainly from states of Brazil’s southeast—which had know-how about crop technology and marketing and attracted them to its irrigation projects with subsidized land and irrigation infrastructure. CODEVASF did this extensively in Petrolina-Juazeiro, only partially in the North of Minas Gerais, and did not do it at all in the *Baixo São Francisco*.

c) Introducing competition for subsidies. In contrast to the usual practices of either providing subsidies across-the-board or to support specific firms or sectors, CODEVASF combined targeted subsidies mentioned above with the practice of making firms compete for subsidies. Agricultural firms interested in establishing in CODEVASF’s irrigation projects in Petrolina-Juazeiro had to bid for specific plots of land by presenting project proposals that detailed the type of crops that they would grow, the technologies that would

apply, the employment that they would generate, and the markets in which they would sell. CODEVASF did not do this at all in the *Baixo São Francisco* and, as explained below, it did it in the North of Minas Gerais, but without monitoring the compliance of firms' project proposals.

d) Disciplining firms. Similarly to the East Asian policies to promote industrialization, CODEVASF provided subsidized land and irrigation infrastructure to medium-size firms, but required at the same time that they meet production targets, withdrawing subsidies, fining them, or forcing them to leave when they did not comply. Meanwhile, the agency did not monitor firms' performance in the North of Minas Gerais. In addition, although many firms wanted to buy the land, CODEVASF would sign with them lease contracts only. These lease contracts were normally for a five-year period and could be renewed for five additional years, but only with CODEVASF's approval. Only after that period, and upon the condition that it had demonstrated to be a good producer, a firm would become eligible to purchase the land. CODEVASF did not discipline firms in the other regions.

e) Encouraging turnover in irrigation projects. Most analysts of land reform and irrigation in Brazil and elsewhere view turnover in land settlements negatively, often using it as an indicator of failure. For that reason, government agencies dealing with land settlements elsewhere (including DNOCS, INCRA, and even CODEVASF in Brazil), prohibited *colonos* in their projects to sell the land. In contrast, CODEVASF allowed and even encouraged turnover in Petrolina-Juazeiro both among *colonos* and firms. Although turnover also took place in CODEVASF's projects of the North of Minas Gerais and the *Baixo São Francisco*, it only occurred during the first years after the establishment of the projects. In both cases, officials of the agency's local branches in both regions viewed

turnover negatively, so they implemented measures to prevent it.

New marketing connections and the relationship with growers' associations

While investing in irrigation infrastructure and the above-mentioned principles that CODEVASF applied in managing them were crucial for the modernization of agriculture and the economic transformation of Petrolina-Juazeiro, they do not fully explain how farmers were able to solve a number of collective action problems associated with exporting high quality fresh fruits. Exporters of high quality fresh fruits elsewhere often need to carry out tasks that require a high degree of compliance from all producers in a region, such as enforcing minimum quality standards, avoiding harvest concentration, and controlling pests that may decimate the crops or even jeopardize the access to some foreign markets. While exporters need to act jointly in order to solve these constraints, they often fail because of several problems associated with collective action. In Petrolina-Juazeiro, CODEVASF interacted with producers to solve these collective action problems, helping to define the problems, undertaking strategic interventions to solve them, and engaging growers in joint efforts to build associations key for solving them and for learning. Such efforts led to the creation of Valexport, an institution that effectively solved collective action problems and actively represented the interests of exporters before federal, state, and municipal government agencies, demanding good performance from them and effectively signaling the type of support that they needed in producing for export. Such pressures made in turn other government agencies to play key roles in facilitating the access to foreign markets and helping firms to learn about the technologies needed to comply with sanitary regulations in importing countries. In contrast, both the *Baixo São Francisco* and the North

of Minas Gerais lack this type of institutions and CODEVASF did not promote them.

The incorporation of high-value crops and new technologies among *colonos* in irrigation projects

Government agencies dealing with land settlements in Brazil (INCRA, DNOCS, and CODEVASF) and elsewhere have often failed in promoting the adoption of new crops and technologies among small farmers. In contrast, CODEVASF and the Bank of Northeast Brazil succeeded in helping *colonos* introduce new crops for export (mainly grapes and mango) and to adopt new technologies that led them to obtain higher yields, indeed, sometimes even higher than those obtained by medium-size and large firms.

a) Learning by going from easy to difficult. CODEVASF deliberately used a strategy that supported a sequence of crops over time, starting with crops with simpler technology and marketing and less investment and working capital (notably annual crops like melon, watermelon, and industrial tomato for the domestic market), later shifting to crops with more complex technologies and marketing and higher requirements of capital (perennial crops like table grapes and mango for export). Such a sequence allowed *colonos* to learn about irrigation technology, to obtain revenues while growing at the same time crops whose first revenues required three years, and to capitalize their farms.

b) Promoting backward linkages from processing industries. CODEVASF encouraged backward linkages from tomato-processing industries to agriculture, assuming a negotiating role to attract firms from São Paulo to open facilities in Petrolina-Juazeiro. The agency promised these industries that it would encourage *colonos* to grow industrial tomato and negotiated with the Bank of Northeast Brazil for this agency to provide credit for working

capital to *colonos* who grew industrial tomato and signed contracts with processing firms. The tomato industries turned into important actors in the modernization of colonos' agricultural production because they not only purchased their tomato, but also provided inputs and disseminated new production technologies among them.

c) Intermediating in the transfer of technology from firms. The Bank of the Northeast played an instrumental role in providing not just credit, but intermediating in the transfer of technology between agricultural firms and *colonos*. Both *colonos* and firms applying for investment credit had to present project proposals that detailed, among other things, the technology to be applied. When assessing proposals, technicians of the Bank of the Northeast not only required from *colonos*' projects the same technological standards than from firms, but also made *colonos* apply the same new technologies proposed by the firms' proposals--many of which were unknown even by government research stations and extension agencies.

Mediation in wage negotiations

Conflictive relations between rural workers and employers in non-traditional, high quality crops may have devastating effects on quality and lead to the loss of markets. Government agencies, namely the offices of the Ministry of Labor at the state and municipal level played a key role in Petrolina-Juazeiro mediating in the sometimes conflictive wage negotiations between growers and workers and in monitoring their compliance with labor contracts. In contrast, this did not happen in the offices of the Ministry of Labor in the North of Minas Gerais and in the *Baixo São Francisco* focused on urban activities rather than rural.

Methodology

The cases

I selected the three cases included in this study (Petrolina-Juazeiro, the *Baixo São Francisco*, and the North of Minas Gerais) because at the same time that they shared many similarities--especially the role played by CODEVASF in their economic transformation--they differed substantially in the type of interventions implemented by government agencies. The similarities between the different regions are the following:

- 1) Similarly to many other areas in the semiarid Northeast, the characteristics of their natural resources give all of three cases great advantages if compared to Brazil's southeast region (a traditional producer and exporter of agricultural products) for producing an export-oriented irrigated agriculture--though only Petrolina-Juazeiro has been able to break into exports. Being located in the São Francisco River Basin, a 640,000 km² area that is part of the semiarid Northeast and comprises 7.5% of Brazil's territory, it had a semiarid climate, though Petrolina-Juazeiro had a lower rainfall (450 mm annually) than the North of Minas Gerais (650 mm) and the *Baixo São Francisco* (800 mm). These climate conditions allow farmers to obtain two or more harvests a year in several crops like rice, grapes, and other fruits and vegetables, and have a high supply of these products during the US and European counterseason. The lower rainfall of Petrolina-Juazeiro turned out to be an advantage when producing with irrigation because it reduces the costs of controlling pests and allows to produce during some periods of the year in which the others would not be able to do so. While all three cases had poor soils, the *Baixo São Francisco* had the ones with the lowest fertility and the North of Minas Gerais the richest ones, with Petrolina-

Juazeiro showing an intermediate pattern. In addition, the *Baixo São Francisco* had an important proportion (75%) of soils of low permeability, which are very appropriate for the cultivation of crops irrigated with inundation (notably rice). The North of Minas Gerais was located closer to large cities in the south of Brazil, while the *Baixo São Francisco* was located closer than Petrolina-Juazeiro to large harbors (Salvador).

2) Being part of the São Francisco River Basin, the three regions were subject to the same macroeconomic conditions, the same regional policies of the federal government, and (at least in principle) to several similar interventions of federal government agencies. Through agencies created to promote the development of the Northeast region, such as CHESF, SUDENE, and mainly CODEVASF, the federal government made heavy investments in roads, electrification, and irrigation infrastructure in the São Francisco River Basin. In 1955, CHESF completed the construction of the Paulo Afonso dam, an endeavor that raised dramatically the supply of electric power for the whole Northeast and thus allowed the establishment of irrigation based on electric power. In 1979, CHESF finished the construction of the Sobradinho dam in the São Francisco River, another large investment that not only generated electric power but also regularized the São Francisco river--previously characterized by extreme variations in its flow. Thus, this project led to the irrigation of additional areas away from the river that had not had previous access to a regular supply of water from the São Francisco River. In addition, CVSF, SUVALE, and CODEVASF constructed between 1945 and 1990 2,000 kilometers of roads in the São Francisco River Basin, 2,700 kilometers of electric power distribution lines, and 1,800 kilometers of water distribution lines.²⁰ Between the late 1960s and the early 1990s,

²⁰ See CODEVASF (1991).

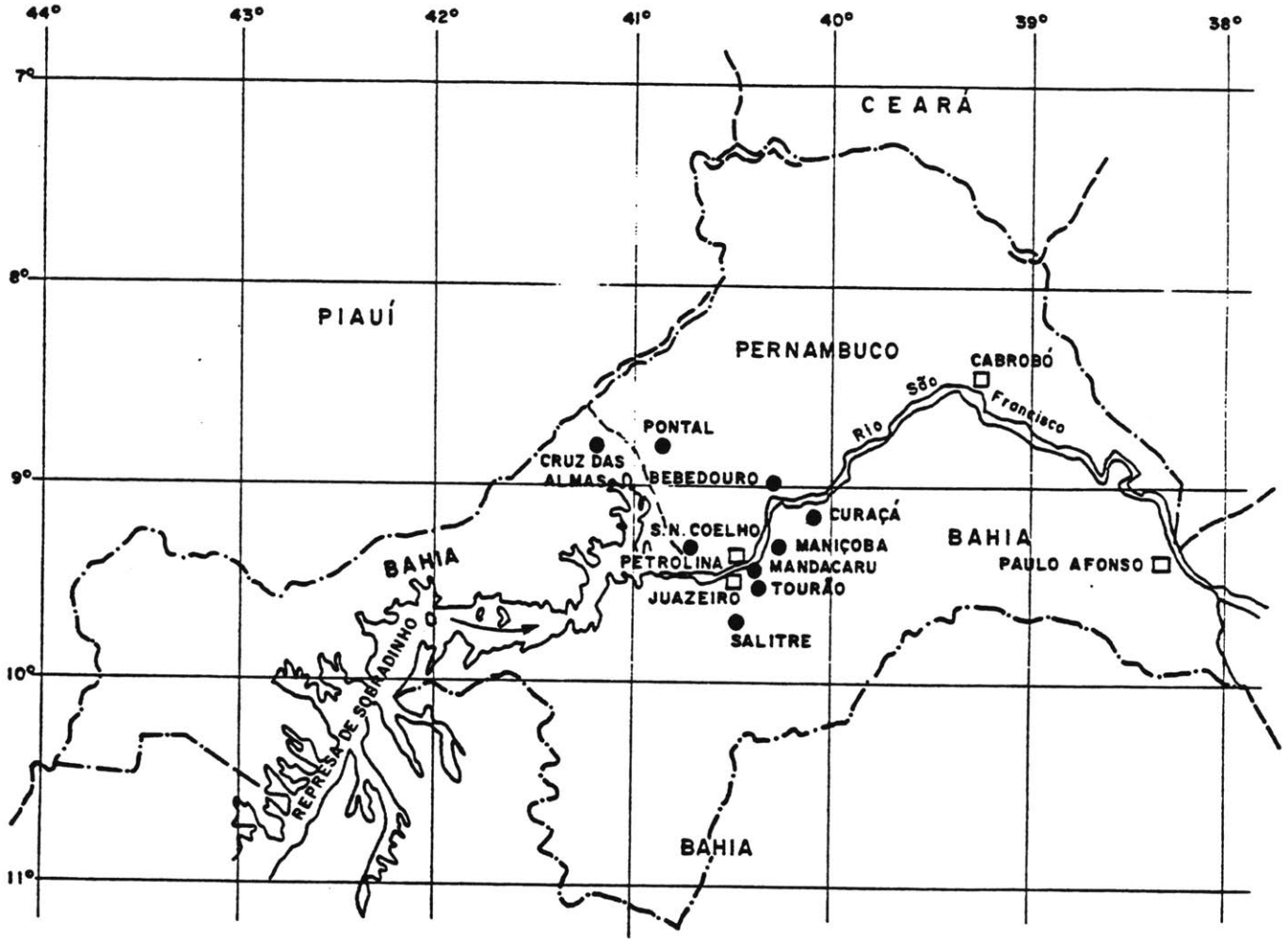
CODEVASF established irrigation projects to water more than 80,000 hectares of land in the three regions (see table 1 and maps 4 to 6).

Table 1. Irrigation projects in the São Francisco River Basin by 1996

Irrigation project	Year operation	Area with irrigation (hectares)
<u>Petrolina-Juazeiro</u>		
Bebedouro	1968	2,418
Mandacarú	1973	434
Curaçá	1978	4,397
Maniçoba	1980	4,317
Tourão	1979	10,454
Senador Nilo Coelho	1985	15,876
TOTAL		37,876
<u>North of Minas Gerais</u>		
Jaíba	1987	24,075
Gorutuba	1978	7,149
Pirapora	1979	1,262
Lagoa Grande	1992	1,660
TOTAL		34,126
<u>Baixo São Francisco</u>		
Betume	1977	2,860
Propriá	1976	1,177
Cotinguiba-Pindoba	1981	2,215
Boacica	1980	3,334
Itiúba	1975	833
TOTAL		10,419

Source: Information provided by CODEVASF.

Map No. 4. Irrigation projects implemented by CODEVASF in Petrolina-Juazeiro

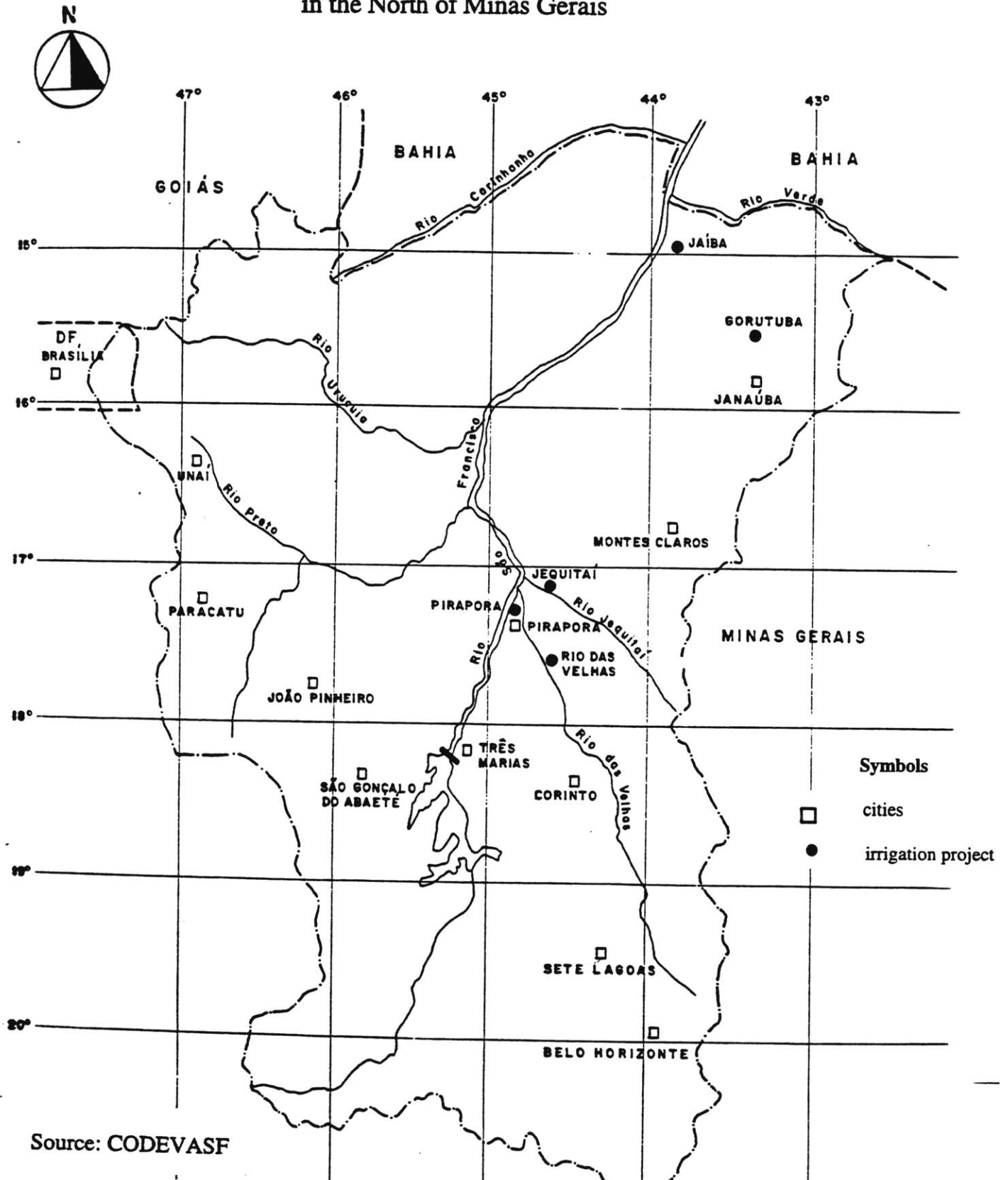


Symbols

- cities
- irrigation project

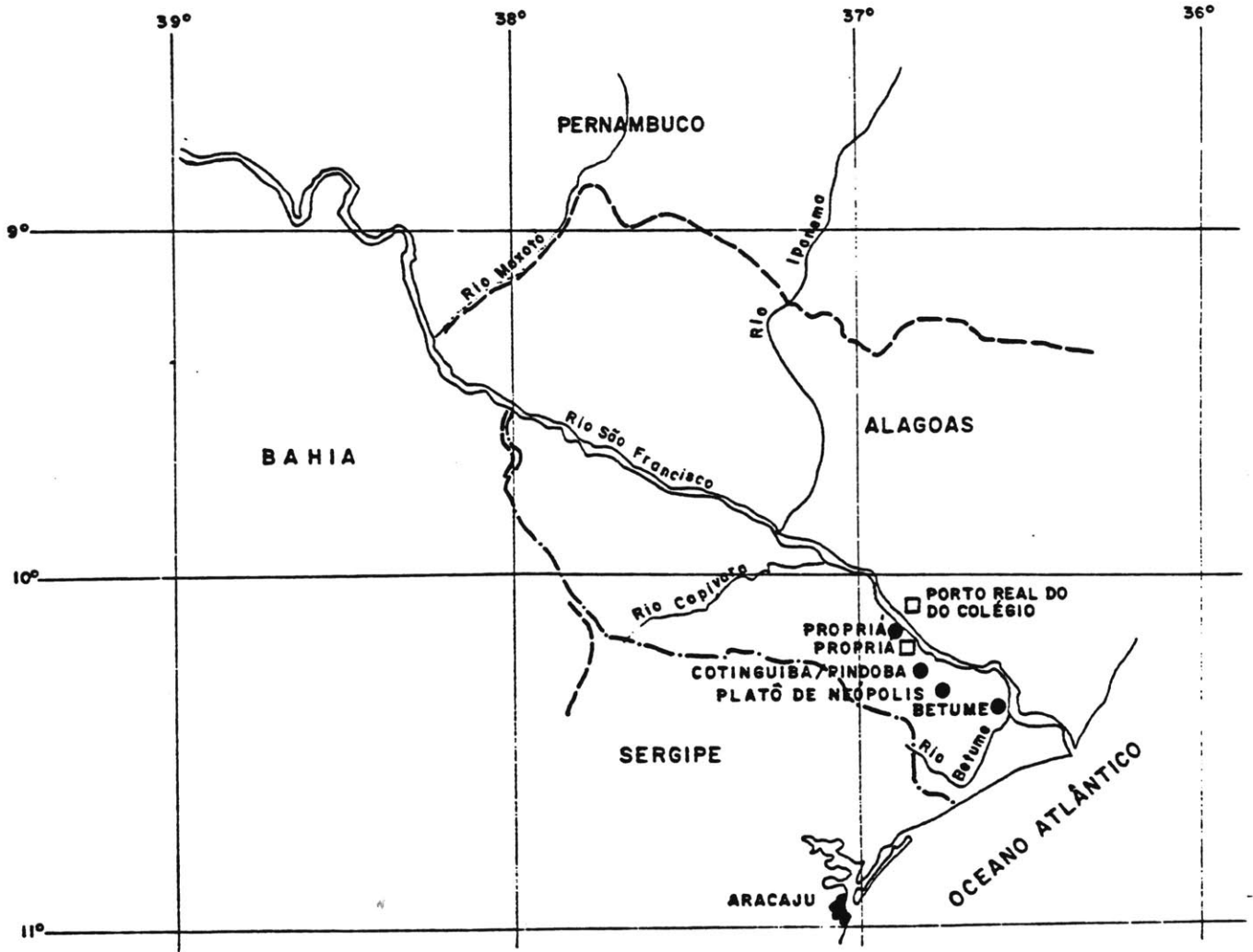
Source: CODEVASF

Map No. 5. Irrigation projects implemented by CODEVASF
in the North of Minas Gerais



Source: CODEVASF

Map No. 6. Irrigation projects implemented by CODEVASF
in the *Baixo São Francisco*



Symbols

- cities
- irrigation project

Source: CODEVASF

In spite of these investments in irrigation infrastructure, the comparison between the three regions shows substantial differences with respect to the performance of agriculture and the characteristics of the labor market. Some of the main differences are the following:

1) Crop structure. Petrolina-Juazeiro has developed a diversified agriculture that includes crops both for export (grapes and mango) and the domestic market (banana, passion fruit, guava, tomato, melon, watermelon, and onion, among others). In contrast, farmers in the *Baixo São Francisco* have focused on cultivating rice of low quality for regional markets (mainly the capital cities of the Northeast of states Sergipe and Alagoas). By 1996, the area with rice in CODEVASF's irrigation projects in the *Baixo São Francisco* reached 7,900 hectares, accounting for 94 percent of their total cultivated area.²¹ The North of Minas shows an intermediate pattern, with farmers growing mainly banana, plus a mix of substantially smaller areas of beans, corn, table grapes, and mango (see table 2).

2) Yields. While the average yields in several crops (especially those for export) in Petrolina-Juazeiro have been significantly higher than in the Northeast region and Brazil as a whole, average yields of crops in the *Baixo São Francisco* and the North of Minas Gerais were usually lower than in other regions of irrigated crops and than the yields expected by the designers of irrigation projects in the respective regions. For example, average yields of rice in the *Baixo São Francisco* varied between 2.5 and 3.5 tons per hectare between 1991 and 1993 and only reached an average of 4 tons per hectare in 1994-96, compared with a minimum of 4.7 tons per hectare and a maximum of 5.1 tons per hectare during the same periods in the state of Rio Grande do Sul.

²¹ Information obtained from CODEVASF (1997).

Table 2. Area with main crops in CODEVASF's irrigation projects in Petrolina-Juazeiro, the North of Minas Gerais, and the *Baixo São Francisco* by 1996

	North of Minas Gerais	Petrolina-Juazeiro	Baixo São Francisco
Mango	1,800	8,500	---
Grapes	380	6,000	---
Beans	26,500	5,300	---
Tomato	10	4,000	---
Onion	100	4,000	---
Banana	8,000	3,500	---
Rice	1,450	---	7,900

CODEVASF (1997). "Relatório Anual de Monitoria, 1996." Brasília: CODEVASF.

3) Quality and markets. Producers in Petrolina-Juazeiro have achieved a production of high quality, especially in export crops. Exporters have been selling mango and table grapes in demanding markets in Europe and the United States, adopting new production technologies, investing in expensive post-harvest facilities, and training their labor force in order to improve quality (see tables 3 and 4). Petrolina-Juazeiro has even displaced the much more developed Southeast of Brazil from export markets in mango and table grapes, accounting for 90% and 74% of Brazil's exports of grapes and mango respectively by 1993. In contrast, farmers in the *Baixo São Francisco* have been selling their production in markets that are not demanding in quality--mainly in capital cities of Northeast states--and have been slow to adopt new technologies. In the North of Minas Gerais, producers obtain intermediate quality levels, good enough for demanding markets in the cities of Belo Horizonte and Rio de Janeiro, but not good enough to export.

4) Labor. Irrigated agriculture in Petrolina-Juazeiro led to widespread increases in wages, upskilling of labor, and improvement in labor standards. In contrast, most wage workers in both the North of Minas Gerais and the *Baixo São Francisco*—as well as in

Table 3. Petrolina-Juazeiro - Area, production, and exports of mango

	Total crop area (ha)	Area currently in production (ha)	Quantities produced (t)	Exports (t)
1991	3.220	1.150	8.800	3.000
1992	4.230	1.900	12.000	9.000
1993	5.400	2.650	25.000	13.000
1994	6.200	3.600	35.000	15.000
1995	6.800	4.500	43.000	20.000
% growth	111,2	291,3	388,6	566,6

Source: Valexport

Table 4. Petrolina-Juazeiro - Area, production, and exports of table grapes

	Total crop area (ha)	Area currently in production (ha)	Quantities produced (t)	Exports (t)
1991	2.620	2.300	32.000	1.050
1992	3.780	2.500	40.000	5.000
1993	4.000	3.000	52.000	10.000
1994	4.300	3.500	94.500	10.000
1995	4.500	4.000	110.000	12.500
% growth	71,8	73,9	243,8	1.090,5

Source: Valexport

most cases of non-traditional export crops analyzed in the literature, are temporary, earn low wages (frequently lower than the legal minimum), are not registered, and do not receive fringe benefits. In addition, workers usually work under poor conditions and they do not enjoy the rights of rural workers in Petrolina-Juazeiro gained through negotiations with growers.

5) In addition, as I explained earlier, the three regions differed in some important government interventions whose analysis will be the core of this dissertation. The main differences were: a) the principles applied by CODEVASF in the management of its irrigation projects; b) the interactions of CODEVASF and other government agencies with associations of producers; c) the interventions to promote the adoption of high-value crops

and new technologies among *colonos* in irrigation projects; and d) the interventions of the regional and local offices of the Ministry of Labor in the relationship between growers' and wage workers' organizations.

Field research

I carried out field work in Brazil during sixteen months between May 1996 and September 1997, spending about three quarters of the time in Petrolina-Juazeiro and the rest in the other two cases. The core arguments emerge from interviews that I carried out with producers (owners of firms and *colonos*) and landless wage workers involved in the cultivation of crops for export and for domestic market, firm managers and agronomists, representatives of firm and workers' associations, planners at government agencies, and politicians at the municipal, state, and federal levels. The interviews were open-ended and usually lasted about two hours, being based on an outline of questions that depended on the specific informant. In most firms, my interviews included field visits to the crops and to post-harvest facilities. In all cases, my visits to firms to interview wage workers were separate from those to interview owners or managers, agronomists, and *colonos*, so that I could interview workers without the presence of supervisors, managers, etc.

My initial task during the field work was to reconstruct the historical record of government interventions in the regions, for which I relied on different types of information. First, I reviewed an extensive amount of published articles, books, and reports from Brazilian government agencies both in Cambridge and in libraries of several Brazilian agencies and universities, including the Bank of Northeast Brazil, CODEVASF, DNOCS, EMBRAPA, IPEA, SUDENE, and the Federal University of Pernambuco (UFPE). Second,

I carried out interviews with planners and policy-makers who had been directly involved in the design and implementation of some of the most important government interventions carried out between the late 1950s and the late 1980s, especially with respect to irrigation investments and agricultural research. A second group of interviews included current government officials, especially in CODEVASF, EMBRAPA, Bank of Northeast Brazil, Bank of Brazil, SUDENE, EMATER, and IPA in the cities of Brasilia, Fortaleza, Juazeiro, Petrolina, Recife, and Salvador. A third group included leaders, members, and professionals of various associations: regional producers associations, user associations of irrigation projects, and rural workers organizations. A fourth group included governors, mayors, state legislators, and top-level government officials in all the regions involved. Lastly, I interviewed task managers at the World Bank who were involved with the supervision of projects of this institution that financed irrigation investments carried out by CODEVASF.

Interviews of growers included both firms and *colonos* in government-sponsored irrigation projects, as well as farmers of all sizes. I interviewed 30 firms in total, including most of the exporting firms and all the tomato-processing industries. With respect to *colonos*, I worked with a sample that included all the irrigation perimeters.

During the research period, I was fortunate enough to have an affiliation with the Technical Office of Northeast Economic Studies (*Escritório Técnico de Estudos Econômicos do Nordeste*, ETENE) of the Bank of Northeast Brazil (BNB), as part of a larger joint research project of MIT and the Bank of Northeast Brazil of which Prof. Judith Tendler was the principal investigator. This relationship provided me with the opportunity to interact with researchers and to obtain invaluable economic information from the bank

branches in each of the regions that I studied. In addition, I benefited from meetings with other MIT doctoral students who carried out field research in Northeast Brazil as a part of the same research project and from discussions in a research seminar directed by Profs. Judith Tandler and Richard Locke during the fall semester of 1997-98, in which each student of the group presented and discussed his/her research findings. I also maintained close links with the Post-Graduate Program in Economics (PIMES) at the Federal University of Pernambuco (UFPE), which gave me the opportunity to interact with faculty members who had carried out substantial research focused on irrigated agriculture in Northeast Brazil, as well as to have access to valuable research materials.

Organization of the dissertation

This dissertation is organized as follows. After this introductory chapter, chapter 2 will present a detailed account of the government interventions in the earlier stages of the economic transformation of Petrolina-Juazeiro, the North of Minas Gerais, and the *Baixo São Francisco*. During such earlier stages, federal government agencies emphasized building electric power and basic infrastructure (mainly irrigation) and carrying out research about the possibilities of different crops cultivated with irrigation. Chapter 3 will concentrate on how CODEVASF managed its irrigation projects, how and why it selected and attracted specific firms, how it made firms compete for subsidies, and why and how it monitored their compliance with project proposals. Chapter 4 will focus on how CODEVASF promoted the creation of Valexport, and how this association of growers who aimed to gain access to foreign markets played a key role in solving collective action

problems, such as the need for all exporters to meet minimum quality standards, and how it turned into an organization essential for growers learning about new technologies, gaining access to foreign markets, and signaling government agencies what they needed most to solve production and marketing problems. Chapter 5 will focus on the interventions implemented by CODEVASF and the Bank of Northeast Brazil to promote the adoption of new crops and technologies among colonos in government-sponsored irrigation projects. Chapter 6 will focus on the effects of agro-export growth on employment, wages, and working conditions, explaining how and why Petrolina-Juazeiro is different than the other cases. Chapter 7 will present policy conclusions.

CHAPTER TWO

AN OVERVIEW OF EARLY GOVERNMENT INTERVENTIONS

Analysts from different theoretical perspectives have explained the recent growth of dynamic, export-oriented, non-traditional crops that took place in Petrolina-Juazeiro--as well as in several Latin American countries--as a result of changes in world demand and of some specific government policies. First, they stress that the raise in incomes and the concerns for healthy foods, especially in industrialized nations, have led to an increase in the demand for and the prices of fresh fruits and vegetables.¹ These market changes pushed producers to shift from other crops to fruits and vegetables. Second, most analysts of NTECs stress that regions that developed these export sectors have been characterized by competitive advantages based on appropriate natural resources and cheap labor. Third, analysts--especially from the neoclassical perspective--have argued that governments of countries and regions that developed NTECs have implemented specific interventions: a) they have provided a “market friendly” policy environment, maintaining inflation low, avoiding overvalued exchange rates, lifting trade barriers, and reducing government intervention in factor and product markets, which encouraged farmers to invest in new crops and technologies; and b) they have invested in public goods--mainly infrastructure (roads, irrigation, and harbor facilities) and agricultural research.²

In contrast to these views, I argue that the successful outcomes of Petrolina-Juazeiro do not relate to market-friendly policies, as trade liberalization policies in Brazil started

¹ While dietary changes have varied between countries and among different income groups within countries, there has been a general shift towards the consumption of fruits and vegetables, high-protein foods like meats and dairy products, and prepared foods.

² Among others, see Valdez and Siamwalla (1988), Ferreira Irmão (1984), Houck (1991), Jaffee (1993), Marsden et al (1996), Martine (1987).

only in 1989 and successful stabilization policies began only in 1994. While these measures had important positive effects in the growth of cultivated areas in Petrolina-Juazeiro, its emergence as a successful producer of fresh fruits and vegetables of high quality both for export and the domestic market started before--in the late 1980s, when inflation was still high.³ In addition, I argue that the economic transformation of Petrolina-Juazeiro cannot be fully explained by government investments in public goods--mainly roads, electrification, and irrigation infrastructure. However, the long history of government investments in public goods were essential in making possible the growth of irrigated agriculture. This is interesting because policy analysts and the conventional wisdom in Brazil have often portrayed negative views of government interventions targeting the Northeast region, arguing that some of the main government agencies (like SUDENE and DNOCS) have been ineffective in doing their jobs and have been plagued by clientelism and corruption problems.

This chapter provides a background of the main interventions of federal and state government agencies in Petrolina-Juazeiro, the *Baixo São Francisco*, and the North of Minas Gerais between the mid-1940s and the mid-1980s, showing that negative views with respect to the role of government were not correct. The early interventions of the federal government included investing in infrastructure (electric power and roads) and agricultural research, tasks that most agricultural economists view as part of what the state should do to promote agriculture. The first section focuses on the period from the mid-1940s to the late 1950s, in which government agencies concentrated on research on the natural resources of

³ For analyses of stabilization programs implemented in Brazil during the 1980s, see Cardoso (1991), Cardoso and Dornbusch (1987), Kiguel and Liviatan (1991), and Modiano (1988).

the region and on building electric power, electrification, and road infrastructure. The second section focuses on the shift towards the support to small-scale irrigation that took place in the late 1950s. The third section concentrates in the shift towards large-scale irrigation investments.

The early period: emphasis on electric power, basic infrastructure, and agricultural research

The interventions of the federal government in the São Francisco River started only in the 1940s and departed substantially from the previous policy approach towards the Northeast region. Since the beginning of the 20th century, the federal government had focused on dealing with the periodic droughts (every 6 to 8 years) characteristic of the Northeast's semiarid zone. These droughts aggravated the problems of a low productivity agriculture and widespread rural poverty partly related to poor soils and a semi-arid climate, leading to increased unemployment and the migration of thousands of people to capital of the Northeast states and cities in the southern part of the country. In 1909, the federal government had created the Inspectorate of Works Against the Drought (*Inspetoria de Obras Contra as Secas*, IOCS), later transformed into the Federal Inspectorate of Works Against the Drought (*Inspetoria Federal de Obras Contra as Secas*, IFOCS) in 1919, and finally into the National Department Against the Drought (*Departamento Nacional de Obras Contra às Secas*, DNOCS). DNOCS concentrated on building small infrastructure projects (dams, wells, and roads) and implemented emergency programs during the drought periods that

provided employment to the rural population in exchange for a minimum wage.⁴

In contrast to these interventions related to alleviating the problems of drought and unemployment, the attention of the federal government to the São Francisco River Basin related to more “developmental” interests. The São Francisco River runs 2,700 km north through five states from its origins in the south of Minas Gerais to its termination in the Atlantic Ocean, including Minas Gerais, Bahia, Pernambuco, Sergipe, and Alagoas. First, the federal government viewed it as an important source for generating electric power and promoting irrigated agriculture. Second, the Brazilian army also viewed the São Francisco River as a means of transportation between the South and the Northeast of the country. German submarines had attacked ships moving along Brazil’s Atlantic Ocean coast during the World War II. Because the main highways and railroads communicating the South with the Northeast were still under construction, the army had no choice but to use the São Francisco River for the transportation of forces and materials during the war. As a result of these concerns, a new Constitution approved by the Brazilian Congress in 1946 established that the federal government had to carry out a series of studies and formulate a plan to develop the São Francisco River basin within the next 20 years. Thus, the federal government created two agencies to intervene specifically within the limits of the São Francisco River⁵:

- a) The São Francisco River Hydroelectric Company (*Companhia Hidroelétrica do Rio São Francisco*, CHESF), created in 1948, would focus on building electric power

⁴ For analyses of federal government policies against the drought and the role of DNOCS, see Albuquerque and Cavalcanti (1976), Carvalho (1979 & 1988), Hirschman (1963), and Sobrinho (1958).

⁵ In addition to these two agencies specialized in the São Francisco River Basin, the federal government created the Bank of Northeast Brazil (Banco do Nordeste) in 1952 in order to provide credit for the development of industry, agriculture, and services in all the Northeast region.

infrastructure. By 1994, CHESF had built several hydroelectric power plants--Paulo Afonso, Sobradinho, Itaparica, Moxotó, and Xingó--which generated 14% (34 billion KW/hour) of the electric power produced in Brazil.⁶

b) The São Francisco River Basin Commission (*Comissão do Vale do São Francisco*, CVSF), also created in 1948, transformed into the Superintendency for the São Francisco River Basin (*Superintendencia do Vale do Rio São Francisco*, SUVALE) in 1967 and into the Sao Francisco River Basin Development Agency (*Companhia de Desenvolvimento do Rio São Francisco*, CODEVASF) in 1974.⁷ Modeled after the US Tennessee Valley Authority, but significantly different in that it did not manage electric power infrastructure, CVSF's mission was to formulate a development plan for the São Francisco River Basin which included the promotion of navigation, irrigation, and agricultural and industrial development.⁸ In spite of this range of tasks, the agency concentrated during the first ten years after its creation (until the late-1950s) on investigating the potential of soils for irrigated agriculture, determining that 3 million hectares of land were appropriate for irrigation. However, the agency experienced pressures from local elites all over the São Francisco River Basin to invest in basic infrastructure, so it ended up focusing on building roads, schools, health posts, and electrification infrastructure in small cities and towns. CVSF built 1,900 km of roads, 50 small airports, more than 120 water supply projects in small cities, 14 electric power plants that generated 408,000 KW, and 2,700 km of transmission lines.⁹

Although these investments in infrastructure did not have an immediate substantial

⁶ For a detailed account of CHESF's interventions in electric power infrastructure, see CODEVASF (1991)

⁷ CVSF was created by the Law No. 541 of December 15, 1948, SUVALE by the Decree-Law No. 292 of February 28, 1967, and CODEVASF by the Law No. 6088 of July 16, 1974.

impact in the rural economy, they were important (though not sufficient) for a successful economic transformation. Because roads in the Northeast of Brazil were very bad and poorly maintained, farmers had great difficulties to reach markets other than local towns. In addition, the investments in electric power and electrification detailed above made possible the great expansion of irrigation in the Sao Francisco River that took place in the 1980s.

Starting in the mid-1950s, CVSF began working with agricultural production, opening regional offices in several cities and hiring agronomists and agricultural technicians to provide extension services to farmers. These early extension services played an important role in the transformation of agriculture. Most producers in the São Francisco River basin at that time comprised large landowners who raised livestock in natural pastures, obtaining low productivity levels. Landless people often cultivated cotton as sharecroppers, paying part of the production (usually 50%) to the landowner. In addition, farmers located in the margins of the river grew some crops (mainly onion, corn, and beans) on the river beds during the dry season--a traditional technology of production that led to higher crops than dryland agriculture but substantially lower than with irrigation. Extension services concentrated on distributing small-scale irrigation kits (usually a 10 HP pump and some irrigation tubes) among these farmers and on providing them with technical assistance in the use of the kits and the management of irrigated crops like onion and watermelon. These interventions led to an increase in the area with irrigated crops, the rise of crop areas, and the introduction of some new crops. These farmers who received irrigation kits started to grow irrigated crops--mainly onion and watermelon--in areas other than the river bed.

⁸ See Article 7, Law No. 541/1948.

By the end of the 1950s, the Petrolina-Juazeiro region had turned into one of the main onion producers in Brazil's Northeast.

After concentrating on these tasks for more than a decade, CVSF shifted in the 1960s towards investing in large-scale irrigation because of the influence of a new and powerful agency that the federal government created in 1959 to promote the development of the Northeast region, the Superintendency for the Development of the Northeast (*Superintendencia para o Desenvolvimento do Nordeste*, SUDENE). The next section will focus on the creation of SUDENE and its influence in CVSF's shifting towards building and operating large-scale irrigation projects.

The creation of SUDENE and the shifting to investing in large-scale irrigation projects

While CVSF was having an increasing presence in the São Francisco River Basin, DNOCS's infrastructure projects and employment programs still represented the main interventions of the federal government in the Northeast region until the late 1950s. Although these interventions aimed to deal with the periodic crises in unemployment, poverty, and out-migration in the rural areas caused by the drought, policy analysts from different perspectives and politicians from both the South and the Northeast criticized them. While DNOCS built dams to increase the availability of water, it often built them in the lands of large landowners, so they ended up benefiting them rather than the poor. Celso Furtado, a progressive and well-known Brazilian Northeastern development economist, argued:

⁹ See CODEVASF (1991)

“DNOCS’s efforts failed because there were no institutional conditions to succeed. The most important problem, which affected all the others, was the agrarian structure of the (Northeast) region. Dams were built in the lands of large landowners, who focused on extensive livestock production and were adverse to any fundamental change in the organization of work and any type of social project... The result of such enormous efforts turned into a mere caricature, with the Northeast probably being the region in which human beings have accumulated more water in the world while watching how it evaporates instead of using it adequately.”¹⁰

In the mid-1950s, the political pressure from these problems on the federal government became more serious with the emergence of the “*Ligas Camponesas*,” a social movement in the sugarcane zone of Pernambuco that claimed for land reform interventions. The concern with these problems led Juscelino Kubitschek, the newly elected President who aimed to incorporate all regions in the development of the country, to create a task force called Working Group for the Development of the Northeast (*Grupo de Trabalho para o Desenvolvimento do Nordeste*, GTDN). Coordinated by Celso Furtado, GTDN had to analyze and propose interventions to develop the Northeast region. During its first two years, GTDN’s work faced opposition from politicians from various parties and states and for different reasons, such as the fear that DNOCS could lose its hegemonic role in the Northeast, or the concern of Governors of smaller states in the Northeast (like Piauí and Paraíba) that federal government interventions could benefit mainly the most influential states at that time (Bahia and Pernambuco).¹¹

In 1958, a serious drought affected Northeast Brazil, pushing the federal government to channel funds for traditional interventions based on emergency employment programs and the construction of small infrastructure projects. However, accusations of misuse of federal funds during the drought made during the political campaign for the national elections in 1958 gave new life to the work of GTDN. In addition, President

¹⁰ Furtado (1962), p. 3.

¹¹ Cohn. Amélia (1976), cited by Carvalho (1979), p. 163.

Juscelino Kubitschek had received that year a report from one of his military advisors, which portrayed Northeast Brazil as a region experiencing “a somber and alarming economic and social disintegration,” as well as representing “a potential danger for the political unit of Brazil.”¹² These problems led GTDN to present a report in 1959 and the President to implement one of this report’s main recommendations: the creation of a new agency to promote the economic transformation of the Northeast region.¹³ In February 1959, the federal government sent a bill to the Congress to create the Superintendency for the Development of the Northeast (*Superintendencia para o Desenvolvimento do Nordeste*, SUDENE), a bill that the Congress approved in December of that year.¹⁴

SUDENE represented a new approach to dealing with the problems of the Northeast region. In contrast to DNOCS, which concentrated on struggling against unemployment and poverty in rural areas through emergency employment programs, SUDENE aimed to promote the economic transformation of the Northeast.¹⁵ SUDENE’s main tasks would be: a) to study and design strategies and plans for the development of the Northeast region; b) to supervise and coordinate the design and implementation of federal development programs and projects; c) to coordinate programs of technical assistance to Northeast states; d) the agency could also implement development projects directly or jointly with other agencies.¹⁶

¹² See Carvalho (1979), pp. 167-168.

¹³ See GTDN (1959).

¹⁴ The Law No. 3.692 that creates SUDENE was approved on December 15, 1959.

¹⁵ See Hirschman (1971) and Vieira (1990) for an analysis of tax exemptions and credit subsidies to industries in Northeast Brazil. See Holanda (1979) and Bezerra (1990) for analyzes of FINOR--a program of subsidized credit to finance industrialization in the Northeast. Also, see Magalhães (1983) and Rebouças (1978) SUDENE (1992) for overviews of industrialization in the Northeast.

¹⁶ For analyses from different perspectives of SUDENE’s work, see Furtado (1962), Carvalho (1979), and de Oliveira (1981).

GTDN's report was very influential in SUDENE's approach to rural development and in the type of interventions that the federal government implemented with respect to irrigation.¹⁷ The report argued that promoting industrialization was the main strategy to reduce unemployment in the Northeast because only the industry could provide a large number of jobs in urban areas. In contrast, it considered that agriculture could not play an important role because of the constraints of a semi-arid climate and poor soils and the conservative behavior of the traditional elites linked to agriculture, who would not invest in modernizing agricultural production. The main role of agriculture would be to provide cheap food to urban workers, avoiding that the low productivity of agriculture led to an increase in the prices of food and thus in wages. Thus, the report proposed that the federal government promote livestock and a few crops through credit and technical assistance.

Although SUDENE had an approach to rural development different than DNOCS—focusing on promoting agricultural growth rather than DNOCS's focus on water infrastructure and emergency employment programs—it avoided challenging the power of large landowners and actually supported their main activities—livestock and cotton interplanted with corn and beans. In addition, GTDN's report considered that the rural poor had few possibilities to improve their standards of living in the semiarid region, so it considered that the best solution was to transfer most of them to new areas in the state of Maranhão, the only Northeast state that had large areas of good and unoccupied lands. These lands were located in the south of the state, where climate conditions were

¹⁷ See GTDN (1959).

substantially more favorable for agriculture (more rains).¹⁸

In addition, the report argued that irrigation could not lead to a transformation of Northeast rural areas for four reasons: a) the area that could be irrigated was relatively small; b) the costs of building irrigation infrastructure would be too high; c) farmers doing irrigated agriculture could not reach markets other than the semi-arid region itself, a market that was very limited during normal years, when the harvest of foodstuff provided enough products for the consumption of the population; and d) irrigation could not help to solve what SUDENE viewed as the central problem in the semi-arid region—an unstable income of the poor rather than low food production because employment in irrigated agriculture would continue to be mostly seasonal.

These views and assertions with respect to the role of agriculture and irrigation--which the next chapters will show were not correct--were heavily influenced both by predominant views in the development field, which viewed the industrial sector as the engine of growth, and the limited information available at that time with respect to agricultural technologies and the potential of different crops with irrigation. However, GTDN's report ended up having an important role in the selection of the Petrolina-Juazeiro region for concentrating federal government investments in irrigation infrastructure. As I said earlier, GTDN worried that Recife--Pernambuco's capital city and the main industrial center of Northeast Brazil at that time--was experiencing problems with the supply of food. Because many of the agricultural products consumed in Recife at that time had to be

¹⁸ In contrast to these proposal, the state government of Maranhão started to give tax breaks to large farmers who opened new lands to the cultivation of soybean in the south of the state. In the 1980s, Maranhão had turned into one of the rapidly expanding new areas of soybean in Brazil, along with the west of the state of Bahia and the south of Piauí.

brought from other regions, they had to pay high transportation costs and thus had higher prices than in other capital cities in the Northeast. In addition, the “*Ligas Camponesas*” land reform movement became most active during the 1950s in Pernambuco, where Francisco Julião--a state deputy--had been one of the most influential leaders participating in its creation.

In order to deal with these problems, GTDN proposed the creation of a task force comprising specialists from several federal and state government agencies: SUDENE, SUVALE, CONDEPE (Pernambuco’s state planning agency), and the Bank of Brazil. This task force had to analyze the possibilities of increasing food production in areas relatively close to Recife and which GTDN’s authors viewed as having good potential for agriculture: the sugarcane zone in the Agreste region, and in the mid-stream portion of the São Francisco River Basin--where Petrolina-Juazeiro is located. GTDN pointed out that the margins of the São Francisco River closer to Recife could be used to promote irrigated agriculture, thus increasing food production. While the proposals of GTDN emphasized that the main objective of irrigation was to increase food production, the large-scale irrigation projects that it proposed resembled land settlement projects. One technician from SUVALE who participated in these meetings argued: “What we were really talking about was some kind of ‘soft’ land reform. We emphasized on promoting irrigation, but we were also proposing land expropriations to create large irrigation projects and settle landless people.”

Because SUDENE did not have the technical capacity to implement these studies, it rapidly negotiated a project with the Food and Agriculture Organization (FAO) to study the possibilities of irrigated agriculture in the portions of the São Francisco River Basin that

were closer to the city of Recife, i.e. the lower middle basin between the Paulo Afonso waterfall and power plant--280 km from the river mouth--and Sobradinho--520 km upstream of the Paulo Afonso power plant (see map No. 2). Although small-scale irrigation was already common among small farmers in the margins of the river, SUDENE asked FAO to analyze the feasibility of large-scale rather than small-scale irrigation. Specialists from SUDENE--particularly Celso Furtado, agency's President and intellectual leader--firmly believed in principles from theories popular at that time. Two of the most influential ones in SUDENE's interventions were: a) that investments in irrigation infrastructure for water distribution were characterized by economies of scale; and b) that concentrating investments in a number of selected places rather than dispersing them was a more efficient government intervention because it would lead to "growth poles".¹⁹ Officials from SUDENE expected that an agency of the federal government would be in charge of operating the projects (i.e., distributing the water and collecting water fees) and maintaining their infrastructure. However, it was unclear to them which agency would be in charge of these tasks and expected FAO's studies to propose the best solution partly based on the international experience of management of government-sponsored, large-scale irrigation projects. These type of irrigation investments were common in countries like Mexico, Perú, and Egypt, consisting of the construction by a government agency of pumps and canals to bring the water from a river and to distribute it among farmers. In addition, they usually included land settlement projects and building of farm-level irrigation infrastructure. Officials from SUDENE thought that the combination of large-scale central irrigation systems with settlement projects would allow to promote another key intervention that

¹⁹ For literature about growth poles, see Perroux (1961), Nichols (1969), and Kuklinsky (1972).

GTDN had recommended in its report, namely to establish landless farmers brought from semi-arid areas without possibilities of doing irrigated agriculture.

After SUDENE and FAO signed a contract in 1960 approving the project, a mission from FAO started to carry out a wide range of geological, hydrologic, agronomic, economic, and sociological studies. In the first eighteen months, these studies had to determine whether large-scale irrigation was physically feasible, and in a second stage of similar length, if they were economically feasible. The third phase of two years had to detail proposals for large-scale irrigation projects and related settlement schemes.

FAO's research produced a detailed mapping of the region's soils and recommended several places to establish large-scale irrigation projects, pointing out to Petrolina-Juazeiro as the most appropriate region for three reasons:²⁰

- 1) Petrolina-Juazeiro was relatively close to Recife (630 kilometers), which was—as I explained earlier—the city that most concerned SUDENE because of the food supply problems that could constrain industrial growth.
- 2) Petrolina-Juazeiro had a much larger concentration of soils appropriate for large-scale irrigation (a total of 270,000 hectares) than regions upstream and downstream the river, where areas of lands with potential for irrigation were smaller and more dispersed.
- 3) That portion of the São Francisco River had less problems of alternative uses of the water other than irrigation than downstream and upstream, where CHESF had either completed or had plans to build several electric power plants. In contrast, the number of sites available for hydropower development in Petrolina-Juazeiro was very limited.

Because the federal government did not have any experience with large-scale

²⁰ See UNDP/FAO (1966).

irrigation projects, FAO's report recommended that the initial investments in Petrolina-Juazeiro be small and serve as a pilot experience. These pilot projects had the advantage of involving the expropriation of a small area of land (a total of less than 500 hectares), so they would not create opposition from landowners. The pilot projects would serve to study the best crops to establish, the response of small farmers to irrigated farming, the most appropriate farm-size, the type of water management system that would bring the least complications, and the problems of implementation that could arise.

Following FAO's recommendations, SUDENE built two small "pilot" projects (Mandacarú and Bebedouro) in 1965, establishing close to one hundred farmers on each. In each of the projects, the agency established an agricultural research station of 20-25 hectares. Agricultural research would continue to focus on the yields of crops and crop varieties with irrigation and the water requirements of each crop. Some of the crops studied, such as corn, beans, cotton, onion, and watermelon, were already common in Petrolina-Juazeiro. Others, such as grapes, mango, melon, tomato, and lettuce, were mostly unknown. In fact, most farmers in Petrolina-Juazeiro did not even believe that they could grow crops like grapes and melon partly because they were typical of a temperate climate.

A former director of CODEVASF's office in Juazeiro stressed:

"Now it looks natural in this region to grow irrigated crops, have good yields, and obtain two harvests a year in several crops. However, we knew almost nothing at that time about what crops could do well in the climate and soil conditions of Petrolina-Juazeiro. We had to do research from scratch to see what crops would actually grow here, when would be the best harvest season for each crop, what would be the average yields, how much water they would require irrigation, and what could be the potential constraints, such as pests or soil conditions."

The results of the research on the performance with irrigation of different crops and crop varieties provided SUDENE and CVSF relevant information to select the crops that

these agencies would promote among *colonos* in irrigation projects. Interestingly, SUDENE's choice of crop mix included not only several cash crops like onion, melon, watermelon, and tomato, but also corn and beans, which *colonos* used to grow when they were landless. As I will explain in detail in chapter 5, growing them was important as an intermediate stage to diversify into more complicated, export crops. In addition, SUDENE's and CVSF's comprehensive research about the characteristics of soils and natural resources, and the possibilities of large number of crops with irrigation produced a large amount of valuable information that CODEVASF later used to attract agricultural and agro-processing firms to Petrolina-Juazeiro. As I will explain in more detail in the next chapter, once CODEVASF established the first irrigation projects at the end of the 1970s, the agency called for public bidding for land in its irrigation projects. Interviewing a former director of CODEVASF, I questioned him about government agencies spending such a long time doing just research. His response was the following:

“How could we tell agricultural firms that it was good to invest in the São Francisco Valley without showing them where the good soils for irrigated agriculture were located? When we started to organize meetings in São Paulo to attract firms to come to the region, we noticed that they did not believe much about the possibilities of doing irrigated agriculture in the Northeast. Many entrepreneurs from São Paulo did not even believe that crops such as tomatoes and grapes could grow in such hot temperatures. We noticed that we needed detailed information, very good maps, and specific information about yields obtained from our research stations.”

To sum up, the results of CVSF's and SUDENE's research made much easier for firms to evaluate the possibilities of investing in irrigation projects in Petrolina-Juazeiro and for CODEVASF to evaluate the technical feasibility of the proposals, a process that I will explain in more detail in chapter 4. In the next section, I will show that the initial experience of SUDENE with the FAO project and the establishment of irrigation projects in Petrolina-Juazeiro influenced the nature of SUVALE's work, making the agency change its

previous focus on building roads, health posts, and electrification to building and operating large-scale irrigation projects. In addition, I will show that some of SUDENE's views and interpretations about the development of the Northeast, the role of agriculture, and the role of government investments in irrigation infrastructure had a great influence in irrigation policies that the federal government would implement in the 1970s.

The emergence of irrigation policies

Agricultural economists in Brazil have recently opposed government-sponsored irrigation projects because they argue that they involve too large investments and costly operation and maintenance. In contrast, they associate "private irrigation" (i.e., based on individual investments in irrigation infrastructure at the farm level) with small-scale irrigation--even though this is not necessarily true, as individual farmers and firms may and frequently use large-scale equipment. This section focuses on how the federal government chose to promote large-scale rather than small-scale irrigation, analyzing the role of different government agencies involved in the design of irrigation policies that emerged in Brazil in the late 1960s.

Although several federal government agencies (mainly DNOCS, SUDENE, and SUVALE) had carried out irrigation investments, irrigation only became important in federal government policies in the late 1960s.²¹ In 1968, the federal government appointed

²¹ The "Government Program of Economic Action (*Programa de Ação Econômica do Governo*), 1964-66" proposed to increase the studies and research about irrigation and drainage and to provide incentives to farmers to improve the use of the soils and the conservation of water. The "Strategic Development Program (*Programa Estratégico de Desenvolvimento*), 1968-79" included an "Irrigation Program" with large-scale irrigation projects to be implemented by DNOCS, SUVALE, and DNOS mainly in the São Francisco and Jaguaribe River Valleys. The "Goals and Bases for Government Action (*Metas e Bases para a Ação do Governo*), 1970-71" also proposed to increase the area with irrigation in Brazil in 20 percent. See Ministério do Planejamento e Coordenação Geral (1965 & 1968), Presidência da República (1970).

the Executive Group for Irrigation and Agricultural Development (*Grupo Executivo de Irrigação e Desenvolvimento Agrário*, GEIDA), a task force to study the possibilities of irrigation in Brazil, formulate irrigation policies, and supervise federal agencies involved in irrigation.²² GEIDA was located in the Ministry of the Interior and included representatives from several federal government agencies, including the Secretariat of Planning and the Ministries of Agriculture, Mines, and Energy; Interior; Health; and Finance. Because DNOCS and CODEVASF were part of the Ministry of the Interior, several of GEIDA's representatives included irrigation specialists and agronomists from agencies working in the Northeast region, such as DNOCS and CODEVASF. These representatives viewed irrigation as the main intervention to increase the productivity of agriculture and to improve the life conditions of the population in the Northeast semiarid region. The views and interests of these representatives was key for GEIDA to establish contacts with an Israeli consulting firm in irrigation technology and policy (Tahal Consulting Engineers Ltd) to receive technical advice in irrigation. Many Northeast agricultural engineers had taken irrigation courses in Israel—a country with a successful experience with irrigation technology in climate conditions even more arid than in the Northeast—and had been deeply impressed about Israel's know-how. The Israeli state had played an active role in building large-scale irrigation infrastructure, including the construction of pumps and canals to bring water from long distances. In addition, Tahal had extensive international experience in the design of large-scale, government-sponsored irrigation projects in other Latin American countries (e.g., Mexico and Perú), and its views and experience were coincident with those of SUDENE in promoting irrigation projects of similar

²² The federal government created GEIDA through the Decree No. 63,375 approved on December 11, 1968.

characteristics.

GEIDA first presented a report with guidelines for the design of irrigation policies in 1970 and then went on to formulate a national plan to promote irrigation (the Pluriannual Irrigation Program, or *Programa Plurianual de Irrigação*, PPI), which the federal government approved in 1971.²³ Most of the government irrigation investments included in the PPI were located in the Northeast region.²⁴ The PPI considered irrigation as one of the main instruments to promote the economic transformation of the Northeast and made some important definitions that would determine the nature of irrigation interventions of different government agencies.²⁵ The most important ones were the following:

- 1) Because there was no tradition of irrigation in the Northeast, farmers would be reluctant to invest in irrigation. For this reason, the state had to participate actively in promoting irrigation. In 1975, the area of irrigated lands in Northeast Brazil had reached 163,000 hectares, only 6.9 percent of the Northeast's farmland and 15 percent of Brazil's irrigated lands. Most of the irrigated areas included farmers who used rustic small-scale equipment in the margins of the main Northeast rivers, such as the São Francisco River and the Jaguaribe River.
- 2) The PPI stated that federal government investments in irrigation infrastructure had to be large-scale and concentrated in a limited number of places rather than small-scale and scattered in a large number of places. First, large-scale investments would take advantage

²³ See GEIDA (1971).

²⁴ These projects would become part of the Pluriannual Irrigation Plan for the Northeast (*Programa Plurianual de Irrigação para o Nordeste*) also elaborated by GEIDA and included in the National Integration Program (*Programa de Integração Nacional*).

²⁵ The federal government also approved the Law No. 6662 on June 25, 1979, often known in Brazil as the "Irrigation Law". The "Irrigation Law" contained general definitions about the objectives of national irrigation policies and the government agencies in charge of implementing them.

of economies of scale characteristic of canals and pumps necessary for bringing water to places far from the main water source. Second, because the federal government had limited funds, it would be better to select a few places and concentrate investments on irrigation infrastructure than to disperse efforts in a large number of locations. Third, heavy investments in one particular place would trickle down to the surrounding areas, as opposed to small investments that would have limited impacts.

3) The PPI appointed SUVALE and DNOCS as the two federal government agencies in charge of implementing irrigation policies. Both agencies would focus on carrying out large-scale irrigation projects, which would include expropriation of lands, building of a central irrigation system, selection of farmers and distribution of plots among them, construction of irrigation infrastructure at the farm level, and operation and maintenance of projects--including provision of water for irrigation to farmers and collection of water fees. While SUVALE would concentrate only in the São Francisco Valley, DNOCS would work in all the Northeast semi-arid zone except for the area under SUVALE's authority. In addition to operating in different areas, DNOCS and SUVALE would pursue different objectives and strategies. While DNOCS would emphasize social objectives, such as employment generation among the rural poor and decreasing their migration to urban areas, SUVALE would have a more mixed mission that combined poverty alleviation with promoting economic development through the creation of growth poles based on irrigated agriculture.

4) Finally, the PPI defined that while DNOCS's projects could only include small farmers, SUVALE's could also include medium-size and large firms. These firms, the PPI

argued, were likely to bring capital and new technologies.²⁶

While SUDENE enjoyed a high level of autonomy when implementing its first interventions in Petrolina-Juazeiro, local elites from Petrolina-Juazeiro started to play an increasingly more important role in the implementation of irrigation policies. The next section will describe some changes in the local politics that took place in the region and how they influenced the interventions carried out by CODEVASF.

The concentration of irrigation projects in Petrolina-Juazeiro and the role of local elites

The new irrigation policies, along with political changes that took place in Petrolina-Juazeiro, started to play an important role in the emergence of Petrolina-Juazeiro as a growth pole based on irrigated agriculture. Members of the Coelho family--one of the traditional members of the elites in the municipality of Petrolina--had occupied important positions at the municipal and state of Pernambuco levels since the 1940s. One of the family members (Nilo Coelho) had become Pernambuco's state deputy in 1947 and federal deputy in 1950, and one of his brothers (Osvaldo) was elected state deputy in 1958. At the municipal level, the Coelho family had dominated politics since 1955, when another family member (José de Souza Coelho) became mayor, occupying the position twice from 1955 to 1959 and from 1963 to 1969.

Although these positions gave the Coelho family some space to influence decisions at the state and federal levels, it did not play a role in the period in which the first government-sponsored irrigation projects were built in the early 1960s. The main reason

²⁶ The Decree No. 89,946 of March 29, 1984 defined that firms could occupy no more than 20 percent of the land area of CODEVASF's irrigation projects. This limit was soon raised to 40% of the total land area.

was not that SUDENE enjoyed a high degree of independence, but that the Coelhos initially did not have a homogeneous position with respect to the initiatives that SUDENE was undertaking in the early 1960s, as some family members opposed and others supported them. Although the first irrigation projects (Bebedouro and Mandacarú) initially involved small areas, some family members--especially those who were in charge of running the family businesses--distrusted the government-sponsored irrigation investments, fearing the possibility of land expropriation to build large-scale irrigation projects--a sort of unwelcomed land reform. In contrast, those family members who were involved in political positions, and especially Nilo Coelho, who was the leader in the family, viewed investments from the state and federal governments as a great opportunity for the economic transformation of a municipality like Petrolina, which was far and isolated from Recife, and which had trouble to generate its own revenues. For example, one of the first and more important state government investments when Nilo Coelho became governor of Pernambuco in 1966 was the construction of the highway between Recife and Petrolina. Thus, he viewed government-sponsored irrigation projects--which included not just irrigation but road construction, electrification, and the construction of schools and housing for project beneficiaries--as a great source of incoming federal funds for infrastructure.

The positions in favor of irrigation investments not only prevailed, but also the Coelho family—which consolidated its dominant position at the municipal level and started to become influential at the federal level—turned out to be one the most supportive of further irrigation projects, playing an important role in the negotiation of funds for new irrigation projects in each national budget. Nilo Coelho was appointed governor of Pernambuco in 1966, occupying that position until 1971, while his brother Osvaldo became

federal deputy in 1967. In this way, the family started to influence at the federal level and to play an important role in drawing funds from the national budget for the Petrolina-Juazeiro region. More important, they became highly influential in the location of future projects and the interventions of the federal agencies involved with the projects.

Coupled with the little interest that the agency was receiving from local and state-level elites in other regions, the influence of the Coelho's led the agency to concentrate its investments during the 1970s and 1980s in Petrolina-Juazeiro, securing funds from the federal budget and starting the implementation of irrigation projects faster than in other regions. By 1986, CODEVASF had built six irrigation projects with close to 38,000 hectares of irrigated lands, compared with only 10,419 hectares in the *Baixo São Francisco* and 8,411 hectares in the North of Minas Gerais (see table 5).

Many Brazilian and foreign analysts alike have frequently criticized CODEVASF's irrigation projects, arguing that they have made little contribution to solve the problems of low productivity of agriculture and poverty in the Northeast. The next chapter will focus on how CODEVASF put into practice the principles of irrigation policies when building and operating irrigation projects and how it introduced further measures to solve problems that appeared during the operational stage.

Table 5. Irrigation projects built by CODEVASF in Petrolina-Juazeiro, the North of Minas Gerais, and the *Baixo São Francisco*

Irrigation project	Year of operation	Area with irrigation (hectares)
Petrolina-Juazeiro		
Bebedouro	1968	2,418
Mandacarú	1971	434
Curaçá	1978	4,397
Maniçoba	1980	4,317
Tourão	1979	10,454
Senador Nilo Coelho	1985	15,876
Total by 1986		37,876
Total by 1996		37,876
North of Minas Gerais		
Gorutuba	1978	7,149
Pirapora	1979	1,262
Lagoa Grande	1988	1,660
Jaíba	1988	24,075
Total by 1986		8,411
Total by 1996		34,126
Baixo São Francisco		
Betume	1977	2,860
Propriá	1976	1,177
Cotinguiba-Pindoba	1981	2,215
Boacica	1980	3,334
Itiúba	1975	833
Total by 1986		10,419
Total by 1996		10,419

Source: Information provided by CODEVASF.

CHAPTER THREE

THE MANAGEMENT OF GOVERNMENT-SPONSORED IRRIGATION INVESTMENTS

Many Northeast Brazilian analysts have explained the economic transformation of Petrolina-Juazeiro mainly as a result of heavy investments of the federal government in large-scale irrigation infrastructure.¹ However, although investments in irrigation infrastructure were essential to the modernization of agriculture, they do not fully explain why Petrolina-Juazeiro developed and how it later turned to be a successful exporter of non-traditional agricultural products, as CODEVASF made the same type of investments in the North of Minas Gerais and in the *Baixo São Francisco*, without these regions showing the successful economic transformation of Petrolina-Juazeiro. In this chapter, I argue that it was not just the federal government investments in large-scale irrigation schemes that explains the success of Petrolina-Juazeiro, but the way in which CODEVASF managed them—which was substantially different than in the North of Minas Gerais and the *Baixo São Francisco*. In Petrolina-Juazeiro, CODEVASF applied innovative principles unusual in Brazil, providing subsidies to specific firms, monitoring producers' production and demanding from them good performance in exchange for the subsidies that they had received, and accepting and even encouraging turnover in irrigation projects. These principles were similar to the ones that government agencies applied in East Asian countries, such as South Korea and Taiwan, to support industrial development, and which most of the literature argues that Latin American governments have not applied.

¹ See Banco do Nordeste do Brasil (1990a, b, & c), Carvalho (1988), Galvão (1990), Maffei & Ramos de Souza (1986), and Lima & Katz (1993) and Ramos de Souza (1990).

Managing irrigation investments in “East Asian style”

Analysts of the economic transformation of Latin American and East Asian newly industrialized countries (NICs) have shown that government policies were a key factor in explaining their different patterns of industrialization.² East Asian countries provided subsidies to selected firms and industries and protected them from imports. In exchange for these benefits, governments required firms and industries to meet productivity and export targets, withdrawing subsidies and protection when firms did not comply. These policies helped East Asian economies to attain and sustain competitive advantages of their industrial sectors. In contrast, governments in Latin American countries provided similar subsidies and protection to all industries, without requiring them to perform in exchange for these benefits. These policies led to inefficient industries that were frequently unable to compete in a more open economic environment.³

Some political scientists have argued that these different industrial policies in Latin American and East Asian countries can be explained by a different nature of the state and its relations with civil society. Some of these authors argue that a developmental state that intervened selectively but actively to promote capital accumulation and industrialization represented one of the main institutional features in the successful East Asian experience.⁴ In contrast, subsidization and protection to selected industries and firms in Brazil and elsewhere in Latin America often led to corruption and clientelism. In addition, some authors have portrayed the success of East

² The expression of newly industrialized countries (NICs) emerged in the mid-1970s to identify a number of developing countries that were rapidly expanding their world share in the production and exports of manufactured products. East Asian NICs include South Korea, Taiwan, Singapore, and Hong Kong.

³ Among others, see Amsden (1989 & 1994) and Wade (1990 & 1994).

⁴ Among others, see Collier (1979), Johnson (1987), and Wade (1990).

Asian NICs as influenced by cultural factors. While Confucian high values on hard work, respect for authority and loyalty might have influenced East Asian countries, Ibero-Catholic norms dominant Latin America might have constrained its economic transformation.⁵ All these explanations tend to view the East Asian experience as a model of industrialization unique to these countries and difficult--if not impossible--to replicate in Latin America.⁶

Neoclassical and neo-marxist analysts alike have frequently criticized Brazil's irrigation policies with arguments similar to the ones applied to understand the Latin American difficulties to create competitive industrial sectors. As I explained in chapter 2, irrigation policies implemented in Brazil since the late 1960s gave a strong role to government agencies in the construction and operation of large-scale irrigation infrastructure--what is known in Brazil as "public irrigation." "Public irrigation" includes government-sponsored projects in which state or federal government agencies, such as DNOCS and CODEVASF, not only construct water reservoirs, pumping systems, and delivery canals, but also expropriate lands appropriate for irrigated agriculture and create "irrigation perimeters," each of which serve to irrigate between 3,000 and 20,000 hectares of land. In these irrigation perimeters, CODEVASF and DNOCS divide the land into plots, build on-farm irrigation infrastructure (internal pumping, pipelines, sprinklers, and drainage systems), social infrastructure (schools and health posts), and housing. Once they have finished with these works, the agencies lease the developed land to

⁵ Among others, see Johnson (1983) and Valenzuela and Valenzuela (1978)

⁶ Neoclassical explanations also focused on explaining the difference in industrialization in both regions in government policies, but emphasized that while Latin American countries followed a path of import-substituting industrialization, relying on protectionist policies, East Asian turned to export-oriented industrialization. Policy reforms aimed at a greater outward orientation would promote economic growth, increase employment, and exports. See Balassa (1981) and World Bank (1987).

producers and carry out the operation (water distribution and collection of water fees) and maintenance of the projects.

Similarly to the across-the-board subsidies in the industrial sector, Northeastern economists argue that “public irrigation” has given producers heavy subsidies in the form of cheap land, irrigation infrastructure, and water without any requirement for beneficiaries to perform well. In addition, evaluations of DNOCS and CODEVASF irrigation projects have argued that these agencies have been paternalistic, not even enforcing the payment of subsidized land and water fees.⁷ Partly as a result of not demanding performance, most *colonos* in these projects have continued to grow subsistence crops (mainly corn and beans) rather than high-value crops like fruits and vegetables and to obtain low yields compared with farmers doing irrigated agriculture out of those projects.⁸ Therefore, critics argue, government-sponsored irrigation projects have made a significantly lower than expected contribution to improve the productivity of agriculture and the incomes of the rural population. For this reason, turnover among *colonos* in these projects has been high—a phenomenon that the literature about irrigation and land settlements has viewed as an indicator of “failure” or at least low performance.⁹

In contrast to “public irrigation”, current standard thinking of irrigated agriculture in Brazil views “private irrigation”—defined by Brazil’s irrigation laws as comprising producers who purchase land out of government-sponsored irrigation schemes and use tubewell irrigation or low-lift pumps to obtain water from rivers or reservoirs (even if they were built by government agencies)—as less costly and more dynamic than

⁷ Among others, see Mavignier and Pereira (1990), MINTER/SUDENE/BNB (1985), and World Bank (1990).

⁸ Among others, see Assirati (1994), Barros (1987), Coelho (1975 & 1982), FAO/World Bank CP (1983 & 84), Hall (1978a & b, 1983), Mavignier and Pereira (1990), MINTER/SUDENE/BNB (1985), Noronha (1980), de Oliveira (1981), and World Bank (1990).

government-sponsored irrigation. Based on these arguments, Brazilian analysts and reports from international organizations that financed DNOCS's and CODEVASF's irrigation projects (notably the World Bank) have recommended that these agencies transfer the administration of irrigation schemes to user associations. In addition, they have argued that government intervention in irrigation should concentrate on regulating the alternative uses of the water (irrigation, electric power, human consumption) from rivers and public water reservoirs and on investing in large-scale infrastructure (water reservoirs, canals), avoiding other interventions typical of irrigation schemes, such as land expropriation, beneficiary selection, subsidization of farm-level irrigation infrastructure, and promotion of specific crops and agricultural activities among beneficiaries.¹⁰

Officials and reports from the Brazilian irrigation government agencies have defended their irrigation projects, stressing that they although they have involved subsidies to land, irrigation infrastructure, and water for irrigation, they were not so costly if compared with government subsidies to irrigation infrastructure and water for irrigation in other countries like the United States.¹¹ Other analysts of Brazilian irrigation policies and of government-sponsored irrigation projects have supported—sometimes explicitly—subsidies to irrigated agriculture, arguing that government projects have had positive effects on production and employment and led to the emergence of rural industries like tomato-processing and fertilizers, as well as services like banking and transportation.¹²

⁹ See Binswanger and Deininger (1993) and Kinsey and Binswanger (1993).

¹⁰ See Mavignier and Pereira (1990), World Bank (1990).

¹¹ See CODEVASF (1995).

¹² See Banco do Nordeste do Brasil (1990a, b, & c), Carvalho (1988), Galvão (1990), Maffei & Souza (1986), Lima & Katz (1993) and Ramos de Souza (1990).

In this chapter, I argue that the sole concentration on the subsidies and costs of “public irrigation” vis a vis “private irrigation” obscures the understanding of why Petrolina-Juazeiro was able to develop and to turn into a successful agro-export growth pole, and of what the role of government interventions was in such a successful economic transformation. I will show that subsidized government-sponsored irrigation schemes played a crucial role in the economic transformation of Petrolina-Juazeiro in many ways. First, CODEVASF established its irrigation schemes at a time in which producers from Petrolina-Juazeiro and other regions were not interested and did not even believe that irrigated agriculture could be successful in the semi-arid Northeast region. Thus, CODEVASF’s irrigation schemes had a demonstration effect, showing that irrigated agriculture had a great potential, and thus lowering the risks perceived by these firms of investing in Petrolina-Juazeiro. In that way, “public irrigation” made possible the later development of irrigation in private lands. Second, and more important, the economic transformation of Petrolina-Juazeiro relates partly with government agencies managing subsidies to irrigation schemes in a way that resembles government intervention of East Asian countries with respect to the industrial sector. In fact, CODEVASF managed irrigation projects applying principles that departed dramatically from how other government agencies were managing similar investments, and from what CODEVASF itself did in the North of Minas Gerais and in the *Baixo São Francisco*. The main differences, which I will explain later in detail, include the following:

a) Similarly to other government agencies working with land settlements, CODEVASF provided land in its projects in the *Baixo São Francisco* only to *colonos* who were formerly landless. However, in Petrolina-Juazeiro, CODEVASF established in

its irrigation projects a mix of *colonos* and medium-size agricultural firms (see maps 7 and 8). In the North of Minas Gerais, CODEVASF's irrigation projects had both *colonos* and firms, but the number and proportion of firms was substantially smaller than in Petrolina-Juazeiro.

CODEVASF provided both *colonos* and firms with subsidized lease prices for land and built canals to deliver water for irrigation from the São Francisco River to the projects, supplying water to *colonos* and firms charging them the same water fees. However, CODEVASF only provided subsidized farm-level irrigation infrastructure (pumps and canals internal to the farm and drainage systems) to *colonos*. In contrast, firms had to build their own farm-level irrigation infrastructure. In addition, the agency provided a whole set of other free services only to *colonos*, including training in crop and irrigation technologies and agricultural extension.

b) In contrast to the other government agencies working with land settlements in the region, CODEVASF did not provide firms with across-the-board subsidies. Instead, it selected agricultural and agro-processing firms from outside Petrolina-Juazeiro which had know-how about crop technology and marketing and attracted them to its irrigation projects with subsidized leased land and irrigation infrastructure. CODEVASF did this only partially in the North of Minas Gerais and did not do it at all in the *Baixo São Francisco*.

c) Current popular thinking in Brazil argues that government intervention should focus on attracting large “anchor” firms which play the role of bringing capital and know-how about production and marketing. In contrast, CODEVASF's strategy focused on medium-size firms, imposing land size limits to avoid the concentration of land within

a few large firms. Thus, although a large proportion of the firms was part of larger corporations and business groups, a large number of smaller firms (between 100 and 200 hectares or irrigated lands) dominated irrigation projects in Petrolina-Juazeiro.

d) In contrast to the usual practice of government support through either providing across-the-board subsidies or selecting specific firms or sectors, CODEVASF also introduced competition in the provision of subsidies. Agricultural firms interested in establishing in CODEVASF's irrigation projects in Petrolina-Juazeiro had to bid for specific plots of land by presenting project proposals that detailed the type of crops that they would grow, the technologies that they would apply, the employment that they would generate, and the markets in which they would sell. CODEVASF did not do this at all in the *Baixo São Francisco*, and though it did it in the North of Minas Gerais, it did not monitor firms' compliance with their project proposals.

e) Similar to what several East Asian governments did when promoting industrialization, CODEVASF required firms that received subsidized land and irrigation infrastructure to meet production targets, withdrawing subsidies, fining them, or forcing them to leave when they did not comply. In contrast, the agency did not monitor firms' performance in the North of Minas Gerais. In addition, CODEVASF offered five-year renewable leasing contracts, allowing firms to buy the land only upon completion of the leasing period and if firms had demonstrated good performance.

f) In contrast to what other federal government agencies, such as DNOCS and INCRA, were doing with their settlement projects, CODEVASF allowed and even encouraged turnover in Petrolina-Juazeiro both among *colonos* and firms. Ten years after the establishment of irrigation projects, turnover among firms varied between 25% and

50%, including mostly firms that did not comply with their project proposals; turnover among *colonos* did not reach much more—60%. Although turnover also took place in CODEVASF's projects of the North of Minas Gerais and the *Baixo São Francisco*, officials of the agency's local branches in both regions viewed turnover negatively and implemented measures to prevent it.

These innovations that CODEVASF applied in the management of its irrigation projects were important not only for improving the agency's projects' performance, but also for the transformation of agricultural production in Petrolina-Juazeiro. Incoming medium-size firms became the main actors in introducing new crops (especially those for export, such as table grapes and mango) and technologies and in bringing market connections both in Brazil and abroad--crops and technologies that also spread to *colonos*.

The first section of this chapter gives details about the innovations that CODEVASF adopted in the organization of its irrigation projects with respect to the incorporation of agricultural firms. The second section focuses on how and why CODEVASF selected firms and negotiated with them the conditions to establish in its irrigation projects. The third section concentrates on how CODEVASF disciplined these firms. The fourth and last section focuses on how CODEVASF handled the problem of turnover in its irrigation projects.

Including a mix of *colonos* and medium-size firms

Because rural poverty in Brazil and in many other developing countries has been associated in a great deal with unequal patterns of land distribution, governments of these

countries have often created agencies that establish land settlements to provide land to landless population. In the case of Brazil, this approach not only characterized the interventions of land reform agencies at the federal (INCRA) and state levels, but also of those implementing investments in irrigation infrastructure (DNOCS and CODEVASF).¹³ These projects usually included the expropriation of a large land area, its division into plots to be distributed among landless farmers, and the construction of housing for the newly established *colonos*. Both DNOCS's and CODEVASF's projects included the construction of a central irrigation system (pumps and canals) to bring the water from a reservoir or a river to farms. At the same time, CODEVASF's projects present some differences with DNOCS's and INCRA's: a) CODEVASF's projects usually expropriated a larger area of land (usually between 5,000 and 17,000 hectares) than INCRA's and DNOCS's--an important difference with political implications to which I will come back later; b) while DNOCS often built a dam to provide the water for irrigation to its projects, CODEVASF's projects are closer to the São Francisco River and thus use it as the source of water; and c) CODEVASF's projects often included heavier investment in other basic infrastructure than INCRA's and DNOCS's projects, including roads, electrification, schools, health posts, and water supply for human consumption.

More important, CODEVASF's irrigation projects in Petrolina-Juazeiro included both *colonos* and agricultural firms (see maps 7 and 8). This characteristic made them different from DNOCS's and INCRA's, which only included *colonos*, but also from the agency's projects in the *Baixo São Francisco*, which included only *colonos*, and in the North of Minas Gerais, which included predominantly only *colonos*. Most *colonos* in all

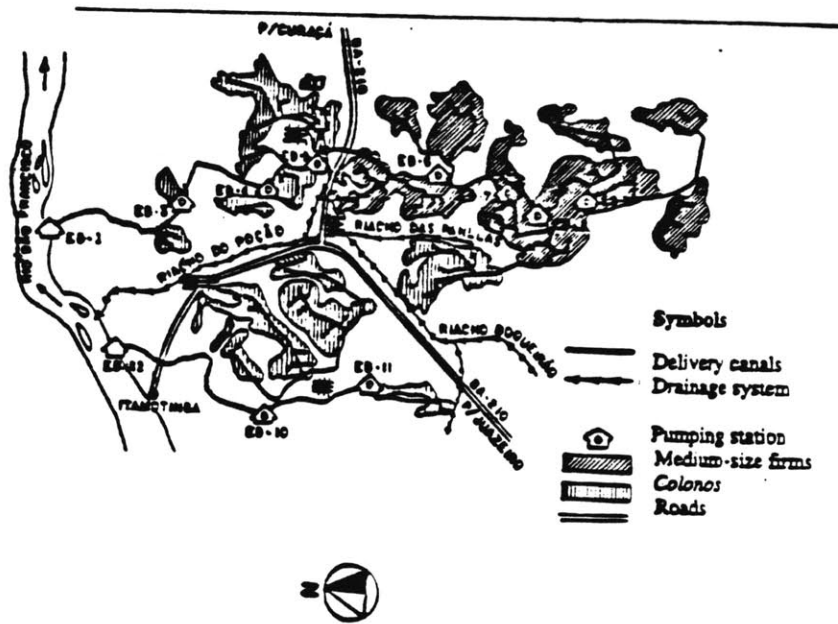
¹³ For a review of land tenure problems in Brazil, see De Janvry (1981), Goodman (1990), Hall (1990), and Leite (1994).

cases were former landless poor who used to work and live in or nearby the lands expropriated by these agencies.

In CODEVASF's projects in all three regions, the agency provided *colonos* with 6 to 12 hectares of land appropriate for irrigated agriculture per family, as well as farm-level infrastructure (pipelines, sprinklers, and drainage system) and housing. Although *colonos* had to pay for both land and irrigation infrastructure, CODEVASF charged prices that were low and did not correct them to inflation. Because the agency started to enforce payments fifteen years after project construction—a period in which inflation was high—*colonos* ended up paying highly subsidized prices. In addition, the agency provided a whole set of free services only to *colonos*, including training in crop and irrigation technologies and agricultural extension.

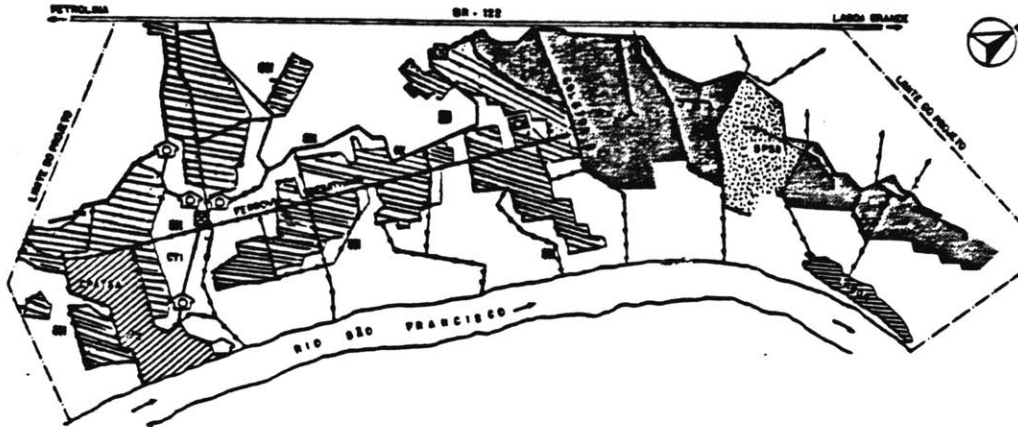
Firms also received plots in Petrolina-Juazeiro, but their size varied between 50 and 100 hectares appropriate for irrigated agriculture. The land did not include any farm-level irrigation infrastructure, and they had to build it themselves. Although several firms got more than one plot and had more than 200 hectares, they were substantially smaller than the type of large firm envisioned by some policy-makers in Brazil as the ones capable of bringing capital and know-how to promote an agricultural-based economic transformation. CODEVASF supplied both *colonos* and firms with water for irrigation and charged them the same subsidized water fees.

Map No. 7. Firms and colonos in irrigation projects
 implemented by CODEVASF in Petrolina-Juazeiro
 Curaçá project









Source: CODEVASF

Map No. 8. Firms and colonos in irrigation projects
implemented by CODEVASF in Petrolina-Juazeiro
Bebedouro project



Symbols

-  Colonos
-  Medium-size farms
-  EMBRAPA agricultural research station
-  Delivery canals
-  Drainage system
-  Pumping station

Source: CODEVASF

The following table shows the distribution of land between *colonos* and firms in CODEVASF's irrigation projects in Petrolina-Juazeiro, the North of Minas Gerais, and the *Baixo São Francisco*. Some of the projects (mainly Mandacarú and Bebedouro) include higher proportions of colonos because CODEVASF built them before the 1979 irrigation law allowed the agency to establish firms in its projects.

Table 6. Distribution of land between *colonos* and firms in CODEVASF's irrigation projects in Petrolina-Juazeiro by 1996

Irrigation project	Small farmers	Area (has)	Firms	Area (has)
Bebedouro	129	1,494	5	924
Mandacarú	53	370	1	66
Tourão	34	182	14	11,958
Maniçoba	235	1,808	53	2,463
Curaçá	268	1,964	15	2,490
Sen. Nilo Coelho	1,434	9,280	116	5,975
TOTAL	2,153	15,098 (63.2%)	204	23,876 (36.8%)

Source: Based on information provided by CODEVASF

The idea of including agricultural firms in irrigation projects emerged in the late 1960s from discussions between technicians of CVSF (later transformed into SUVALE and then into CODEVASF) and the US Bureau of Reclamation, agency of the US government in charge of the administration of water for irrigation. The U.S. Bureau of Reclamation provided technical assistance to CVSF between 1964 and 1967 and to the

newly created SUVALE between 1967 and 1970, carrying out a study of the potential use of the water and soils of the São Francisco River Basin and of the institutions involved with the development of the region. As I explained in chapter 2, the federal government also created GEIDA--a working group that included members from SUVALE and other federal agencies--in 1969 to formulate irrigation policies. It was in the meetings that GEIDA held to formulate irrigation policies that members of SUVALE presented the arguments in favor of including firms in irrigation projects. These arguments were the following: a) firms would bring capital investments, as well as new crops and technologies; b) the presence of firms would benefit *colonos* through the transfer of their innovations; c) growers would invest in industrial facilities to process agricultural products from *colonos*, facilitating the marketing of their crops and generating employment in the rural areas; and d) the presence of firms would decrease the costs of the projects to CODEVASF because, in contrast to *colonos*, firms had to pay for their irrigation infrastructure at the farm level.

As I explained in chapter 2, irrigation policies that the federal government initiated in 1970 had stated that DNOCS's projects would continue to include only *colonos*. DNOCS had had a long institutional history of interventions in Northeast Brazil that focused on preventing the negative social effects of the drought, including mainly the implementation of employment generation programs and the construction of reservoirs of water for human consumption. The agency started to build irrigation projects since the 1960s, aiming to provide landless people with a source of income during the dry season. In contrast, the federal government created CVSF with a “developmental” perspective because it viewed the São Francisco River Basin as a region with high potential as a

source of electric power and irrigation. For this reason, the law that created CVSF in 1948 stated that the agency had to formulate a plan to develop the São Francisco River Valley--a different mission than DNOCS's fight against the drought. Irrigation policies approved in 1970 as a result of studies carried out by GEIDA reinforced the goals of both agencies, stressing that while DNOCS would focus on social goals, CODEVASF would focus on economic development.¹⁴ As a result of this approach, DNOCS would continue to provide land in its irrigation projects only to *colonos*, while CODEVASF's would be able to incorporate both *colonos* and firms.

Although CODEVASF was supposed to include both *colonos* and firms in all its projects, the agency proceeded differently in Petrolina-Juazeiro than in the *Baixo São Francisco* and the North of Minas Gerais. In Petrolina-Juazeiro, the agency started to include firms in the late 1970s and local elites (the Coelho family) supported such a strategy. In contrast, CODEVASF faced strong opposition in the *Baixo São Francisco* from local politicians—some of whom were affected by land expropriations, the beneficiary population, and the Church. Such an opposition left the agency with little space to maneuver in terms of beneficiary selection, making it work only with the rural population who previously lived in the expropriated land. “These projects were not designed to bring large farmers or attract firms from other regions, but to solve the problem of the pre-existing population and re-settling it. Including people from outside was unthinkable for us,” stressed a social worker from CODEVASF who worked in the implementation of those projects at that time. Thus, CODEVASF established worked only with *colonos* in its projects in the *Baixo São Francisco*.

¹⁴ See GEIDA (1971).

An important question is how CODEVASF avoided opposition and elicited local support for including outside firms in irrigation projects in Petrolina-Juazeiro, as these projects were in fact land settlement projects and thus the conventional wisdom in Brazil viewed them as intended to benefit landless people. The views of agronomists, policymakers, and the general public alike about land issues in Brazil has been strongly influenced since the late 1980s by the concern for providing land to landless people and the strong pressures from social movements (notably the *Movimento dos Sem Terra*, or Landless Movement) for land reform. One would expect that those favoring land reform would oppose including firms in government-sponsored land settlements. However, CODEVASF did not face opposition from these actors when it implemented most of its projects in Petrolina-Juazeiro in the 1970s and 1980s, mainly because land reform was not an important issue between 1964 and 1986—where a repressive military regime governed Brazil. An official from CODEVASF who participated in these meetings said: “Although including firms in settlement projects sounds politically very difficult today, land reform was not as popular in the late 1960s, so it was not seen as an alternative to government-sponsored irrigation projects. Thus, it was not so unfeasible to propose the inclusion of firms in irrigation projects.”

While including firms in CODEVASF’s irrigation projects did not elicit opposition of social movements, several Brazilian agricultural economists from different schools of thought and even government reports criticized the practice. These critics recognize that because firms built their own irrigation infrastructure at the farm level, they helped CODEVASF reduce project costs. However, they argue that commercial firms often apply capital intensive technologies and tend to use mainly seasonal labor, so

including them in irrigation projects might not help improve income distribution and alleviate rural poverty. In addition, critics argued that some crops, such as some fruits and vegetables, were not characterized by economies of scale, so including large firms could not even be supported by claims of higher efficiency.¹⁵

In contrast to this criticism, I found that medium-size, commercial firms played a key role in the transformation of Petrolina-Juazeiro in many ways:

a) These firms were very active in introducing crops--especially those for export (mango and table grapes)--and new crop and post-harvest technologies--such as the use of chemical products to control the harvest season in mango and classification of fruits according to quality. These firms frequently came from the southeast of Brazil (mainly the states of Sao Paulo and Paraná), and had investments in other sectors, large amounts of capital available, and experience with both production and marketing of agricultural products like coffee, soybean, and melon. One of the most important actors was COTIA, a São Paulo-based cooperative founded in the 1950s by Japanese immigrants for collectively marketing their crops which became the largest agricultural cooperative in the world in the 1980s. COTIA introduced in Petrolina-Juazeiro the cultivation of table grapes for export. It established 36 of its members in the Curaçá irrigation project in 1978, who initially grew tomato and melon, and later shifted to table grapes for export in the early 1980s. Two other firms, Mapel and Fazenda Curaçá, were the ones that initiated the cultivation of mango for export after firm owners and agronomists of both firms visited Israel and became enthusiastic with that country's farmers' success in producing

¹⁵ Among others, see Barros (1987) and MINTER/SUDENE/BNB (1985).

mango in similar climate and soil conditions to Petrolina-Juazeiro. These and most of the other medium-size firms often brought agronomists from the south of Brazil and other countries that had succeeded in producing fruits for exports (e.g., Chile). Their owners and agronomists frequently traveled to other countries like United States and Israel to learn about new irrigation and crop technologies. In addition, firms also trained most of their workers in specialized tasks that required skills that the labor force did not have at that time, such as the management of irrigation equipment and pruning in crops like mango and table grapes.

b) Firms played a major role in opening new domestic and export markets for these new crops, bringing connections and experience in solving common problems of exporting. COTIA played a major role in teaching other growers in the region how to solve problems of exporting fresh fruits because it already had a long experience with exporting other agricultural products, including coffee, soybean, and fresh fruits like melon and apples—crops that its members already grew. COTIA had opened a permanent office in Rotterdam in the mid-1960s to deal with the marketing of these products in European countries and had a direct relationship with several of its buyers, who frequently visited the crops of COTIA's members in Brazil. As I will explain in chapter 4, a great proportion of the mango and table grapes exporters in Petrolina-Juazeiro—even those who were not members of COTIA--ended up using COTIA's offices in Rotterdam to sell their products in Europe. In addition, COTIA participated actively in Valexport, the association of agricultural exporters created in 1986, providing know-how

to all other members on how to solve major problems of exporting fresh agricultural products. I will come back to this topic in chapter 4.

Table 7. Main agricultural firms in CODEVASF's projects in Petrolina-Juazeiro by 1995

Mango producers	Area (has)
Nova Fronteira	347
CAMPIM	337
Lastro Agricola	293
Curaca Agricola	311
Agrodan	200
DAN	160
Gilberto Antonio	170
UPA	150
Masahatsu Otzuka	143
S. Francisco Agricola	138
Timbauba Agricola	100
Meta Export	100
Mapel	100
Agronova	93
Barreiro de Sta Fe	65
Francisco Rocha	52
Vitoria	50
Table grapes producers	Area (has)
Coop. Agric. Juazeiro	270
Agrop. Labronier	120
Vitivinicola Sta Ma.	100
Frute Vale	95
DAN	52
Timbauba Agricola	50
Fazenda Gabriela	50
Nova Fronteira Agricola	50
Frutiner	40
Novo Horizonte	30
Agro Olimpia	30
Temistocles Duarte	30
Frontone	26
Manicoba Agricola	26
Barreiro de Sta. Fe	21

Source: CODEVASF

“Picking winners”

Development economists interested on the role of the state in supporting industrialization have often criticized Latin American import-substitution policies because they provided across-the-board subsidies to all sectors and firms. In contrast, governments in East Asian NICs (notably South Korea and Taiwan) provided subsidies and protection to selected industries and firms according to criteria like their capacity to export and to adopt new technologies.¹⁶

While most analysts view this way of doing things as specific to East Asian countries and to manufacturing, the good performance of CODEVASF’s irrigation projects relates to a similar provision of targeted subsidies. CODEVASF did not simply organize public bidding to sell land to firms, publicizing them extensively at the national level--mainly in São Paulo, Rio de Janeiro, Recife, and Salvador. In Petrolina-Juazeiro, CODEVASF chose firms that could bring know-how and technology about marketing and agricultural production and aggressively negotiated with them to bring them to the irrigation projects—an approach that state governments in Brazil have been recently applying and most policy makers in Brazil associate negatively with “fiscal wars”. These firms frequently came from other states (especially São Paulo), some of them came from Recife and Salvador, and a few of them were local. In addition, they were part of economic groups with investments in other sectors like construction, engineering, and metal-working, and were willing to introduce new crops and technologies, bringing their

¹⁶ Among others, see Amsden (1989 & 1994), Collier (1979), Johnson (1987), and Wade (1990 & 1994).

agronomists from abroad and frequently sending them to visit other countries with successful irrigated agriculture. In contrast, although CODEVASF included firms in its irrigation projects in the North of Minas Gerais, the agency did not make the same efforts to select and attract firms like in Petrolina-Juazeiro. As a result, most of the firms that established in the projects in the North of Minas Gerais are smaller, have less capital available, and have been less innovative. For example, several of the firm owners who I interviewed in the irrigation projects in the North of Minas Gerais considered that sending technicians abroad to learn about new technologies was a waste of money.

In the mid-1970s, CODEVASF started to organize workshops in São Paulo and Rio de Janeiro in which it presented complete information to potential investors about its irrigation projects. While CODEVASF directed these workshops to potential investors in general, the agency contacted some specific firms. Some of these firms were tomato-processing industries based in São Paulo, among them CICA and ETTI, two of the largest ones. The reason why CODEVASF contacted these firms was that the agency had decided to promote among *colonos* in its first irrigation projects in Petrolina-Juazeiro the cultivation of industrial tomato—a strategy that preceded the emphasis on export crops. CICA had a tomato-processing facility in Pernambuco’s city of Pesqueira, 200 miles from Petrolina.¹⁷ The region nearby Pesqueira had been a traditional producer of industrial tomato and had become the main producer of tomato products in Brazil by the early 1960s. However, the Pesqueira region had substantially more rains and lower average temperatures than Petrolina-Juazeiro and tomato producers in Pesqueira did not use irrigation, so their harvests were concentrated in two months of the year. Officials of

CODEVASF showed CICA's and ETTI's managers and technicians that in contrast to Pesqueira, Petrolina-Juazeiro could supply industrial tomato grown with irrigation during several months, helping to the full use of the firms' processing capacity. In addition, officials of the agency showed technicians from CICA and ETTI the results of experiments with several varieties of industrial tomato that the Pernambuco Agricultural Research Institute (*Instituto de Pesquisa Agropecuária de Pernambuco*, IPA) carried out in the Bebedouro project in Petrolina-Juazeiro in the early 1970s. These experiments had obtained very high yields that impressed technicians from both firms. Moreover, CODEVASF promised tomato-processing firms that the agency would encourage *colonos* to negotiate contracts with them and make contacts with managers of the Bank of Northeast Brazil to negotiate with them the establishment of a special credit line to finance *colonos* who grew industrial tomato, upon the condition that they signed a contract with any of the tomato-processing firms. As a result of these negotiations, CICA and ETTI decided to establish processing facilities in Petrolina-Juazeiro—the former in 1976 and the latter in 1981—and the great majority of *colonos* quickly signed contracts with them to grow industrial tomato.

Also in the early 1970s, officials of CODEVASF made an effort to attract agricultural firms with recognized experience in exporting which could provide the know-how necessary to produce with quality and to gain access to foreign markets. One of the first firms that CODEVASF contacted was COTIA, a cooperative that was a well-known success in Brazil as an exporter of several agricultural products (e.g., coffee, soybean, apples, and cantaloupes). While COTIA purchased from its members part of the

¹⁷ CICA was acquired by the transnational Gessy-Lever in 1995.

production it exported, it also purchased products all over Brazil through affiliated cooperatives and associations. In Petrolina-Juazeiro, COTIA had been buying melon from farmers in the Bebedouro and Mandacarú irrigation projects since the early 1970s, exporting the product to European countries with COTIA's brand name. Officials of CODEVASF's central offices in Brasilia thought that the presence of COTIA would be very important to diversify the production of irrigated projects towards exports not only in Petrolina-Juazeiro, but also in the other regions of the São Francisco Basin in which the agency was establishing irrigation projects.

COTIA managers were attracted to the idea of establishing members in irrigation projects in different regions within the São Francisco River Basin. One of the main reasons were that CODEVASF's offer was a great chance to provide land to the sons of COTIA members, who were interested in becoming farmers themselves but had difficulties finding low priced land in São Paulo and Paraná. One of COTIA managers at that time said: "We needed land where to send the children of our members, and this was a great opportunity to obtain cheap land in a region of great potential." In addition, managers of COTIA knew the potential of Petrolina-Juazeiro because they had been purchasing melon from farmers in the Bebedouro and Mandacarú projects, and they were impressed with the high yields and good quality of production. Thus, when CODEVASF completed the Curaçá project in Petrolina-Juazeiro in 1978, COTIA leased an area of 1,927 hectares (834 of them irrigated), establishing 36 of its members from São Paulo and Paraná. In addition, the coop opened branch offices in the city of Juazeiro to provide members with technical assistance and to purchase production from both members and non-members.

COTIA's growers brought with them a baggage of capital and experience in agriculture. At the beginning, they concentrated on growing industrial tomato and cantaloupes, selling tomato to CICA and marketing the cantaloupes through the coop. In 1984, they started to grow table grapes, using varieties accepted in foreign markets and applying from the beginning methods of production to obtain a production of good quality. Tomato was already the main crop in the region, pushed by the presence of the processing firms.

In addition to COTIA's members introducing new crops and technologies, COTIA itself played an instrumental role in the development of cooperative marketing institutions in Petrolina-Juazeiro. After the creation of Valexport in 1986, COTIA lent the newly created organization some of its managers who had worked in São Paulo and who had extensive experience in exporting agricultural exports. In addition, Valexport started to use COTIA's offices in Rotterdam, which allowed it to take advantage of COTIA's great contacts with European buyers. The development of these cooperative institutions will be the focus of chapter 4.

The fact that CODEVASF made firms bid for specific plots of land and infrastructure, selecting the ones that presented the best project proposals, implied that the agency applied an unusual combination of two principles: a) targeting of subsidies (land, irrigation infrastructure, and water) to specific firms; and b) competition among firms to obtain subsidies. While CODEVASF elaborated rules for each irrigation project, these rules did not vary substantially from project to project. Once CODEVASF completed an irrigation project, it advertised in the national press that land was available for agricultural firms. This land was already divided into plots and mapped, so firms had to

bid for specific plots of land by presenting investment project proposals. These proposals had to detail the investments to be made, the area of crops to be grown, the technology to be applied, and the economic and financial results to be obtained. While several firms often bid for the same piece of land, CODEVASF had to select only one. CODEVASF appraised these proposals according to a set of detailed criteria, which privileged not the price offered for the land, but the firm's availability of capital and technology and its past experience in agricultural production.

Disciplining firms

Although CODEVASF required firms to present project proposals, firms may have not complied with their proposals. However, in contrast to what I myself expected, the local branch of CODEVASF in Petrolina-Juazeiro monitored the performance of agricultural firms that received subsidized land and irrigation infrastructure, requiring them to meet targets in a way similar to what analysts have pointed out as key for East Asian industrialization. Several of the agency's officials feared that firms could speculate with the low prices, signing leases and then keeping the land idle to sell it later at higher prices. Thus, CODEVASF decided to make the selected firms to occupy land in the projects to sign contracts committing to provide complete information to the agency about the advances in the implementation of their project proposals and their agricultural production in general. In addition, CODEVASF set specific targets which firms had to agree on meeting: once a firm received the land, it had to start implementing its project in no more than three months, it had to complete 30% of the project at the end of the first year, 70% at the end of the second one, and 100% at the end of the third one. At this

point, the firm had to grow at least 60% of the total area of land purchased with irrigated crops. These targets were easy to monitor, not requiring substantial technical expertise. If a firm did not meet any of these conditions, CODEVASF could fine it heavily and eventually evict it from the irrigation project.

In addition to meeting these targets, officials from CODEVASF created another mechanism to enforce firms' compliance: a firm could only purchase the land after a period of time during which it demonstrated to be a good producer. If a firm had become the owner of the land immediately, CODEVASF would have not been able to evict it, so it would have not been able to enforce its compliance with its project proposal. Thus, although firms presented proposals for buying the land, CODEVASF would only sign a lease contract with the selected firm, normally for a five-year period, renewable for five additional years. Only after that period, and upon the condition that it had completed the implementation of its project proposal and proved to be a good producer, a firm would become eligible to purchase the land. In that case, CODEVASF considered the amounts paid during the lease—which were indexed to inflation—as part of the agreed land price. Thus, the lease mechanism allowed CODEVASF to demand good performance from firms.

While these rules were valid and should have been applied for all CODEVASF's irrigation projects, the agency only enforced their compliance in Petrolina-Juazeiro. In the *Baixo São Francisco*, CODEVASF did not apply the rules because projects did not include firms but *colonos* only. In the North of Minas Gerais, the agency did include firms but did not enforce the rules for reasons that I will explain later. In Petrolina-Juazeiro, CODEVASF monitored the compliance of the rules harshly for two reasons:

a) Former regional directors and technicians who I interviewed often genuinely believed that the agency had to focus on landless rather than on large farmers and firms, so they tended to distrust the firms. Several of them argued that they did not believe that firms would meet the promises made in the project proposals, so they considered very important to monitor their behavior.

b) More important, local elites in Petrolina-Juazeiro also preferred to benefit *colonos* because they viewed them as an important part of their voting constituency. By 1986, when CODEVASF established the Senador Nilo Coelho project in the municipality of Petrolina, CODEVASF's projects already included more than 1,500 families, which represented nearly 20 percent of the municipality's rural population at that time. The Coelho family in Petrolina was the dominant actor in local politics, with family members occupying the positions of mayor of Petrolina, Pernambuco's state deputy, and federal deputy. The Coelhos often had a great influence in the appointment of the director of the local offices of CODEVASF in Petrolina, so they had close relationship with him and his closest collaborators. Thus, they were also able to intervene in the selection of project beneficiaries and thus elicit an important voting constituency from the irrigation projects. In contrast to *colonos*, firms that came from outside were not only smaller in number and would represent less number of votes, but they were also powerful and thus could challenge the Coelho's power at the local level.

In order to carry out monitoring tasks, CODEVASF organized a monitoring system that included some of the best technicians working for the agency in the Petrolina office. The system consisted of a team of nine agronomists (four in Petrolina and five in Juazeiro) reporting directly to the Director of the Petrolina office. A couple of these

professionals visited each firm once a month, controlling the degree in which firms were meeting deadlines. When visiting the firm, they filled some forms and wrote a very brief (less than one page) report.

The monitoring system worked effectively, letting the agency know if firms were making their investments according to what they had committed. Technicians frequently detected delays in the cultivation of the land or in the construction of facilities included in the project proposals. In this case, they would write a negative report and start a process to enforce compliance, which included letters to the firms' managers warning of fines and of an eventual eviction. "We were continuously harassing firms that did not comply with what they had stated in their project proposals. We sent them harsh letters that observed their delays in implementation and other problems that we were finding, and we warned them of possible fines and eventual eviction", one of the former directors of CODEVASF in Juazeiro said. After sending warning letters, CODEVASF would go to the courts to start an eviction process.

However, because eviction was a long and bureaucratic process, CODEVASF rarely evicted firms. What the agency most often did was to cut off the supply of water for irrigation to the firms that did not comply. Not receiving water even for a few days may have a devastating effect in a firm's profits because crop yields and quality are likely to fall dramatically. Thus, firm owners in trouble would soon contact managers of CODEVASF in the local offices of the agency in Petrolina-Juazeiro to see how they could solve the problem. These managers often asked the firm to find another firm interested in taking over its business. As a result of this way of doing things, the transfer of land between agricultural firms in Petrolina-Juazeiro became common, leading to a high

turnover among firms, especially during the first two years of operation of the perimeters. For example, 25% and 50% of the original firms left the Curaçá and Maniçoba projects respectively during the first two years.

Policies towards turnover

Most specialists in land settlements characteristic of irrigation schemes in Brazil, land reform and resettlement programs elsewhere view turnover as a major problem of these programs.¹⁸ Although beneficiaries of land settlements elsewhere are often prohibited from selling the land, they frequently transfer it informally to other farmers. Because the new settlers often have to pay for a key value for the land, they are usually better-off than the original ones. In addition, because these transactions do not go through the scrutiny of government agencies managing land settlement projects, the new farmers frequently purchase land from more than one farmer. Thus, critics argue, turnover is usually associated with land concentration within land settlements.

In contrast to the arguments against turnover, I argue that turnover in land settlement projects should not be considered as a negative process. CODEVASF'S irrigation projects showed important levels of turnover in Petrolina-Juazeiro, the Baixo São Francisco, and the North of Minas Gerais. CODEVASF officials in Petrolina-Juazeiro estimate that nearly half the original beneficiaries in the Senador Nilo Coelho project had transferred land to other farmers by 1996, i.e., only ten years after the project was established. In the Bebedouro perimeter, most of the original settlers established in 1969 have left. In the remaining perimeters (Curaçá, Maniçoba, and Mandacarú)

¹⁸See Binswanger and Deininger (1993) and Kinsey and Binswanger (1993).

turnover has been somewhat lower (nearby 30 percent). However, each regional office of CODEVASF approached differently the problem of turnover and, in addition, making both the levels of turnover and the characteristics of turnover to differ substantially in the three regions.

In contrast to firms, *colonos* in CODEVASF's irrigation projects in Petrolina-Juazeiro did not have to present project proposals to become eligible. Because the agency monitored firms' compliance with the implementation of their project proposals, CODEVASF had a relatively simple method to demand performance from them. In contrast, CODEVASF was not able to demand performance from *colonos* based on some commitment from them. In addition, irrigation laws prohibited CODEVASF both from cutting off *colonos*' water supply and evicting them. Thus, even though CODEVASF had good information about *colonos*' agricultural production and knew well what they were not doing well, the agency had no way to push them to perform better.

In the absence of ways to enforce the performance of *colonos*, turnover became an unplanned process to improve the performance of irrigation projects because those who entered often had more experience and capital than the ones who exit the projects. *Colonos* who received land in CODEVASF irrigation projects were not able to sell it because they did not receive titles, but a document that authorized them to use the land and the irrigation infrastructure.¹⁹ Because he did not have a title, a *colono* aiming to quit from the irrigation project could not sell the land. However, he could transfer the right to use the land to another person under the condition that CODEVASF authorized the transfer. CODEVASF would evaluate new applicant by studying his/her background and

¹⁹ CODEVASF started to provide titles to *colonos* in 1995.

interviewing him/her. The entering *colono* would usually paid the one exiting a “key value” for the land (between US\$ 3,000 and US\$ 3,500 per hectare of irrigated land). The *colono* exiting the project often had unpaid water fees and bank loans, so the entering one also had to cancel these debts.

The fact that CODEVASF has allowed the transfer of land in its projects is quite unusual, as none of the other federal government agencies carrying out similar projects did. Moreover, my interviews in CODEVASF’s projects showed me that there has been an increasing land concentration within the projects. While there is no quantitative information available, I identified several cases of “*colonos*” who possess from two to eight plots (a total area from 12 to 48 hectares of land for irrigation), often putting each of them under the name of a different family member.

My interviews showed that this situation is widely known by CODEVASF’s managers and technicians, as well by other government agencies dealing with the projects, such as banks and extension services. Having more than one lot is explicitly banned by CODEVASF’s rules governing perimeters. However, the agency started not to enforce these rules when concentration began to occur in the late 1980s. At that time, a large number of *colonos* faced difficulties to pay the water fees, partly because the production of tomato had fallen dramatically due to the attack of a pest new in the region. The managers of CODEVASF in Petrolina feared that the projects in the region could collapse, as the agency could become unable to provide water to farmers. Thus, they decided to allow transfers of land and to “close their eyes” to the concentration of many lots by a single owner.

Although most specialists would view such a policy negatively, I argue that it led to good effects. Without it, CODEVASF's irrigation projects in Petrolina-Juazeiro would have continued to depend on heavy government subsidies to sustain the unpaid costs of irrigation. In addition, turnover has improved substantially the performance of agriculture in CODEVASF's projects because the incoming producers have managed their farms more successfully than the *colonos* who quit. Most of the incoming producers look very much as medium-size entrepreneurs; they are frequently agronomists who came from other states--mainly Paraná and São Paulo--and other professionals from Petrolina who work in the private or even the public sector. In addition, my interviews showed that most of them not only came with more capital and had connections, but also showed great commitment to their farms and the development of the region. In addition, they often paid higher wages and provided better working conditions to their rural workers than the *colonos* who left the irrigation projects. Thus, although turnover may be associated with land concentration, the case of Petrolina-Juazeiro shows that when a government agency closely monitors the process and controls the characteristics of the newcomers, turnover may work as a "natural selection" process that pushes bad producers out of the projects.

To conclude, the good performance of government-sponsored irrigation schemes in Petrolina-Juazeiro as compared with those in the *Baixo São Francisco* and the North of Minas Gerais can be explained partly by CODEVASF applying innovative principles when managing these projects, including a mix of small tenants and medium-size agricultural firms, targeting subsidies and introducing competition for subsidies, demanding performance from agricultural firms receiving subsidies, and allowing turnover in irrigation projects. While these principles were crucial for the modernization

of agriculture and the economic transformation of Petrolina-Juazeiro, they do not fully explain how farmers were able to solve a number of collective action problems associated with exporting high quality fresh fruits. The next chapter will focus on initiatives that CODEVASF implemented jointly with growers in Petrolina-Juazeiro, including the creation of Valexport, an association that became a key player in solving such problems and in demanding good performance from government agencies.

CHAPTER FOUR

NEW MARKETING CONNECTIONS AND THE JOINT EFFORTS WITH PRODUCERS' ASSOCIATIONS

The previous chapter showed that CODEVASF managed its irrigation projects in Petrolina-Juazeiro not only differently than other government agencies like DNOCS, but also differed from other regions where the agency carried irrigation projects. By applying innovative principles in the relationship with *colonos* and firms which resemble the ways in which East Asian governments related with industrial firms, CODEVASF's interventions became an important factor to understand the transformation of Petrolina-Juazeiro into an export-oriented growth pole.

While investment in irrigation infrastructure and the management principles that CODEVASF applied were crucial for the modernization of agriculture and the economic transformation of Petrolina-Juazeiro, they do not fully explain how farmers were able to solve a number of collective action problems associated with exporting high quality fresh fruits. Exporters of high quality fresh fruits often need to carry out tasks that require a high degree of compliance from all producers in a region, such as enforcing minimum quality standards, avoiding harvest concentration, and controlling pests that may decimate the crops or even jeopardize the access to some foreign markets--problems that will be explained in more detail in the next section. While exporters need to act jointly in order to solve these constraints, they often fail because of several problems associated with collective action. Coordinating actions requires negotiations and meetings to agree on solutions, an effort that is costly and time consuming. Even if exporters agree, when joint outcomes depend on multiple actors whose contributions are costly and difficult to

measure, individuals have incentives to behave opportunistically, i.e. non complying with collective norms to improve one's own welfare at the expense of others.¹ For example, one of several producers who jointly export table grapes to markets paying premium prices for high quality may feel tempted to include some product of lower quality than the minimum standards if he believes that he will not be discovered. Monitoring this opportunistic behavior is often costly and difficult.

These problems of collective action and the possible ways to solve them, for example through producer associations, have been extensively addressed by the development literature. However, this literature often stresses that associations do not work well and often argues that government interventions to support them have failed. Most of the agricultural and rural development literature stresses the problems of farmer associations and the limited benefits that they provide to the smaller farmers.² A small group of large producers often dominate the associations and benefit most from its services like credit and extension services.³ Financial problems often plague associations due to frequent mismanagement and to the difficulty of controlling "free riders" who receive benefits of collective action without contributing to the costs of providing them.⁴ These obstacles are so serious that many policy-makers in developing countries challenge the idea of promoting collective action as an instrument for rural development and the alleviation of rural poverty.

¹ See Williamson (1975 & 1979).

² I use the term farmer association to define organizations in which their members are agricultural producers who join to pursue objectives of collective interest. These organizations may have different objectives, from selling their individual crops to producing collectively. They may undertake different tasks, from interest group representation to marketing and provision of services to members and non-members. They may have different legal status, ranging from informal groups to registered cooperatives.

³ Among others, see Attwood (1987), Attwood and Baviskar (1987), Fals-Borda et al (1976), Fox & Hernández (1989), Lele (1981), Peek (1988), Peterson (1982), Tendler (1983 & 1984).

Thus, one of the challenges in the development field is to understand under what conditions successful collective action may arise, why and how collective institutions may work well, how the actors involved in these institutions learn to abide by collective rules, and how government interventions may promote these successful outcomes. The literature analyzing successful cases of cooperatives and other institutions of collective action have frequently emphasized the relevance of shared values and the “cooperative” characteristics of certain communities. In contrast, others have emphasized that individuals will cooperate only when an individual solution is not possible.

This chapter focuses on how government agencies interacted with producers in Petrolina-Juazeiro to solve collective action problems associated with exporting fruits. I show how solving these problems required exporters to learn from the initial inability to solve them—which led to the loss of foreign buyers of melon in the mid-1980s. The process of learning in turn required the leading role of an experienced exporter (COTIA) and of a government agency (CODEVASF) in defining the problems and identifying the possible solutions. I argue that one of the strategic interventions that government agencies carried out in Petrolina-Juazeiro was to engage local producers in joint efforts to build private sector cooperation institutions in which farmers dealt with collective action problems.

The chapter is organized as follows. The first section explains the new challenges that producers in Petrolina-Juazeiro faced when they started to produce fresh fruits for export. The second section focuses on an initial experience of producers exporting melon, showing how it helped producers and government agencies learn how to deal with

⁴ See Ostrom (1987 & 1990) and Wade (1986 & 1987).

them. The third section explains how CODEVASF interacted with medium-size agricultural firms to create Valexport, an association of exporters that would serve to enforce minimum quality standards in fruits for export, and how the agency provided the newly created association with strategic support in its early period of life. The fourth section describes the organizational structure of Valexport and explains how the organization faced the main problems associated with exporting fruits. The fifth section focuses on how Valexport demanded good performance from government agencies, playing an important role in the type of interventions that they carried out.

Problems of producing fruits for export

Producers of fresh fruits for export must reach the market timely with a product of high quality. In order to succeed, an exporter needs to solve several problems:

- 1) An exporter needs to apply complex and costly technologies in order to have a production of high quality. Consumers in industrialized nations give great importance to fruit characteristics, such as color, size, uniformity, and taste. Fruit characteristics have to be as uniform as possible, avoiding fruits of different sizes and even different taste. Some of these characteristics are often specific for each country or group of countries; for example, European consumers prefer melons or watermelons of small size that can be fully consumed in a single meal. In contrast, consumers in Latin American countries prefer them in a larger size. Any quality problem in the product exported is usually accompanied by great penalties in the price obtained and may jeopardize the future access to the market. While high income consumers in Brazil also care about these characteristics and pay higher prices for fruits of high quality, the largest part of

consumers are less demanding and give more importance to lower prices than to quality standards.⁵ Obtaining these quality characteristics requires: a) the application of a production technology that prevents the attack of pests and ensures uniform and nice-looking fruits; b) a careful harvest, classification, post-harvest treatments to prevent the presence of pests that could damage the fruits after the harvest, and packing; and c) transporting the fruit in trucks and ships with controlled conditions of humidity and temperature. All these tasks are expensive because they require large amounts of inputs, such as fertilizers, pesticides, and labor.

2) An exporter needs to coordinate a high number of tasks. In contrast to most manufactured products, grains, and some fruits like melon and apples, or fruits exported from Petrolina-Juazeiro (grapes and mango) are highly perishable and cannot be stocked without losing quality and value. Thus, they need to be available to the final consumers no later than two or three weeks after the harvest. Producers usually agree to supply buyers in European and US markets during specific weeks (e.g., one buyer may want to receive mangoes in the first two weeks of November and another one in the last two weeks of the month). Any delay involves losses in quality and thus price penalties. In order to avoid delays, producers need to have labor available for the harvest and packing of production, they must purchase boxes to pack the production and have them available at harvest time, and they must secure freezing and storage facilities. In addition, producers must contract trucks to bring the fruit by road from the fields to the Suape harbor--a trip of 700 km from Petrolina that takes about 12 hours--and then ships to transport it to Europe or the United States--a trip of about two weeks. In addition, fruits

⁵ See Carraro & Da Cunha (1994) and CODEVASF (1989).

must arrive in the foreign markets when prices are higher, so farmers must also program the production technology in order to harvest during the high season. For example, if the technology of inducing the correct harvesting time of mango fails and the product is ready in December instead of November, the price obtained both in the domestic and export markets can be 50% lower because a large supply of mango is already available from growers in southeast Brazil and other countries.

While a single producer faces many problems to be able to export, other problems require a high degree of collective action:

- 1) Producers need to control pests that not only may decimate their crops or affect the quality of production, but also their sole presence in the region may jeopardize the access to foreign markets. Several countries, and notably the United States, regulate the imports of fresh fruits and vegetables in order to avoid the entrance of pests that may attack the crops of their own farmers. Controlling these pests in the exporting region requires not just the timely application of pesticides. Because pests do not respect the barriers of farm wires, farmers who apply measures to control them may not be able to do so if his neighbors do not comply too.
- 2) Exporters need to avoid harvest concentration for two reasons:
 - a) If all exporters decide to harvest about the same time--when the climate is most appropriate or when they think they may obtain the highest prices--they will concentrate in a very short time the demand for packing and freezing facilities, trucks, and ships. As a result, not only the prices of those services increase substantially, but also many farmers may face significant delays in making post-harvest treatments and in transporting their

products to the market. Therefore, producers need to agree not to harvest all at the same time if they want to avoid these problems.

b) While Petrolina-Juazeiro accounts for a relatively high proportion of the world's exports of mango (8.1 percent in value terms in 1996), the proportion for table grapes is quite low (0.3 percent in 1996). More importantly, growers from Petrolina-Juazeiro concentrate their exports in short periods of time (mango in October-November and grapes in June-July) in which there is little or no competition at all from producers in other countries. Thus, exporters from Petrolina-Juazeiro may obtain high prices for their products as long as they do not compete against each other and they do not concentrate their shipments in a few days. One buyer who I interviewed said: "We have to sell the fruit that arrives in Rotterdam as soon as possible because it will rapidly lose quality. We buyers have an idea of how much we can sell in the next one or two weeks, so we would panic if we saw two or three ships arriving with mango the same day. The result of this would be an immediate and important fall in prices."

3) Buyers of fresh fruit in the international market often do not identify fruits with their brand names, but with the countries or regions that produce them, such as table grapes from Chile or Italy, strawberries from California, or oranges from Florida. Thus, all producers of a particular export crop in a region or country must meet the same quality standards because a few producers with quality problems may hurt the image of all exporters and thus jeopardize their possibilities of obtaining good prices and even their future access to a particular market.

The next section focuses on an initial experience of producers in Petrolina-Juazeiro exporting melon, showing how they were unable to solve some of the above-

mentioned problems. While this negative experience led producers to initially lose access to European markets, it served as a learning experience on how to deal with such problems.

Learning from an initial failure

Exporters in Petrolina-Juazeiro faced problems of collective action in the mid-1980s when they started to sell melon in Europe and failed to jointly agree on meeting quality standards. Although exporters lost their buyers as a result of these problems, the negative experience provided useful lessons to exporters and government agencies, pushing them to undertake solutions to prevent that the same problems occurred with other crops.

In the early 1980s, melon became one of the most important crop in Petrolina-Juazeiro, occupying an area close to 1,000 hectares by 1980 and 3,000 hectares (10 percent of the area with irrigated crops) by 1986. *Colonos* from the Mandacarú, Maniçoba, and Curaçá irrigation projects accounted for about 70 percent of the total area and medium-size firms for the remaining 30 percent, with members of COTIA accounting for 10 percent of the total, i.e., one third of the medium-size firms' area.

As I explained in chapter 2, FAO-SUDENE had carried out research in Petrolina-Juazeiro between 1961 and 1966 on the potential of a large number of crops with irrigation. This research identified a set of crops—mainly tomato, beans, onion, melon, and watermelon—that showed high yields and seemed appropriate for *colonos* because their investment and production costs were low compared with perennial crops and they allowed producers to obtain the first harvest and revenues in only a few months. Thus,

when SUDENE established the two first irrigation projects (Bebedouro and Mandacarú) in Petrolina-Juazeiro in the late 1960s, it promoted melon among *colonos* and the other crops mentioned above.

Melon rapidly turned into one of the main crops grown by *colonos* and firms, and buyers from the south of Brazil (mainly São Paulo) started to purchase melon in the region. At that time, the Vale Assú/Mossoró region in Rio Grande do Norte—which has better climate conditions to grow melon—was still not a player in the production of melon, and farmers in Petrolina-Juazeiro were able to produce melon at a lower cost compared with producers in Brazil's south and southeast, and almost anytime during the year. One of the buyers was COTIA, the São Paulo-based cooperative which later became a major actor in the economic transformation of the region. COTIA had been purchasing agricultural products like coffee, soybeans, and apples from producers (both its members and others) mainly in the southeast of Brazil and exporting them to Europe since the mid-1960s. Expanding to the marketing of other crops, COTIA opened 200 branch offices all over Brazil by the mid-1970s, including one of them in the city of Juazeiro. At that time, COTIA started to purchase melon from *colonos* in the Bebedouro and Mandacarú irrigation projects and sell them both in São Paulo and Europe with its own brand. While other buyers purchased melon to sell in the domestic market--mainly São Paulo--COTIA was still the main buyer for the domestic market and was the only one that exported melon to Europe from Petrolina-Juazeiro--a position that it maintained until the mid-1980s, when other exporters came in.

In addition to purchasing melon, as I explained in chapter 3, COTIA established a group of its members in the newly established Curaçá irrigation project in the late 1970s

as a result of an agreement with CODEVASF. These producers, who were sons of other members of COTIA of Japanese origin who lived in Paraná, chose melon as one of the main crops to grow because *colonos* in the region were already growing it successfully, they could sell it easily to COTIA, and they had grown melon in the south of Brazil. In addition to melon, COTIA members in the Curaçá project also initially grew table grapes--with which COTIA members also had experience--and industrial tomato--a crop with a secure market at that time because tomato-processing firms had been recently established in Petrolina.

The good prices of melon and the initial success of growers in the Mandacarú and Bebedouro projects who sold melon through COTIA led *colonos* and firms in the new irrigation schemes (especially in Maniçoba and Curaçá) to also start growing melon. By 1984, the area with melon had reached more than 2,000 hectares (close to 10 percent of the total area with potential for irrigation in all government-sponsored projects in Petrolina-Juazeiro). Such a large area attracted several exporters from both São Paulo and capital cities of Northeast states, mainly Recife and Salvador. Most of these exporters did not have previous links with the Petrolina-Juazeiro region and they did not grow melon, focusing on other crops and sometimes even other activities like construction. In contrast to COTIA, which had links with buyers in each European country and sold them directly, the new exporters brought melon to the Rotterdam harbor and sold it in public biddings--a normal way of marketing incoming agricultural products in that harbor.

By 1984, Petrolina-Juazeiro had turned into the main exporter of melon in Brazil. However, the experience of exporting melon soon confronted serious problems. With

the incorporation of new producers (most of them *colonos*), the technology of production (e.g., varieties used, application of fertilizers and pesticides, etc.) varied greatly among producers, so the quality of production became very diverse, with melon of different types, sizes, and taste. In addition, the presence of many buyers--in contrast to the previous monopsonistic presence of COTIA--led to additional problems. As I said earlier, COTIA was until the late 1970s the only exporter of melon from Petrolina-Juazeiro. Because it had been selling agricultural products since the early 1960s, COTIA had opened its own office in Rotterdam, and it was concerned about meeting quality standards. However, COTIA was unable to control the quality of the buyers of melon for export that came to the scene in Petrolina-Juazeiro in the early 1980s. These exporters became much more "flexible" with quality standards, partly because they had links neither with the region nor with the marketing of melon. One of the former employees of COTIA stressed: "Most of the new buyers did not really have experience in exporting melon. Even though they were able to bring the fruit to Rotterdam and sell it in public biddings, they did not have a thorough knowledge of the quality required and the possible problems of not meeting the buyers' expectations. They also did not realize or did not care that all exporters would be hurt if one wanted to make a quick buck and sent a shipment with small fruits and the next one with bigger ones, or a single shipment with fruits of diverse quality."

Because several exporters sent fruit of bad quality, the price paid in biddings of melon from Petrolina-Juazeiro in Rotterdam fell dramatically by 1986 to levels that did not allow to pay for the costs of exporting the product. As a consequence, the prices of melon received by producers fell sharply that year, leading to the collapse of the crop and

to default among a high proportion of the colonos in government-sponsored irrigation projects. The area with melon in Petrolina-Juazeiro fell dramatically in 1987 and never reached more than 1,200 hectares (i.e. only a third of the area in 1986) since then in spite of CODEVASF having established the Senador Nilo Coelho project, which included more than 15,000 additional hectares.

The failure with exporting melon helped COTIA managers identify the problems associated with sharing the market of fruits with other exporters. A former COTIA manager who was assigned to the Juazeiro branch office of the coop argued:

“We made the mistake of not making any effort to agree with other buyers on minimum quality standards. Production had grown steadily in only a couple of years, so we were not the only ones anymore in purchasing and exporting melon. While we were sure of the quality of the fruits that we exported, we could not control in any way the quality of fruits exported by others. Unfortunately, some of them ended up sending fruits of both good and bad quality, making high profits in the short term but hurting the image of the São Francisco River Basin in European markets as an exporter of melon. Eventually, nobody in Europe was willing to import melons from any of the exporters here, so we “lost” a very important export crop.”

In addition, the negative experience provided important lessons in terms of the strategies that COTIA would undertake in the marketing of agricultural products for export. When losing monopsonistic position when buying in Petrolina-Juazeiro fruits for export, COTIA would have to be concerned not only with the quality of its own shipments, but also that of the other exporters'. Solving these problems required working with other exporters to work out a way of all meeting minimum quality standards. Meeting quality standards required not only to agree and comply with quality standards in the classification and packing of the product, it was also essential to improve the quality of production, including the use of varieties demanded by the export markets and resistant to local pests and diseases, the application of treatments against pests, and solving the

problem of a scarce skilled labor force--a problem that I will look in detail in chapter 6.

In the words of the same former COTIA manager:

“After discussions that we held in São Paulo with the managers of the Export Division to analyze the problems with melon, we arrived to the conclusion that we needed to undertake two tasks: a) to become more involved in agricultural production to direct farmers’ production technology, as quality characteristics depended highly in things such as the variety cultivated and the methods applied to prevent pests and diseases. We could do that relatively easily, at least with the farmers who were members of COTIA. And b) in any case that we were not the only exporters, we would need to coordinate with the others, agreeing on complying with clear quality standards in the classification of the fruit after the harvest. This was more difficult because we had to depend on others.”

These lessons became very important because not only members of COTIA, but also other firms in Petrolina-Juazeiro were growing table grapes and mango having in their minds the possibility of exporting them. Thus, COTIA would not have the monopsonistic power that it once had, and the same problems experienced with melon could arise in the future. An agronomist who worked for COTIA during the 1980s stressed:

“Not only the members of COTIA were growing grapes by the mid-1980s, but also six or seven firms with pretty large areas. The quality of production of most producers was very heterogeneous, each one obtaining fruit of both very good and very poor quality. Most have problems not just in the classification and packing stages, but especially in the technology of production and the scarce availability of a trained labor force. Without some kind of organization to improve such a picture, the future looked like a mess.”

Not only COTIA became worried about the problems with exporting melon, but also CODEVASF officials, who had seen positively the rapid growth in the area cultivated with melon in its irrigation projects and had considered the exports of melon as a great achievement of the agency, which had promoted melon among *colonos* in the first place. CODEVASF officials had the same views that managers from COTIA had, i.e., that farmers from the region needed to produce with higher quality and that all exporters needed to meet minimum quality standards. Thus, they had in mind that exporters needed

to create an association to address these issues. However, the most important lesson that CODEVASF officials found in the melon experience was that there was still a long way to go for *colonos* to be able to produce with high quality and to be able to export. In addition, they blamed the exporters who were outsiders rather than the producers based in Petrolina-Juazeiro for the problems that arose with melon. Thus, they thought that an association should include--at least in an early stage--only firms which were based in Petrolina-Juazeiro and which would be able to export directly or would buy fruits from others.

The next section will focus on the creation of an exporter association (Valexport), the forces that led exporters to create it, a detailed analysis of the views and role of CODEVASF, and the emergence of some new problems for mango producers--namely the aim to gain access to the US market.

Building cooperating institutions and the role of government

Development economists analyzing the role of the state in the successful industrialization of East Asian NICs have shown that the state in these countries established close ties with private actors, embarking in joint efforts to solve specific problems. Some authors have argued that this relationship implied an “embedded autonomy” of the state, combining an equilibrium between a capable bureaucracy and a dense network of ties between the state and social groups with transformational goals, in particular industrial capital.⁶ In contrast to the East Asian experience, critics from

⁶ See Evans (1995) for a discussion of the concept of “embedded autonomy”. The view of a competent, coherent, and detached bureaucracy originates in Weber (1904). Evans points to Gerschenkron (1962), Hirschman (1958, 1963, and 1967), Amsden (1989), and Wade (1990) as authors who had presented the

different schools of thought in Brazil have a negative view about the role of government agencies in the development of the Northeast region, arguing that although these agencies have spent large amounts of public funds, they often show poor results, having poor technical capacity and concentrating in subsidizing inefficient activities. Moreover, the conventional wisdom in Brazil and other Latin American countries is often skeptical about close relations between the state and social groups because it tends to be seen as associated with clientelism and corruption.⁷ Some analysts even disregard the East Asian experience as a model possible for Latin American countries because they tend to view the nature of the state and its interactions with industrial groups as influenced by a particular culture. This view makes the East Asian experience “unique” and difficult to replicate in Latin America.⁸

In contrast to these views, I show that CODEVASF went in Petrolina-Juazeiro far beyond its emphasis as an agency managing irrigation projects, working closely with local producers in Petrolina-Juazeiro to solve problems associated with the marketing of fresh fruits. CODEVASF played a crucial role in the creation of Valexport, not only promoting discussions on the advantages of creating an association, but also supporting financially the newly created organization during the early stages of its life.

In fact, CODEVASF and not the fruit producers in Petrolina-Juazeiro was the one that first came up with the idea of creating an association to deal with problems of

state as a strong actor, but at the same time stressing the relevance of “joint” projects and close ties with social groups.

⁷ See Krueger (1974), Bhagwati (1982), and Buchanan et al (1980) for views in which government is associated with “rent-seeking” and “directly unproductive” interventions. See Bates (1983) for an application of these ideas to the analysis of rural development in Africa.

⁸ See Johnson (1982) and Berger & Hsiao (1988) for an interpretation of Confucian beliefs as conferring advantages over other cultures in economic progress. See Valenzuela and Valenzuela (1978) as an example of an explanation of Latin American development related to Hispanic cultural norms.

exporting fresh fruits. CODEVASF had been interested in promoting a strong organization of fruit exporters in the region since 1983, i.e., some time before the problems that arose with exporting melon. In a report prepared in 1983, CODEVASF officials offered the following views:

“We see good perspectives for exporting various agricultural products, such as melon, grapes, and mango. The list could also include varieties of green pepper and watermelon. However, the ‘sine qua non’ condition to succeed in exporting will be to create an organization of producers because a single producer will not be able to overcome the difficulties of exporting, including the high requirements of classification and quality and the minimum quantities necessary to contract trucks and ships.”⁹

Some new problems that arose in the next few years convinced CODEVASF officials that they had to strongly promote among firms the idea of creating an association. These problems were:

- a) The near collapse of the melon crop explained in the previous section, which CODEVASF officials thought that could have been prevented if exporters had jointly looked for solutions;
- b) The aim of mango producers in Petrolina-Juazeiro to enter the US market and the strict import regulations that they faced. In 1986, at the same time that exporters were experiencing problems with exporting melon, a few of the largest firms in Petrolina-Juazeiro were starting to export mango to Europe. These firms also aimed to enter the United States’ market but faced strict import regulations.

In addition to these problems, CODEVASF officials predicted that large quantities of fruits would be available within the next few years and that at least a portion of this production could be exported. By 1986, CODEVASF had established five irrigation projects in Petrolina-Juazeiro (Bebedouro, Mandacarú, Curaçá, Maniçoba, and

⁹ CODEVASF (1983), pp. 20-21.

Senador Nilo Coelho) with 38,000 hectares of lands with potential for irrigation. CODEVASF had good information about the crops and areas that would become dominant in the region in the next few years because the agency was closely monitoring the evolution of areas planted in its irrigation projects. While *colonos* were focusing on melon--which was facing the problems explained earlier--and other crops for the domestic market (mainly industrial tomato, beans, onion, and watermelon), firms were concentrating on table grapes and mango. While a group of these firms, including the 35 members of COTIA and about 10 medium-size firms were focusing on table grapes, another smaller group (about 5 firms) of firms were growing mainly mango. Two of the firms that first grew mango in the region, *Curaçá Agrícola* and *Mapel*, were making their first sales to Europe in 1986, and COTIA--whose members initiated the cultivation of table grapes for export--expected to start exporting production from its members in 1987.

With the above-mentioned new problems and the desire for starting to export, CODEVASF officials in Brasilia decided to create a task force in 1986 to promote interventions towards exporting fruits and vegetables. This task force began to organize workshops and meetings --most of them held in the cities of Petrolina and Juazeiro--to discuss with agricultural firms the possibilities and challenges of selling in foreign markets. In these workshops, CODEVASF would often bring specialists both from Brazil and abroad to lecture about a wide range of issues interesting to exporters, such as the consumer tastes in different countries, the rules governing the imports of fresh fruits in European countries and the United States, and the ways in which the markets of agricultural products were organized in the main fruit importers.

In one of these meetings, which took place in Petrolina in November of 1987, CODEVASF invited the main growers and agro-processing firms and some of the most prominent politicians in the region. The main objective of the workshop was to discuss the possibilities of exporting fresh fruits from the region and to identify the actions that federal government agencies, especially CODEVASF, could undertake to solve major bottlenecks, such as the presence of producers with heterogeneous quality (like it happened in melon), the poor contacts with foreign markets, and the poor infrastructure (e.g., roads) in the region. CODEVASF pushed firms very strongly to organize themselves, arguing that they needed an association for at least the following powerful reasons: a) to collect information and search for export markets; and b) to press the federal government to carry out policies and other interventions that helped producers of fruits for export, such as investing in improving the Suape harbor and the highway between Petrolina and Suape, and increasing the funding for research on export crops available to the EMBRAPA research station in Petrolina. CODEVASF also argued that if firms jointly contracted transportation by trucks and ships, they would save substantial amounts of money.¹⁰

Firm owners were initially skeptical about the idea of creating an association. Some of them had had bad experiences in the past, or were just convinced that it was too difficult to do tasks jointly, pointing out that the Brazil's Northeast does not have a tradition of cooperating institutions because entrepreneurs--especially in the agricultural sector--are too individualistic. "The history of these institutions in the Northeast is

¹⁰ A complete report of the presentations made by specialists in issues related to exporting fruits and vegetables, CODEVASF officials, firm owners and managers, and local politicians is presented in CODEVASF (1989).

unfortunate, so we thought that such initiative would end up being costly and useless,” said one firm owner who is currently part of Valexport. “One ends up wasting a lot of time discussing and when we agree on something nobody wants to pay for the costs,” he added.

Responding to CODEVASF’s pressures, a small group of four firms--followed by 43 additional members in a few months--committed to create an association, which later named as Valexport. The tasks of the association--which will be explained in detail in the next sections--were initially to represent exporters before federal agencies, collect information about foreign markets, and to work out a plan to improve the quality of exports, avoiding the problems with melon exports. In the initial period of life of Valexport, CODEVASF supported its activities in many ways, even bearing a substantial part of the costs of the organization, and it frequently carried out complementary initiatives. The main forms in which CODEVASF supported Valexport were the following:

- a) It designed the “statutes” of the newly created association;
- b) It paid for the rent of an office in the state government managed industrial district and lent the furniture and equipment;
- c) It lent one of its technicians to perform the tasks of an executive manager, paying his salary for one year. The firms agreed to pay for the salary of one secretary and for the office’s electricity and telephone bills.
- d) It contracted out a thorough study of the possibilities of exporting different fruits and vegetables to Europe, analyzing the seasons in which it would be possible to sell at

better prices and the requirements for each product that Brazilian exporters had to meet for selling major importing countries, such as the United States, France, Italy, and Japan.

e) It searched for fairs in Europe to promote the crops from Petrolina-Juazeiro and it organized and partly financed the presentation of stands with the newly created association.

The next section will show how Valexport started to propose solutions to some problems of exporters that could not be resolved solely by the individual firms involved.

Solving collective action problems

In the moment of its creation, Valexport was comprised of only four of the larger growers: *Curaçá Agrícola*, *Mapel*, *Nova Fronteira*, and *Fazenda Milano*. The first three firms were owned by entrepreneurs from Recife and Salvador who had businesses in other sectors, such as construction, transportation, and banking. These firms had introduced mango in the region and were starting to export small quantities to European countries. The fourth firm (*Fazenda Milano*) was owned by *Persico Pissamiglio*, an Italian firm based in São Paulo with investments in the metal-mechanic sector. *Fazenda Milano* was growing a large area with grapes. During the next few months, membership increased to 47 members, including 43 other agricultural firms--36 of them members of COTIA. Valexport currently includes a total of 201 members, out of which 134 (66 percent of total) are *colonos* from the Bebedouro Irrigation Project Agricultural Cooperative (*Cooperativa Agrícola Mista do Perímetro de Irrigação do Bebedouro*, CAMPIB) and 67 (34 percent) agricultural firms--which occupy all positions in the board of directors.

Valexport has played a key role as an institution that connected firms and farmers from Petrolina-Juazeiro with foreign markets in two ways:

1) Working together with government agencies, Valexport was able to make farmers comply with a program for monitoring the fruit fly, making possible for mango producers to access the US market since 1994. The first task that Valexport carried out

Table 8. Members of Valexport and their areas of grapes and mango

	Mango	Grapes
Fruitfort/Curaçá Agrícola	450	10
Fazenda Milano	45	450
Agropecuária Labrunier Ltda	--	120
Agropecuária Santa Tereza	150	100
Frutivale S/A	--	100
Lastro Agrícola	293	--
Logos Butiá Agropecuária S/A	2	80
Cia Jofra Agrícola	150	15
Mandacarú Comercial (Agrovale)	132	--
Mapel	100	--
Meta Export Agrícola Ltda	100	--
Timbaúba Agrícola S/A	100	50
UPA Agrícola	150	50
Fazenda Barreiro de Santa Fé	65	20
Agrodan	200	20
Agro Olimpia Nordeste Ltda	90	30
Aguisa	10	20
CAJ (35 producers)	35	270
Agrolucar	--	12
Cia Agrícola Massangano	37	--
Agrícola Novo Horizonte	--	30
Agropecuária Airgela	1	37
CAMPIB (134 producers) 1/	--	535
TOTAL	2,110	1,949

1/ While CAMPIB has 134 members, only about 120 of them grow grapes.

Source: Based on information provided by Valexport.

after its creation was to contact the Ministry of Agriculture in Brasilia, successfully pressing authorities to start negotiations with the US government. Valexport was able to obtain the support of the Ministry of Agriculture to start a three-year research program and later on a fruit fly monitoring program, two necessary steps to be able to sell in the American market. I will explain these programs in detail in section d.

2) Valexport has been able to organize the production of table grapes for export. The marketing of mango and table grapes for export from Petrolina-Juazeiro differ substantially. While a substantial proportion of the producers in Petrolina-Juazeiro grow mango—including firms of all sizes and *colonos*—exports are concentrated on about ten of the largest commercial firms concentrate exports because of the high investments required to build packing and conservation facilities and cover post-harvest treatments--- between \$ 750,000 and \$ 1 million for a single producer. These firms were the first ones in growing mango and in making the required investments, so they were able to concentrate exports, selling their own production and purchasing from medium-size and colonos. *Colonos* or even Valexport itself could have jointly built these facilities, but *colonos* only started to grow mango in the early 1990s, so only recently have they shown interest in such joint efforts. In addition, the larger mango producers have not been interested in Valexport making these investments because they preferred to maintain their oligopsonistic position in the market of mango.

In contrast to mango, a larger number of producers export table grapes partly because production in Petrolina-Juazeiro was never concentrated in a few growers. A large number of usually smaller firms started to grow grapes in the mid-1980s, including 35 members of COTIA and other medium-size firms. While some of these firms had

areas large enough to build their own packing and conservation facilities, a large proportion were smaller producers and needed to make these investments jointly. These smaller producers included the members of COTIA, which made the coop push the idea of organizing the collective marketing of grapes in Valexport.

In 1992, the table grape producers who were members of Valexport decided to create a special division within the organization: the “Brazilian Grapes Marketing Board” (BGMB). The BGMB included all members that exported table grapes. Through the BGMB producers were able to agree and enforce minimum quality standards, work out a program of when and how much each grower would harvest, and jointly contract trucks and ships to bring the fruit to the market. Valexport ended up coordinating the exports of grapes from 2,000 hectares, selling the product with a single brand (BGMB) for a few years. This production comprised 80% of the grapes exported from Petrolina-Juazeiro and 70% of the Brazilian exports of grapes.

COTIA played a crucial role in Valexport learning how to export, mainly through the active participation of professionals who worked in important positions in the export section of COTIA. As I explained in chapter 3, CODEVASF had negotiated with COTIA the establishment of 30 of its members in the Curaçá project, and COTIA had opened offices in Juazeiro. Managers of COTIA in São Paulo had become interested in Petrolina-Juazeiro because the region could produce table grapes of high quality all-year-round. COTIA participated actively in the discussions that members of Valexport had around the problems of exporting grapes. In addition, COTIA provided some professionals to the organization--notably the manager of its Export Division in São Paulo. COTIA even paid the salaries of these professionals until Valexport decided to

hire them. In addition, COTIA provided important contacts in Europe that the coop had made when selling other agricultural products, as well as the use of COTIA's offices in Amsterdam.

At the same time, when participating in the discussions that Valexport had on how to organize the exports of table grapes, COTIA started to evaluate alternatives on the most convenient options for COTIA itself. According to a former manager of COTIA:

“After a couple of years of working in the cultivation of grapes, and seeing the yields and quality that our producers and others were obtaining, it became obvious for us that the São Francisco Valley would soon dominate the Brazilian market of table grapes. The quality of the product was excellent, yields were much higher than in the southeast, and the climate allowed to produce two or three harvests a year. We had to do something to organize that production.”

One of the possibilities was to create an exporting firm that dominated the market. However, COTIA managers soon dismissed this solution. “The fact that there were some pretty large commercial firms producing grapes in Petrolina-Juazeiro scared us,” one of the former COTIA managers said. Other grape producers agreed with COTIA that working together could reduce the prices of transportation and materials, also giving them better possibilities of obtaining higher quality for the transportation. However, COTIA managers were also concerned about avoiding the same problems that occurred with melons, in which there was no leading agency organizing production.

“By 1988, there were many growers who had large areas of grapes, but the quality was very diverse, so the product had a lot of problems after the harvest, such as the loss of fruits due to nutritional deficits during the production stage. Many producers were exporting grapes, but the quality differed among all of them. Everything was starting to look like the disaster with melons only a few years earlier,” a former COTIA manager argued.

COTIA managers thought that the best choice was an organization not just to reduce the costs of exporting, but also for standardizing production and setting strict quality controls for export products just from the agricultural production stage. In order

to decide what kind of organization they would adopt, they proposed to the other members of Valexport who grew grapes to evaluate the experience of other countries with the institutional organization of fruit exports. These other growers accepted the idea and, as a first step, Valexport brought to Petrolina the President of the New Zealand's State Marketing Board dealing with the marketing of apples and pears to talk about his country's experience. In addition, Valexport organized a trip in 1987 with firm owners and managers to visit other countries, including Chile, South Africa, and New Zealand.

Producers in Petrolina-Juazeiro disliked the Chilean model because growers were not involved in exporting directly, but mainly large marketing firms. One of the entrepreneurs who participated in this trip argued:

"We saw that Chilean producers did not have much to say with respect to exporting and they did not obtain a large part of the 'pie' from sales. It is like the marketing of oranges in the south of Brazil: while the large buyers do great, producers do bad."

Members of Valexport thought that in contrast to the Chilean model of marketing fruits for export, the South African and New Zealand's models involved a too heavy-handed role of the state because they consisted of a single government or semi-public agency (Marketing Board) that purchased and sold all production for export. Thus, growers became convinced that whatever model they came up with, it had to centralize marketing but give a heavier role to the producers themselves. Eventually, Valexport decided to make an adaptation of the South African model, centralizing marketing in a single organization (like the state-managed marketing board), but assuming itself the role that a government agency played in that country. Such an organization would make possible for growers to set and enforce quality standards and thus maintain a uniform

quality of shipments, avoiding that some marketing firms export products of lower quality.

Gaining access to the US market, commodity chains, and the role of government agencies

Recent literature analyzing export-oriented industrialization has stressed that exporting firms in many countries relied heavily in linkages with buyers and multinational firms to learn about technological and organizational innovations.¹¹ Analyzing these commodity chains for different industries in many countries, these authors have found that each industry may be characterized by two types of economic organization, which they call producer-driven and buyer-driven commodity chains. Producer-driven commodity chains are those in which large, usually multinational, manufacturers of the product play the central role in coordinating the production networks, setting product specifications, and teaching local firms about technology and organization of production. In contrast, buyer-driven chains characterize industries in which large retailers and trading companies play these key roles. While automobile and electronics would be typical examples of producer-driven chains, apparel would be an example of buyer-driven commodity chain.

In this section, I show that while trading companies and retail buyers may be important in transferring product specifications to growers of mango for export in Petrolina-Juazeiro, government agencies in both importing (especially the United States) and exporting countries (the Ministry of Agriculture) have played an equally

¹¹ See Gereffi (1994a & b, 1995, and 1996) and Egan and Mody (1992).

crucial role, setting product specifications, enforcing the use of specific production and post-harvest technologies, and helping growers learn how to produce for export. The characteristics of some of these technologies, notably their high requirements of capital for investments, have in turned influenced the organization of production, facilitating the concentration of mango exports in a few number of growers.

Growers of mango who aimed to export fresh mango to the US market in the mid-1980s faced strict import regulations imposed by the US Department of Agriculture (USDA)--regulations also faced by melon producers in the Vale Assú-Mossoró region (state of Rio Grande do Norte) who wanted to export to the US at about the same time. Exporting mango (as well as melon) to the US--which eventually took place starting in 1992--required an active participation of Valeexport, the Ministry of Agriculture, and the US Department of Agriculture, working together to carry out a research program to determine the presence of certain pests and later develop a program to permanently monitor the levels of certain pests among growers who export to the US and certify that exporters comply with treatments.

The US imposes strict regulations to the imports of fresh produce in order to protect their consumers and their agriculture against the introduction of pests from other countries. While some of these pests have never affected US farmers, government agencies dealing with agriculture had to spend many years and large amounts of resources to eradicate other ones. In the case of fresh mango--as well as melon, crop in which two large firms in the Vale Assú/Mossoró region were also attempting to sell to the US--the USDA worried about many different species of fruit flies--which differ according to the crop. Thus, in order to prevent the possible entrance of these pests, any country aiming

to export fresh mangoes or other fruits that may be attacked by fruit-flies go through a long process that includes a comprehensive research to identify if fruit fly species are present in the producing region and eventually make producers implement the same crop treatments with pesticides and post-harvest technologies that growers in Petrolina-Juazeiro had to implement.

Valexport contacted officials from the Phytosanitary Department of the Ministry of Agriculture in Brasilia in late 1986 to find out what could be done to access the US market. About the same time and not related to the contacts of Valexport, two large growers of melon in Vale Assú-Mossoró (Maisa and Frunorte) which started to export to European countries, aimed to sell to the US and also contacted the Ministry of Agriculture for the same problem with melon. As a result of these requests, the Ministry of Agriculture sent an official request to the USDA to find out about the regulations imposed on the entrance of fresh mango and melon and about the possibilities of eventually gaining access to the US market. In these situations, USDA has standard procedures that the agency followed in the case of Petrolina-Juazeiro and Vale Assú-Mossoró. USDA treated the two cases as separate requests because although it involved the same country, it was about different crops and regions. First, USDA asked for information about the characteristics of Petrolina-Juazeiro, the technology of production used by growers, and the sanitary conditions of the fruit. Second, once the USDA received the information requested, the agency sent a mission to Brazil in early 1987 to

visit Petrolina-Juazeiro.¹² In Petrolina-Juazeiro, technicians of the Ministry of Agriculture accompanied the USDA mission, visiting several mango exporters to have a first-hand idea of mango production. Third, the USDA required that the Ministry of Agriculture rather than a private sector organizations like Valexport carry out research to identify the possible presence of pests. USDA demanded that the Ministry of Agriculture become involved in carrying out these research tasks for two reasons: a) the research work required laboratory facilities and trained professionals to identify specific fruit-fly species which firms often do not have; and b) USDA considered that the participation of a government agency legitimized the results of the research. Thus, the Ministry of Agriculture appointed EMBRAPA to carry out the research program. All these same steps were followed at about the same time for melon in Vale Assú-Mossoró.

Both research programs worked between 1987 and 1990, a period in which a technicians from USDA visited Petrolina-Juazeiro and Vale Assú-Mossoró for about one week every two months to closely supervise researchers from EMBRAPA working in the fruit-fly research programs and helping them with any problem that might arise. Similarly to Petrolina-Juazeiro, researchers from EMBRAPA did not find any fruit fly species attacking melon in Vale Assú Mossoró, so both regions were considered by USDA as “fruit-fly free”. However, they did find that two of the species attacking mango (*Ceratitis capitata* and *Anastrepha obliqua*) were present in Petrolina-Juazeiro. The female flies of these species attack ripening fruit, piercing the soft skin and laying eggs in

¹² The Animal and Plant Health Inspection Service (APHIS) is the division within USDA which deals with guarding US borders against foreign agricultural pests and diseases. Among other tasks, APHIS staff inspects plants and plant products presented for importation for foreign pests and diseases before releasing them into US trade markets.

the puncture. The eggs hatch into larvae, which feed inside the fruit pulp, ruining the fruit for human consumption.

Given the results of the research, USDA determined that both melon growers in Vale Assú-Mossoró and mango growers in Petrolina-Juazeiro could export to the US only with the condition of implementing a program to permanently monitor the pest levels in melon (in Vale Assú-Mossoró) and in mango (in Petrolina-Juazeiro) farms, with the objective of monitoring pest levels and enforcing the application of treatments with pesticides in farms that showed the presence of fruit-flies above established maximum levels. In addition, because researchers had found in Petrolina-Juazeiro fruit-fly species that attacked mango, USDA established that exporting mango growers had to carry out a post-harvest treatment only of the fruit to be sent to the US. The treatment, called “hot water treatment”, consisted of maintaining the fruit in water at 46.1 degrees C (116 degrees F) for a period of between 75 and 90 minutes depending on the weight of individual fruits.¹³ Finally, US inspectors (one in each exporting firm) would permanently witness the post-harvest treatment and packing of the fruit and certify--along with an inspector from the Ministry of Agriculture--that the firm met all requirements.

These arrangements are not specific of Brazil, and they have been standard in how USDA does its business. In fact, all countries exporting mango to the US have to implement the same “hot water treatment”, including Mexico, Venezuela, Costa Rica, Guatemala, Nicaragua, Colombia, Peru, Ecuador, Taiwan, and Haiti. In addition, several countries have their shipments inspected “in situ” by USDA inspectors instead of doing it

¹³ Fruits of up to 425 grams required 75 minutes of immersion and fruits between 425 and 650 grams required 90 minutes.

when they arrive in the US--an arrangement called “preclearance” that saves time, allows the fruit to arrive earlier to the final buyers, and avoids the problem of sending fruit that may not be accepted to enter the US and has to be sent back. USDA has been carrying out “preclearance programs” of plants and plant products to be exported to the US for a long time and in a large number of countries. The oldest of these “preclearance program” has been carried out Holland, where APHIS’ officers have been inspecting tulips and other flower bulbs since 1951. In Chile, APHIS’ officials have been inspecting all fruits and vegetables destined for US consumers since 1981.

This treatment implied that each firm that would export to the US needed to purchase expensive equipment--around US\$ 150,000 only for the “hot water treatment”, in addition to between US\$ 500,000 and US\$ 750,000 needed for packing and conservation facilities. In addition, each exporting firm has to pay the salary and other expenses of a USDA inspector on temporary duty during the time of harvesting production to be sent to the US--usually a period of two months.

In order to carry out the monitoring program, USDA required that an association of exporters implemented the program at the local level--a standard practice that the agency has applied successfully in other countries. In the case of Vale Assú-Mossoró, where growers did not have an association, USDA required them to create one so the three larger growers created one to implement the program.¹⁴ In contrast, mango growers in Petrolina-Juazeiro had joined with grape growers to create Valexport two years earlier,

¹⁴ The melon growers in Vale Assú-Mossoró who first aimed to export to the United States were Maisa, Frunorte, and Fazenda São João. These firms created COEX, the association needed to comply with USDA requirements and implement the fruit-fly monitoring program. Other melon producers later joined COEX, including Agroknoll, Dunas, Famosa, Arisa, Jobrasa, Fazenda Santa Julia, Agrosol, Mar d’Espanha, and Paulicéia. See Gomes (1998a & b).

so the USDA and the Ministry of Agriculture agreed that Valexport would become the association in charge of implementing the fruit-fly monitoring program in Petrolina-Juazeiro--an initiative which Valexport also agreed. In addition, USDA required that the Ministry of Agriculture supervised the program and, as a government institution, was responsible for it, sending a report to USDA every three months informing on pest levels.

In 1989, the different actors involved signed an agreement creating the monitoring program. In Petrolina-Juazeiro, the agreement included USDA, the Ministry of Agriculture, Valexport, and EMBRAPA. The fruit-fly monitoring program became a truly joint effort between the private and the public sector, as both shared funding and carrying out program tasks. In Petrolina-Juazeiro, the contribution from the different actors involved was the following:

- a) Valexport would pay for the costs of hiring one biologist and one agronomist (who performed as a program director and was based in Petrolina), purchasing a vehicle, and providing office space for the administration of the program.
- b) The Ministry of Agriculture would coordinate the monitoring program, supervise its implementation, and serve as a link between the program and USDA;
- c) EMBRAPA's research station in Petrolina would provide without charges to the monitoring program the laboratory facilities to analyze the samples collected from firms and put a doctoral level researcher from EMBRAPA specialized in Entomology to work full-time in the operation of the lab.
- d) CODEVASF would lend one of its vehicles to the monitoring program, as well as two of its technicians to collect samples, without any charge to the monitoring program.

e) Bahia's Secretary of Agriculture would also lend two vehicles and one agronomist to the program without any charge.

The monitoring program would permanently monitor the levels of different species of insects in the mango plantations of fruit exporters. A firm that wanted to export mango to the US would have to make a written request to the Ministry of Agriculture in Brasilia. The offices of the Ministry of Agriculture would send this request to the USDA, which would register the applicant and send a team of inspectors to carry out an on-site visit of the firm's plantations and facilities. At the same time, the firm would have to join Valexport (if it was not a member yet) and its monitoring program, and would start paying a monthly fee of US\$ 300 regardless of the size of the firm to support program expenses.¹⁵ By April 1997, 14 firms exporting to the United States were participating on the fruit fly monitoring program. These firms are shown in table 9.

The most important result of facing the fruit fly problem was that firms had to act together to look for help from the Ministry of Agriculture to negotiate with USDA--a task that took five years until USDA authorized the first exports. In addition, USDA imposed on firms a monitoring program that needed to be carried out jointly. Thus, mango

¹⁵ The monitoring program includes a set of tasks applied to each firm included in the program. Technicians from each firm put traps (3 per hectare) hanging in trees in several places of the plantation, especially its borders. Each trap consists of a recipient with a stuff that attracts the insects. A worker from the firm specially trained to do these tasks collects the insects from the traps and puts them into a special bottle provided by the program, which contains alcohol to preserve the samples and a sticker to identify the firm where the sample was collected. Technicians from Valexport collect the sample and send them to the laboratory of EMBRAPA's research station in Petrolina, where a biologist identifies the different types of insects and determines the levels of each one. If one particular sample contains more than seven insects of the specie (i.e., an average of one insect collected each day), the program has to immediately order the firm to make a treatment with pesticides. In addition, the lab biologist writes a weekly report with the results of her analyses and sends it to the monitoring program director, who in turn sends a monthly report to the Ministry of Agriculture in Brasilia.

exporters ended up finding a powerful reason to support the newly created Valexport because they first viewed it as a way of pushing the Ministry of Agriculture to negotiate with the USDA, and later on because it would be the institution that USDA required to implement the monitoring program.

Table 9. Mango producers participating in the fruit fly monitoring program in Petrolina-Juazeiro by 1997

Agrodan	CAJ
Boa Esperanza	Fruitfort
Timbaúba Agrícola	Special Fruit
Mapel	Mandaracú Comercial
Aguisa	Frutivale
Jofra	Lastro Agrícola
Cia Agrícola Volta do Rio	Nova Fronteira

Source: Information provided by Valexport

While Valexport ended up concentrating on implementing the fruit fly monitoring program and on organizing the production and marketing of table grapes from members, it soon started to assume the representation of exporters before government agencies, demanding from them actions that supported the crops for export--just like Valexport had done successfully in the early times with the Ministry of Agriculture. The next section will describe the main initiatives that Valexport has taken to signal government agencies what producers need to succeed in exporting.

Demanding performance from government agencies

Producers' associations promoted by government agencies are frequently seen as inadequate in representing producers' interests and dependent on government funding. This section focuses on the relationship between Valexport and government agencies, showing how even though it emerged as an initiative of a federal government agency (CODEVASF), Valexport soon became an independent institution that not only

represented the interest of its members, but also demanded better performance from agencies of the federal, state, and municipal governments. Some of the main ways in which Valexport pressured government agencies were the following:

- a) In 1991, Valexport joined associations of growers of fruits from the south of Brazil and created the Brazilian Institute of Fruit Exporters (*Instituto Brasileiro de Frutas*, IBRAF), a national association of fruit exporters. IBRAF has become the most important organization of fruit exporters in Brazil, having a great influence in policies of the federal government that influence fruit producers. A member of Valexport has been IBRAF's President since 1995.
- b) Valexport has been in close contact with the Ministry of Foreign Affairs in the last few years, pressing it on a number of issues concerning trade negotiations with other countries. For example, one representative of Valexport has participated as one of the Brazil's private sector representatives in the negotiations on the reduction of tariffs in the Common Market of the South (Mercosul) that Brazil integrates with Argentina, Uruguay, and Paraguay. Valexport also pressed the Ministry of Agriculture and the Ministry of Foreign Affairs to include the fruit sector as one of the main ones to be addressed in negotiations with the Japanese government on the market for automobiles. Thus, the Brazilian government has been negotiating some concessions to Japanese automobile exporters in exchange for opening the Japanese market to Brazilian mangoes.
- c) Valexport participated in the *Conselho da Autoridade Portuaria*, a task force that the federal government appointed in 1996 with representatives of both government and private sector to analyze the investments needed to upgrade Brazilian harbors. As a result of pressures from Valexport, the task force recommended—and the government

eventually included funds in the national budget—that the Pernambuco’s Suape harbor (in the outskirts of Recife) be one of the harbors to receive the greatest investments, including the construction of storage and freezing facilities for fresh fruits.

d) Valexport successfully lobbied congress representatives from Pernambuco in 1996 and 1997 to press the federal government and the Brazilian Congress to include funds in the national budget to improve the railways between the cities of Recife and Salgueiro, and build new railways between the cities of Salgueiro and Petrolina. Firms in Petrolina-Juazeiro considered these investments--eventually approved in 1997--very important to decrease the transportation costs to the Suape harbor.

e) Valexport convinced the authorities of the Ministry of Agriculture to appoint a representative of the organization as a member of a council that gives advice on the design of EMBRAPA’s agricultural research programs. The participation of Valexport led, for example, to the approval in 1995 of a research program to generate varieties of seedless table grapes adapted to the soils and climate conditions of Petrolina-Juazeiro in EMBRAPA’s experimental station in Petrolina.

d) The National Research Council (*Conselho Nacional de Pesquisa*, CNPQ) appointed a representative of Valexport as one of its members, so the organization has the possibility to influence the type of research funded to universities and other Brazilian research institutions.

The next chapter will show how *colonos* were able to slowly catch up with commercial firms in the production of export crops and how government agencies made great efforts to help them succeed in the implementation of these changes in their production.

CHAPTER FIVE

GOVERNMENT INTERVENTIONS TO MODERNIZE POOR FARMERS' AGRICULTURAL PRODUCTION

Government interventions have often faced great difficulties in helping small farmers adopt new crops and technologies even in cases in which the agricultural sector is--like in Petrolina-Juazeiro--characterized by a dynamic growth. The literature analyzing cases similar to Petrolina-Juazeiro in other Latin American countries, where non-traditional export crops (NTECs) have been growing steadily, has stressed the "exclusionary" characteristics of a growing export-oriented agriculture.¹ First, small farmers faced difficulties growing high-value crops like fruits and vegetables because these crops usually require considerable credit to cover heavy investments, such as irrigation and mechanization, and to purchase costly inputs like fertilizers and pesticides.² Second, small farmers had problems diversifying into NTECs because many of them included perennial crops like grapes, mango, and oranges, which not only involve heavy investments, but also require two or three years to obtain the first revenues. Thus, small farmers growing these crops faced difficulties in obtaining the income necessary to support their families. Third, some high-value crops like mango or banana may be characterized by economies of scale because some tasks like delivering treatments with pesticides can be more easily mechanized, so they benefit mainly larger producers. In

¹ Among others, see Carter and Mesbah (1993), Carter et al (1995), Conroy et al (1994), Schurman (1993), Stanley (1994), and Twomey and Helwege (1991). For the Brazilian case, see Ferreira Irmão (1984), Martine (1987), and Martine and Beskow (1987).

² The term high value refers to their high prices if compared to other traditional and non-traditional agricultural products like wheat, corn, soybean, cotton, sugar, and coffee. While world prices for wheat and corn in recent years have been between \$ 75 to \$ 175 per metric ton, those of fruits and vegetables range from \$ 200 to \$ 1,600. The price of Brazilian grapes, for example, oscillated between \$ 900 and \$ 1,500 per ton between 1991 and 1996. In the same period, prices varied between \$ 600 and \$ 995 in mango and between \$ 333 and \$ 597 in melon.

addition, government policies to promote the application of new technologies, such as subsidized credit or low tariffs for machinery, often favor large-scale producers. Fourth, technologies used for growing high-value crops--especially when they are for export and require high quality--are often complicated and thus require specialized technical assistance. Because small farmers frequently have problems to pay for private technical assistance, they have to rely on public extension services that are often ineffective and poorly funded. Fifth, small farmers face great difficulties selling their products because they lack marketing skills and connections, so they have depended on middlemen who pay them low prices. These problems are even more serious for export crops because foreign buyers are far away and often speak a different language, and selling the products require a large number of bureaucratic procedures like permits and tax payments. While specialists often argue that farmer associations may be appropriate organizations to collectively solve these problems, they frequently exclude small farmers from their membership or, even when they include them, they often benefit mainly the crops grown by their larger members.

Many Brazilian and foreign analysts alike from different theoretical perspectives have argued that *colonos* in government-sponsored irrigation projects like the ones that CODEVASF built in Petrolina-Juazeiro have faced the same problems mentioned above.³ These critics argue that the *colonos* that CODEVASF and DNOCS established in these projects have often focused on the crops that they grew before receiving the land, notably corn, beans, and rice, instead of high-value crops like fruits and vegetables. While

³ Among others, see Barros (1987), Coelho (1975 & 1982), Hall (1978a & b, and 1983), and World Bank (1990).

colonos have applied irrigation, they have continued to cultivate these crops using the same traditional technology that has characterized dryland agriculture among the poor in the Northeast, interplanting them, using low quality seeds (usually grain from the previous harvest), not applying inputs like fertilizers and pesticides, and obtaining low yields. Thus, a high proportion of *colonos* in irrigation projects have been in default with banks, have not paid their water fees, and have not improved their incomes and standard of living. As a result of these problems, *colonos* frequently leave their plots, leading to a high process of turnover in most irrigation projects.

When explaining the reasons why *colonos* have not modernized their production, the above-mentioned critics of irrigation projects frequently blame interventions of federal government agencies to help *colonos* for being ineffective and paternalistic. While federal government agencies, notably the Bank of Northeast Brazil and the Bank of Brazil, have provided them with credit to improve their crops, these agencies have concentrated on credit for working capital rather than investment credit. Because most *colonos* do not have collateral, they often face difficulties to obtain investment credit during their first years as farmers. In addition, critics of government-sponsored irrigation projects argue that CODEVASF and DNOCS were responsible for *colonos* managing their plots poorly because they were too paternalistic, taking over all management tasks without promoting their participation in operation and maintenance in irrigation projects.

This chapter shows that, in contrast to the arguments just mentioned, *colonos* in Petrolina-Juazeiro have been growing non-traditional crops and new production technologies—catching up with the commercial firms that first introduced such technologies and frequently obtaining higher yields than them. I argue that the main

constraint faced by *colonos* did not relate to their capacity to grow new crops and apply new technologies, as most critics of government-sponsored irrigation projects in Brazil argue, but to their access to profitable markets both in the domestic and (especially) the international levels—problems often not addressed by government agencies. In addition, I show that government agencies—namely CODEVASF and the Bank of Northeast Brazil—implemented specific interventions that were instrumental in helping *colonos* introduce new crops and to adopt new technologies.

The chapter is organized as follows. The first section will characterize agricultural production among *colonos* in CODEVASF's irrigation projects in Petrolina-Juazeiro, showing the main recent changes in crop structure and yields. The second section focuses on key interventions that CODEVASF and the Bank of Northeast Brazil implemented to promote new crops and technologies among *colonos*. The third section describes how the increasing cultivation of export crops (mango and grapes) by *colonos* has recently pushed Valexport, the association of exporters, to change its membership and agenda, incorporating *colonos* and their concern for problems related to the domestic market. The fourth section focuses on the main problems that *colonos* still face when diversifying into high-value crops, namely obtaining a high quality product and marketing their production.

The evolution of agricultural production among *colonos*

Models of production among *colonos*

Like most small farmers elsewhere, *colonos* in Petrolina-Juazeiro rarely specialize in just one crop, most of them grow several crops for a number of reasons. First, they aim to decrease the risks of potential price and climate variations. Second, diversification helps them obtain revenues more uniformly within the year, for example, by selling beans and tomato during the first semester and banana during the second one. Most *colonos* have adapted the traditional system among sharecroppers in the rural Northeast of interplanting crops (mainly beans and corn). However, in addition to using irrigation, *colonos* have not grown beans and corn alone, but crop combinations that include more profitable crops interplanted with beans and less frequently with corn. Some of the typical combinations include tomato and beans; beans, tomato and onions; beans and grapes; and mango, banana, coconut, and beans.

While both commercial firms and *colonos* have some degree of diversification, they differ in the crops that they grow. Most of the export crops in Petrolina-Juazeiro, such as mango and grapes, are perennial--in contrast to other regions like Mossoró-Vale Assú, in which the export crop (melon) is annual. Firms focus on perennial crops for export, and some of them specialize in either mango or grapes, while others grow both of them. In contrast, *colonos* tend to concentrate on annual crops and on the domestic market, mainly beans, industrial tomato, onion, and watermelon. The reasons for this crop differentiation between firms and *colonos* are the following:

- a) Grapes and mango require larger capital investments than annual crops because they involve the use of plants (which are more expensive) rather than seeds and they

require more infrastructure at the farm level. In addition, because they are perennial crops, farmers do not obtain the first harvest and revenues until the third year after the initial investment, in contrast to annual crops, which can be harvested in only three or four months.

b) Producing grapes and mango for export requires obtaining a product of high quality. Thus, farmers need to spend amounts of fertilizers, pesticides, and skilled labor higher than when they produce with lower quality, so they face higher costs of working capital. In addition, the risks of losing quality and money are enormous if farmers do not have these high quantities of working capital timely available. For example, if a farmer growing table grapes for export has to delay a treatment with pesticides or the pruning of the plants for just a week, he is likely to obtain a product of lower quality which he will not be able to export. For these reasons, *colonos* prefer crops less demanding in quality, requiring lower costs of working capital.

Although *colonos* tend to prefer annual crops to sell in the domestic market, they have been increasingly growing permanent crops, mainly banana, but also coconut, mango, and grapes. Banana is the most important perennial crop among *colonos* for many reasons. First, they can sell it at good prices in markets that are not demanding in quality—especially after stabilization policies implemented in 1994 led to a dramatic raise in incomes of the poor population and thus an increased demand for several agricultural products, among them banana. Thus, *colonos* do not need to apply costly pesticides, hire skilled labor for specialized treatments, or pack the fruit in expensive boxes. Second, *colonos* can obtain the first harvest and revenues just one year after

plantation, so they do not have to wait such a long time like in mango and grapes. Third, banana produces all year round, so *colonos* can obtain constant revenues.

Not all *colonos* grow the same combination of crops. Just the opposite, different types of *colonos* can be characterized by different crop combinations, each of which has a connection with the *colono's* degree of capitalization. The majority of *colonos* (around 50 percent of the total) grow a combination of annual crops, mainly beans, tomato, watermelon, and onions, and perennial crops, mainly banana and/or coconut. Farmers in the lower end (around 30 percent of the *colonos*) often focus only on beans, corn, and tomato, and the ones in the upper end (around 15 percent of the total) grow small areas of mango and grapes, associated with annual crops, mainly beans, tomato, onions, and watermelon (see table 10).

Changes in crop areas and yields

Just like the critics of government-sponsored projects, I expected that *colonos* in CODEVASF's projects Petrolina-Juazeiro would grow mainly traditional crops like beans and corn and would not be able to grow high value crops like fruits and vegetables. To my surprise, I found that *colonos* not only grow a wide range of high-value crops, but they have also been increasingly growing perennial crops and decreasing their areas with annual crops.

By 1996, less than a decade after CODEVASF started to promote the diversification of *colonos'* production in Petrolina-Juazeiro through the incorporation of several fruits (mango, grapes, guava, passion fruit, among others)--a strategy that I will

Table 10. Main production systems present in Petrolina-Juazeiro

Agricultural firms

Crops	Main market
Only grapes	Export and domestic (São Paulo)
Only mango	Export and domestic (São Paulo)
Grapes and mango	Export and domestic (São Paulo)
Grapes, mango, and banana	Export and domestic (São Paulo) in grapes and mango Domestic (regional) in banana
Grapes, mango, banana, and coconut	Export in grapes and mango Domestic (regional) in banana and coconut

Colonos

Crops	Main market
Beans and tomato	Domestic (local)
Beans, tomato, and onions	Domestic (local)
Beans, tomato, and watermelon	Domestic (local)
Beans and melon	Domestic (local)
Beans, tomato, banana and coconut	Domestic (local and regional)
Beans, tomato, and banana	Domestic (local)
Beans, banana, coconut, and mango	Domestic (local and regional)
Beans and grapes	Domestic-local and regional

Source: Based on interviews to *colonos* and firms.

explain in section b--banana had turned into the third most important crop (after beans and watermelon) among *colonos*, with a total area of 3,700 hectares (16.2 percent of their area with irrigated crops). In addition to banana, *colonos* have also increased substantially the areas with the two main export crops in the region, mango and grapes. *Colonos* had 1,500 hectares of mango in 1996, accounting for 18.7 percent of the total area of mango in Petrolina-Juazeiro and 30 percent of the mango areas in CODEVASF's

irrigation projects in the region. At the same time, *colonos* had 820 hectares of table grapes, accounting for 18.2 percent of the total area of table grapes in the region and 58.6 percent of the area of table grapes in CODEVASF's projects. Although these proportions for mango and grapes are relatively small, commercial firms introduced the cultivation of these crops only in the mid-1980s. Thus, *colonos* were able to catch up quite fast. More important, a large proportion of the *colonos* in Petrolina-Juazeiro have been able to start growing perennial crops. By 1996, 77 percent of the *colonos* in irrigation projects in Petrolina-Juazeiro grew mango and 74 percent of them grew table grapes (see table 11).

Colonos have increased their areas with perennial crops in all irrigation projects. In the Senador Nilo Coelho project, for example, the area with annual crops among *colonos* fell from 98 to 65 percent of their cultivated area between 1989 and 1995, while the area with perennial crops increased from 2 to 35 percent. The growth of permanent crops relates mainly to the increase in the area of banana and mango, which went from 0.6% and 0.1% of the crop areas in 1989 to 21.2% and 4.6% respectively. The decrease in annual crops relates mainly to the decrease in the areas with beans and industrial tomato, which fell from 47.3 and 27.2 percent to 27.7 and 16.8 percent of their area with irrigated crops between 1989 and 1995. In the Bebedouro project, table grapes became the main perennial crop, rising from 8.3 percent to 53.4 percent of *colonos*' area with irrigated crops between 1989 and 1995. During the same period, the area with industrial tomato fell from 15.4 percent to only 3.1% of their cultivated area. In the Maniçoba project, the area with permanent crops among *colonos* increased from 4.1 percent of their crop areas in 1989 to 32 percent in 1995. In the same period, the area with mango grew

from 0.7 to 11.4 of their cultivated area and the area with banana from 0.3 to 6.7 percent.

In the Curaçá project, *colonos* went from not cultivating mango at all in 1989 to grow 260 hectares, which represented 9.2 percent of their cultivated area.

Table 11. Areas of irrigated crops grown by *colonos* and commercial firms in CODEVASF's irrigation projects in Petrolina-Juazeiro, 1996 (in hectares)

	Total area in Petrolina-Juazeiro	Area grown by <i>colonos</i>	Area grown by firms	% grown by <i>colonos</i>
Beans	6,000	5,500	500	91.7
Watermelon	4,200	3,750	450	89.3
Banana	4,000	3,700	300	92.5
Industrial tomato	4,000	3,100	900	77.5
Mango	5,000	1,500	3,500	30.0
Melon	1,120	1,030	90	92.0
Grapes 1/	1,400	820	580	58.6
Coconut	670	630	40	94.0
Corn	1,000	600	400	60.0
Onion 1/	650	560	90	86.2
Acerola	540	480	60	88.9
Guava	670	460	210	68.7

Notes: 1/ While the areas grown in CODEVASF's irrigation projects represent almost all the crop areas for most of the crops, large areas of mango, grapes, and onions are grown outside the projects. Agricultural firms outside the irrigation projects grow about 3,000 hectares of mango (37.5% of the total crop area) and 3,100 hectares of grapes (68.8% of the total crop area). Small farmers outside irrigation projects grow mainly irrigated onion—a total of 3,300 hectares.

Source: Elaborated with data provided by CODEVASF

The increasing cultivation of high value crops does not mean that annual crops are no longer important in their structure of production. Bean still represents the crop with the largest area among *colonos* (5,500 hectares, or 24 percent of their total area with irrigated crops), and *colonos* account for 91 percent of the area with beans in Petrolina-

Juazeiro, with farms growing only 9 percent of the total area. However, *colonos* in Petrolina-Juazeiro grow beans differently than sharecroppers in the “traditional” dryland system or *colonos* in most DNOCS irrigation projects. Producers in the “traditional” system often grow beans interplanted with other crops, mainly corn and manioc, obtaining very low yields. Most DNOCS’s irrigation projects have been criticized because *colonos* have applied irrigation but maintained the same mix of interplanted crops. In contrast, the vast majority of the *colonos* in CODEVASF’s projects in Petrolina-Juazeiro interplant beans with crops of higher value, such as banana, grapes, and mango. Such a different mix not only provided higher revenues, but more important, it made possible for *colonos* to start growing perennial crops like banana and mango. Because *colonos* only obtain the first harvests from these crops between one year (in banana) and three years (in grapes and mango) after plantation, growing beans became key to support their families because it provided them with revenues only three months after plantation. After mango and grapes yield their first harvests, *colonos* usually stop growing beans interplanted with them. I will come back to explain this system of production later in this section.

In addition to beans, two of the next three most popular crops among *colonos* are also annual crops: watermelon and industrial tomato. These crops account respectively for 16.4 and 13.5 percent of the area that *colonos* cultivate with irrigated crops. In addition, both crops in Petrolina-Juazeiro are grown mostly by *colonos*, who account for 89.3 percent of the area with watermelon and 77.5 percent in industrial tomato. *Colonos* like these crops because they can harvest production only a few months after plantation, in contrast to perennial crops like mango and grapes, in which they have to wait for two

or three years to obtain the first harvest and revenues. In addition, watermelon and tomato have low investment costs compared with perennial crops like mango, grapes, and banana. Although industrial tomato requires substantially higher working capital than other annual crops like beans, *colonos* who grew it and signed a contract with a processing industry received the inputs from it, only having to pay back after the harvest. In addition, *colonos* growing industrial tomato under contracts with the processing industry had a security market--a topic that I will explain later in this section.

In contrast to what I expected, *colonos* not only raised their areas with perennial crops, but also their yields increased consistently for almost all crops (see tables 12 to 17). Yields for industrial tomato increased from an average of 15 tons per hectare in 1985-87 to 45 tons per hectare in 1993-1995; in the same period, yields in watermelon went from 12 to 18 tons per hectare and in beans from 0.9 to 1.6 tons per hectare. The increase in yields not only characterized annual crops, but also perennial crops which *colonos* started to grow only in the 1990s. For example, yields in mango increased from an average of 6 tons per hectare in 1990-92 to 9 tons per hectare in 1993-95, while banana yields went from 13 to 21 tons per hectare in the same period.

The comparison between the yields obtained by *colonos* and firms shows important differences in annual and perennial crops. While *colonos* have often obtained higher yields in most annual crops, firms performed much better in perennial crops and especially in grapes and mango. In addition, *colonos* showed a much higher interannual variation in all crop yields and especially in perennial crops for reasons that I will explain later.

Table 12. Colonos. Evolution of crop yields for different crops in the Senador Nilo Coelho irrigation project (in tons per hectare)

	1989	1991	1992	1993	1994	1995
Beans	0.6	1.6	1.4	1.8	1.9	1.8
Watermelon	4.9	18.6	11.1	13.0	17.2	16.9
Tomato	4.8	27.8	46.8	41.9	49.5	45.1
Melon	---	10.3	3.8	4.6	9.6	12.2
Onion	3.7	9.9	5.0	15.1	13.3	11.3
Banana	1.7	12.7	14.2	32.3	24.0	15.0
Mango	---	6.0	4.8	9.0	11.9	8.5
Acerola	---	---	2.2	5.7	14.7	5.3
Grapes	1.9	6.7	14.9	87.0	32.0	18.0

Source: Based on information provided by the Senador Nilo Coelho Irrigation

Table 13. Agricultural firms. Evolution of yields for different crops in the Senador Nilo Coelho project (in tons per hectare)

	1989	1991	1992	1993	1994	1995
Beans	0.8	1.7	1.5	1.6	1.0	1.7
Watermelon	5.5	15.7	11.3	14.5	14.9	11.1
Tomato	19.0	39.3	67.4	40.9	49.5	45.2
Corn	2.4	--	2.7	2.8	2.5	2.8
Melon	18.9	4.6	3.0	0.1	9.6	14.0
Onion	13.0	19.5	14.7	11.1	13.3	11.1
Banana	2.3	3.8	5.9	4.7	24.0	14.2
Mango	7.1	19.5	12.5	6.7	11.9	12.7
Grapes	1.1	9.2	16.1	32.9	32.0	23.4
Guava	2.7	2.0	4.1	8.1	13.6	12.4
Acerola	--	--	--	3.9	14.7	6.4

Source: Based on information provided by the Senador Nilo Coelho Irrigation District and CODEVASF

Although the information presented here shows that a high proportion of *colonos* have been able to grow perennial and export crops, not all of them have been able to do so, and most of the ones growing them still face important problems related to improving

the quality of production and marketing--especially in foreign markets. The next section will show that government agencies had a great influence in the crop selection of *colonos*, explaining how they were able to grow increasing areas of perennial and export crops. Although characteristics of the crop technology and the quality required by the market played an important role in the combination of crops that *colonos* grow, CODEVASF also had a great influence on crop types grown and in their capacity to increase yields. The agency implemented two different strategies over time: a) from the late 1960s to the early 1980s, CODEVASF pushed *colonos* to grow annual crops other than beans and, in collaboration with the Bank of the Northeast (which provided credit to *colonos*), promoted contract farming in tomato; and b) starting in the mid 1980s, CODEVASF promoted the introduction by *colonos* of perennial crops, mainly banana, mango, and grapes. In this process, the Bank of the Northeast also provided investment credit essential for *colonos* to start growing these crops.

Crop structure and the role of government agencies

Initial emphasis on promoting annual crops

Most of the interventions supporting *colonos* in CODEVASF's and DNOCS's projects, as well as those supporting small farmers in Northeast Brazil, have faced great difficulties and shown poor results. A high proportion of the analysts looking at these programs have often criticized federal and state government agencies implementing these programs for not doing enough to help *colonos* and small farmers with higher availability of cheap credit and technical assistance. In contrast to these views, I argue that the dynamism shown by *colonos* in Petrolina-Juazeiro relates to the implementation of a

strategy that supported different crops over time, emphasizing the cultivation of annual crops and the domestic market at an early stage, and shifting to perennial crops and export markets only after several years. This sequence allowed *colonos* to learn about new technologies and marketing, and it made possible for them to gradually turn to perennial crops, obtaining revenues while they were waiting to obtain the first harvest and revenues from perennial crops.

Table 14. *Colonos*. Evolution of yields for different crops in the Curaçá project (in tons per hectare)

	1989	1991	1994	1995
Watermelon	14.7	18.9	21.2	19.7
Tomato	11.3	18.5	38.1	32.1
Melon	7.9	9.4	10.6	12.7
Mango	--	1.3	10.1	10.0
Grapes	--	7.1	20.3	10.0
Banana	--	--	10.8	6.2
Passion fruit	--	--	9.8	14.4

Source: Based on information provided by CODEVASF

Table 15. Agricultural firms. Evolution of yields for different crops in the Curaçá project (in tons per hectare)

	1989	1991	1994	1995
Watermelon	16.3	36.0	39.0	---
Tomato	37.8	50.1	---	29.5
Mango	5.7	6.9	14.5	19.7
Grapes	15.3	17.2	20.2	13.2
Banana	7.2	6.1	--	---
Passion fruit	---	--	--	66.7

Source: Based on information provided by CODEVASF

Table 16. Colonos. Evolution of yields for different crops in the Manicoba project (in tons per hectare)

	1989	1991	1994	1995
Beans	0.7	0.8	1.3	2.0
Watermelon	12.8	11.3	18.2	18.2
Tomato	10.9	9.1	18.9	24.9
Melon	4.9	8.1	12.7	9.6
Onion	8.3	7.8	13.7	10.5
Mango	---	--	9.5	15.0
Grapes	18.1	5.9	17.5	19.9
Banana	---	0.5	7.8	20.0
Passion fruit	---	22.0	20.4	16.0
Guava	---	--	7.9	30.0

Source: Based on information provided by CODEVASF

Table 17. Agricultural firms. Evolution of yields for different crops in the Manicoba project (in tons per hectare)

	1989	1991	1994	1995
Watermelon	6.9	16.4	18.1	11.7
Tomato	3.5	45.6	45.8	22.2
Melon	3.3	9.9	8.6	7.3
Onion	4.7	13.5	21.8	9.7
Mango	0.2	3.1	5.2	15.0
Grapes	1.5	27.4	26.0	25.0
Banana	1.4	7.2	6.6	20.0
Passion fruit	--	--	11.2	16.0

Source: Based on information provided by CODEVASF

As I described in chapter 2, FAO carried out a series of studies in the early 1960s to evaluate the possibilities of irrigation in the São Francisco River Basin. In addition to helping select the areas for building government-sponsored irrigation projects, the studies also identified crops and crop varieties appropriate to the soils and climate conditions of Petrolina-Juazeiro. This research showed excellent yields in many annual crops,

including beans, corn, watermelon, melon, and tomato. Taking into account the good yields of these crops, their low investment costs, and the short period to obtain the first revenues, FAO proposed that *colonos* grow annual crops.

Following FAO's recommendations, SUVALE promoted a combination of several annual crops among *colonos* in irrigation projects, including beans, corn, melon, watermelon, and eating tomato. SUVALE's influence in what *colonos* grew in that period was enormous. Most of the first beneficiaries that the agency established in the projects were landless peasants, most of whom had no experience with irrigated agriculture. Thus, the agency trained them in the use of irrigation equipment and imposed the crops that they would cultivate, usually providing farmers with the plots already planted with annual crops. A few years later, the newly created CODEVASF promoted an important change in the agricultural production of its projects by promoting the cultivation of industrial rather than eating tomato among *colonos*. CODEVASF promoted the cultivation of industrial tomato by first attracting tomato-processing industries to Petrolina-Juazeiro, a strategy that I will explain in detail in the next section.

The cultivation of annual crops first made the current cultivation of perennial crops possible, as most *colonos* would not have done it even if credit for investment were available. This contribution has taken the following forms:

- 1) Annual crops have helped *colonos* obtain revenues to maintain their families. As I showed in the first section, most *colonos* who currently grow perennial crops grew annual crops in the past or still have a mix of crops. Most of the *colonos* would have not been able to grow these perennial crops because they not only require a large capital investment (around US\$ 3,000 per hectare), but also a long period (between two and three

years) to obtain the first revenues. Growing crops like beans, melon, and tomato in the transition to perennial crops has been the main way in which colonos have been able to grow perennial crops. They have done it in three ways: a) growing annual and perennial crops interplanted; b) diminishing gradually their areas with annual crops, while at the same time increasing the area with perennial crops; c) using part of the inputs financed with credit for industrial tomato for using them with other crops.

2) Annual crops have allowed *colonos* to learn about irrigation technology. Most *colonos* in irrigation projects had no experience in irrigated agriculture because they were often landless peasants who grew dryland crops. Growing tomato allowed farmers to learn about the timing of production and to work with some institution that coordinated production (timing, technology, etc.). Growing annual crops made *colonos* learn that the timing of the harvest period was essential, and that some kind of institution that programs the timing of the harvest in the whole region would be advantageous for everybody. In fact, the processing industry would have been unable to receive all the production of tomato in Petrolina-Juazeiro if all the farmers harvested in a very concentrated period--which is coincident with the period recommended by agricultural technicians in order to avoid some pests and produce higher yields. For this reason, the industry not only agreed with farmers on the technology that they used and the price that they would pay for the product, it also organized a chronogram and agreed with each farmer on the moment in which he would plant and harvest. This chronogram allowed each firm to work at full capacity within a longer period and avoid the problem of not being able to receive all the production--which would make farmers sell to other buyers, and not comply with the contracts.

While programming the timing of production may seem something easy, farmers growing traditional crops do not do it. The planting and harvest seasons for these farmers are determined not by factors related to the market or the technology of processing, but by factors related to the technology of agricultural production. Without irrigation, what matters most is to plant when the first rains occur (often in January). Immediately after the first rains, a farmer must plant his crops or run the risk of missing one or two of a few number of rains a year. As a result of a concentrated planting season, the harvest of these crops is also very concentrated—often in May. For these producers, growing industrial tomato was a substantial change, something they needed to learn how to do or to be enforced to do.

The timing of the harvesting season is essential in most fruits that have been cultivated later in Petrolina-Juazeiro not because of the requirements of some processing industry, but because of reasons related to the market. For example, mango in Petrolina-Juazeiro may be produced and harvested during about six months every year, so farmers (especially the smaller ones) may be tempted to harvest over the whole six months in order to have a more spread income. However, the best harvest period is between November and December because Petrolina-Juazeiro can sell in foreign markets with no other country competing. Grapes may be also grown all year round, but farmers in Petrolina-Juazeiro need to avoid the times of the year in which there is strong competition from producers in the south of the country (April-May) and other countries in the southern hemisphere, such as Chile, Argentina, and South Africa.

Exporting products that are highly perishable involves a ‘just in time’ production not very different than what happens in many industries. In fact, fruits are so perishable

that they need to be in the market in one or two weeks. In order to avoid the potential losses of reaching the market with part of the product in bad quality conditions, producers have to coordinate many different tasks: harvesting, classifying the product, contracting of trucks to take the fruit from Petrolina to the harbor of Recife 700 km away, and contracting of ships to transport it to the purchasing country mostly in Europe or the United States. This is not an easy task, and the limited capacity of obtaining trucks and ships to transport the fruit to foreign markets acts as a constraint in the same way that the limited capacity of the industry to process tomato does.

Encouraging backward linkages from processing industries

Agricultural and development economists have been interested in the linkages between agriculture and industry since the 1960s. These authors have attempted to understand how these linkages--defined as the degree in which the growth of one sector (e.g. agriculture) affects the growth of another sector (e.g. industry) through factor and product markets--occur, trying to identify under what circumstances these linkages occur and what government interventions may foster them. Until the 1970s, most development economists considered that agriculture had a lower productivity than industry and lacked the capacity to generate forward (from agriculture to agro-processing) and backward (from agriculture to manufacturing) linkages. Hirschman (1958) argued that industry had clear advantages over agriculture in terms of creating linkages, as investment from the

finished product stimulated investment back towards semi-processed or raw materials.⁴ In contrast, many authors since the late 1970s have stressed that agriculture has the potential to generate linkages, arguing that increased agricultural production induces the growth of non-agricultural output and employment. These production linkages may result from the demand of agricultural producers for inputs, such as fertilizers and pesticides, and from the supply of agricultural products like tomato that must or can be processed before their consumption.⁵ In addition, other authors have focused on consumption linkages, defined as the increased demand for non-farm products like construction materials and furniture due to the increase in the income and consumption levels of agricultural producers and rural workers.⁶

Since the 1970s, one of the main policy issues under debate has been whether agricultural growth necessarily sets in motion non-agricultural growth, and under what conditions agricultural growth does foster growth linkages, and what interventions governments may undertake to create a favorable environment for linkages to occur. Some authors have argued that agricultural growth would automatically generate industrial growth in rural regions, especially small-scale and labor-intensive industries, through consumption linkages.⁷ Other authors have shown that linkages with non-

⁴ See Hirschman (1958) for a definition of linkages and an explanation of his reasons for the low capacity of agriculture to generate them. See Johnston & Mellor (1961), Reynolds (1975), Statz & Eicher (1990), and Timmer (1988 & 1991) for a review of the views of the development literature about the role of agriculture in the process of economic development.

⁵ See Ranis & Stewart (1987). For empirical studies documenting the importance of these linkages, see among others Hazell & Roell (1983) and Johnston & Kilby (1975).

⁶ See Mellor & Lele (1973).

⁷ See Hazell & Roell (1983) and Ranis & Stewart (1987).

agricultural activities may not occur even when agriculture grows substantially, for example, because of different macropolicies that promote agricultural linkages.⁸

This section addresses the interventions that CODEVASF implemented in the mid-1970s focusing on the promotion of industrial tomato, showing that:

- 1) The presence of the processing industry was key to disseminate the cultivation of industrial tomato among *colonos* and played a crucial role in the change in the technology of production--in fact a case of backward linkages from the industry rather than of forward linkages from agriculture;
- 2) CODEVASF played a key negotiating role in the development of backward linkages between industry and agriculture; and
- 3) The cultivation of industrial tomato was a key stage that played a crucial role in *colonos* learning how to produce irrigation crops and that allowed them to start growing perennial crops.

As I said earlier, SUVALE first promoted a mix of annual crops, including beans, melon, watermelon, onion and eating tomato. A few years later, the newly created CODEVASF promoted an important change in the agricultural production of its projects by promoting the cultivation of industrial rather than eating tomato among *colonos*. The idea came from officials of CODEVASF in Petrolina immediately after the creation of the agency in 1974. These technicians observed that Pernambuco was at the time the second largest producer of tomato in Brazil after São Paulo and the first one in the Northeast region, accounting for 70 percent of the tomato produced in the Northeast. In addition, processing industries were located in Pernambuco's "Agreste"—a region just a couple of

⁸ See Ranis and Stewart (1987) and Hart (1989).

hundred miles from Petrolina-Juazeiro—where they had established in the early 1910s, and industrial tomato was a common crop among farmers in that region. More importantly, and for reasons that I will explain later, these industries were already purchasing tomato from *colonos* in Petrolina-Juazeiro and bringing it to their plants in the “Agreste”.

In fact, Pernambuco and São Paulo were the first two states to grow tomato in Brazil since the early 1900s. The cultivation of tomato in Pernambuco’s “Agreste” started in the early 1900s at about the same time that farmers started to grow it in São Paulo. The climate conditions in Pernambuco’s Agreste, in which temperatures were lower and rains higher than in the semiarid region and in the Agreste of other Northeast states, were appropriate for the cultivation of tomato without irrigation. In addition, the high transportation costs to bring tomato from São Paulo to the Northeast prevented the competition of tomato producers from the south of the country. While the first growers in the Agreste grew eating tomato, they soon shifted to industrial tomato because of the establishment of the processing industry. Until the 1910s, Brazil depended entirely on imports of tomato products to supply its domestic market. Because several wars that took place in Europe in the early 1900s greatly affected these imports, the federal government supported the establishment of tomato-processing industries and producers of industrial tomato with credit and protection from imports. Taking advantage of these measures, *Fábricas Peixe* built its first processing facilities in the Agreste’s municipality of Pesquera in 1914. Two other large tomato-processing firms, CICA and Palmeiron, later established in the Pernambuco’s municipalities of Belo Jardim and Garanhuns.

Agronomists from the CODEVASF offices in Petrolina-Juazeiro carried out a study of the cultivation of industrial tomato in Pernambuco, noticing that producers in the Agreste region grew it without irrigation. For this reason, yields varied greatly from year to year and, most important, the harvest was concentrated between June and October, with a peak in July and August. Thus, the processing industry often had trouble using their equipment at full capacity. In contrast, producers in Petrolina-Juazeiro would use irrigation and thus could obtain tomato in times of the year in which the industry could not purchase production in the Agreste region.

The officials of CODEVASF in Petrolina-Juazeiro were able to convince their managers in Brasilia of the great potential for the expansion of industrial tomato in the agency's irrigation projects. These officials were worried about the difficulties that *colonos* were facing to sell their production because Petrolina-Juazeiro was far away from the main consumption centers of the country (São Paulo and Rio de Janeiro), roads were in bad shape, and *colonos* did not have experience in marketing their production. Thus, *colonos* were selling most of their production to middlemen who visited each plot and purchased production before the harvest, thus bringing the tomato processing firms would help them solve their marketing problems. In addition, the processing industry would promote the adoption of new production technologies among *colonos*.

Officials of CODEVASF in Brasilia contacted managers of CICA and ETTI in São Paulo to try to convince them to settle in Petrolina-Juazeiro. During the negotiations which took place between 1975 and 1976, CODEVASF's officials agreed that the extension agents of the agency would promote the cultivation of industrial tomato in irrigation projects once they moved there, convincing *colonos* that tomato was a great

option because the processing industry would provide inputs and technical assistance and would purchase the production, avoiding the problems of marketing the product. In addition, CODEVASF would contact the managers of the Bank of Northeast Brazil in Petrolina and in the main offices in Fortaleza in order to establish a new credit line for working capital available only to tomato growers who signed a contract with a company.

At the same time, CODEVASF started to support a research program that the Agricultural Research Institute of Pernambuco (Instituto de Pesquisa Agrícola de Pernambuco, IPA-PE) was starting in 1973 to develop new varieties of industrial tomato. IPA's research efforts were initially unrelated to CODEVASF's efforts to attract the processing industry to Petrolina-Juazeiro. In fact, IPA was a prestigious agency of Pernambuco's state government that had carried out research on tomato and other crops since the 1930s. Thus, the agency had contacts with other institutions both in the south of Brazil and abroad, such as the University of São Paulo and Purdue University in the United States. The research on tomato consisted of an evaluation of varieties that had high yields and were resistant to diseases, and it was carried out in close collaboration with the Institute of Genetics of the University of São Paulo (USP) and the Department of Horticulture of Purdue University. The role of CODEVASF was to convince technicians from IPA to incorporate Petrolina-Juazeiro as one of the locations for their experiments, providing lands for them in the Bebedouro project in the municipality of Petrolina. The research project, carried out in IPA's experimental station in the municipality of Belém do São Francisco in Pernambuco, in USP's Institute of Genetics in Piracicaba, and lands of the Bebedouro project in Petrolina eventually led to the generation of two varieties of

industrial tomato, IPA 5 and IPA 6. These new varieties, which started to be used in 1981, soon became the best and most well-known in Brazil.

As a result of negotiations with CODEVASF, processing firms decided to establish processing facilities in Petrolina-Juazeiro. CICA opened its processing facilities in 1976, soon followed by ETTI and three additional firms. Managers and technicians of these firms became convinced that irrigated industrial tomato in Petrolina-Juazeiro had substantial competitive advantages over São Paulo, so they could obtain a more steady supply at lower prices. One of CICA managers at that time stressed:

“Establishing in Petrolina-Juazeiro ended up being a relatively easy decision. Although a large part of Brazil’s production of industrial tomato came from São Paulo, and we had our main processing facilities there, we came to the conclusion that irrigated production in Petrolina-Juazeiro had great advantages over São Paulo. Our agronomists were stunned when they saw the yields of some varieties grown with irrigation in IPA’s experimental fields in CODEVASF’s projects in Petrolina-Juazeiro. Although these varieties were cultivated under the ‘controlled’ conditions of an experimental station, yields were very impressively high. In addition, farmers in São Paulo frequently faced the problem of frosts that decimated their crops--something that could never happen in the Northeast. And finally, the production season was more flexible in Petrolina-Juazeiro, which means that it could be possible to program production to have a longer harvest season so that processing facilities worked for a longer period of time during the year. All these advantages allowed us to pay a price for the tomato that was lower than in the south but still attractive to farmers.”

Immediately after establishing processing facilities, CICA and ETTI started to sign contracts with *colonos* in which they committed to purchase all production of industrial tomato at an agreed price, upon the condition that *colonos* use the technology--especially the varieties--defined by the industry. Technicians working for CICA and ETTI would visit *colonos* to evaluate the characteristics of their plots for growing tomato, to agree on the area that each would cultivate, and to give them directions on the technology to be applied in the crop. Technicians would then visit *colonos* periodically in key stages in the crop cycle, such as the emergence of the plants and harvest time, or in the case of some problem like the attack of a pest. In addition, *colonos* received the seeds directly from the

processing firms; and *colonos* in turn purchased directly most other inputs, including fertilizers and pesticides, receiving credit from the Bank of the Northeast that was earmarked for that purpose.

The presence of the industry led to the rapid growth in the areas with industrial tomato. By the mid 1980s, industrial tomato had become the most important crop in Petrolina-Juazeiro, with an area of 15,000 hectares and the tomato industry producing more than 40% of the tomato pulp consumed in Brazil. However, the conditions that gave rise to the boom of tomato changed dramatically in the late 1980s. First, a new pest (“traça”) attacked the tomato crops in 1988, leading to very low yields and great losses for farmers. While the extension services of the processing industry promoted a new technological package to solve this problem as early as 1990, *colonos* had to use substantially more expensive pesticides, raising their costs of production. Second, the trust relationship between farmers and the industry worsened. Great interannual variations in the yields of irrigated tomato led the industry to occasionally not comply with contracts that it had signed with farmers because it was not able to receive all production. Third, the federal government started to implement a policy of lower tariffs for imports and signed an agreement creating the Common Market of the South (MERCOSUL) with Argentina, Uruguay, and Paraguay). Lower tariffs increased the competition of imported tomato products, especially from Argentina and Chile. Thus, the tomato industry started to purchase part of the tomato pulp from abroad. While tomato-processing industries and CODEVASF were concerned with the negative effects of liberalization on tomato production, they were not able to influence decisions concerning MERCOSUL, as more powerful industries from São Paulo (especially automobile)

played the most influential role in negotiations. As a result of these problems, a large number of *colonos* were not able to repay their loans to the Bank of Northeast Brazil, so the Bank suspended the supply of credit to tomato producers in 1990. The areas with tomato started to decline dramatically, falling from 15,000 hectares in 1987 to 4,500 hectares in 1996.

The problems with tomato pushed CODEVASF to look for other crop alternatives for *colonos*. The next section will show that even before the crisis with industrial tomato that took place in the late 1980s, CODEVASF had already started looking for ways to diversify the production of *colonos*, a strategy that began giving visible results in the 1990s.

Promoting diversification through the introduction of perennial crops

Even a few years before the production of tomato started to experience the problems mentioned in the previous section, technicians from CODEVASF in Brasilia were concerned with the dependence of *colonos* on a single major cash crop, giving the industries too much power to set the prices of tomato. Processing firms had established facilities in Petrolina-Juazeiro precisely because they could pay a lower price for tomato than in the south of Brazil and even in the international market. For example, CICA paid *colonos* in Petrolina-Juazeiro an average of 50 dollars per ton of industrial tomato in the period 1985-89, compared with US\$ 68.5 in the international market.⁹

The problem of low prices not only affected tomato producers, but also CODEVASF. The agency had not been enforcing the payment of water fees from

⁹ CODEVASF (1993), pp. 5-6.

colonos for several years as a way of subsidizing their process of learning how to produce irrigated crops. Thus, it was facing great difficulties to pay the bills to CHESF, which provided the electric power to CODEVASF's irrigation projects. For the very same reason, CODEVASF was facing increasing criticism from different places, ranging from the Ministry of Finance and politicians in Brasilia to international organizations that funded irrigation projects, notably the World Bank. Technicians from CODEVASF saw that while the introduction of tomato had brought several benefits, such as the possibility that *colonos* obtain credit for inputs and extension from the processing industry, farmers were still not able to pay their water fees because the price received for the tomato was too low. Thus, CODEVASF thought that introducing other crops would be a way of making production more profitable and increase the collection of water fees.

At the same time, local elites from Petrolina were increasingly pushing CODEVASF to focus on *colonos* because they wanted to gain constituency among them. Members of these elites had traditionally occupied important positions at the municipal, state, and federal levels. They had long supported the agency's efforts in Brasilia to secure funds from the national budget for further investments in irrigation, and they had been able to influence greatly in the appointment of its Directors. In a little more than a decade, CODEVASF's irrigation projects had settled more than 2,000 families in Petrolina-Juazeiro and had served to attract a large number of people from other municipalities and other states to work as rural wage workers. Thus, large-scale irrigation projects included a large number of potential voters.

In order to address these concerns from different actors, CODEVASF implemented studies of alternative marketing channels and alternative crops for export.

As early as 1983, only a few years after the establishment of the tomato-processing industry in Petrolina-Juazeiro, the agency had already identified that the industry paid low prices to farmers, and it was proposing the diversification of production into specific crops for export, such as mango, melon, passion fruit, and grapes. The central offices of CODEVASF in Brasilia created a task force in 1986 to promote crop diversification among *colonos* and firms. This task force started to push *colonos* to grow perennial crops of high value which they could eventually export, and organize workshops for *colonos* to promote crops like mango, banana, and grapes.

In addition, CODEVASF and the Bank of the Northeast provided credit for investment to *colonos* which gave a big push to the cultivation of perennial crops. CODEVASF created in 1989 a program (*Programa da Fruticultura*) to promote the cultivation of fruits among *colonos* in its irrigation projects. The program received funding from the World Bank and involved the supply of credit for investment required by fruits like mango, grapes, and banana to *colonos*. CODEVASF signed an agreement with the Bank of Northeast Brazil for this institution to administer the provision of credit. Moreover, the Bank of Northeast Brazil started to provide its own credit lines for investment open to both firms and *colonos* with additional funds that it received from the Constitutional Fund approved by the 1988 Constitution.¹⁰ This access to credit was key for *colonos* who in turn were able to incorporate perennial crops since such credit was one of the main constraints that *colonos* were facing to grow them. The result of these

¹⁰ The Constitutional Fund for the Northeast (FNE) included a 1.8 percent of the funds collected from the income tax and the tax over industrialized products. The 1988 Constitution created the FNE to promote the economic development of Northeast Brazil through credit programs to all sectors of production. The Bank of Northeast Brazil is the agency that administers the FNE funds.

interventions was the great growth of the area with perennial crops, mainly banana, mango, and grapes.

Colonos not only benefited from interventions that CODEVASF and the Bank of Northeast Brazil implemented to help them introduce perennial crops, but also by some unintended spillover effects from the presence of firms in the projects. The next section will focus on how government agencies (specifically the Bank of Northeast Brazil) played an important role as an intermediary in the transference of technology between *colonos* and firms.

Spillover effects from firms and the role of government agencies

As I explained in chapter 4, CODEVASF promoted a model of settlement that included a mix of *colonos* and medium-size firms. The aim of this strategy was not only to bring capital and technology to the region, but also to promote technical change and the incorporation of new crops by *colonos* through their learning from the experience of large farmers. However, this process of learning usually does not occur automatically, and CODEVASF did not carry out any specific intervention to facilitate the exchange of information and experience between *colonos* and firms. Surprisingly, other agencies, notably the Bank of Northeast Brazil, ended up playing an indirect, though important, role in these exchanges between firms and *colonos*.

The Bank of Northeast Brazil implemented some measures that even though the institution designed them just as a part of the credit management, they ended up being mechanisms in which information about crops and technologies were transferred from firms to *colonos*. In fact, when the Bank of Northeast Brazil opened new credit lines for

investment targeting export crops in the beginning of the 1990s, it set some standard procedures as part of the loan application. A firm or a *colono* who aimed to grow perennial crops needed to present a project proposal to the offices of the Bank of the Northeast in Petrolina or Juazeiro. Because the project had to clearly present the technology to be applied and the economic results to be obtained, even *colonos* had to hire a professional (often an agronomist trained in irrigated agriculture) to design the project. The credit for investment normally included the costs of hiring the agronomist and designing the project. Professionals from the Bank of Northeast Brazil in Petrolina and Juazeiro who were highly experienced in irrigated agriculture would assess the proposal, visiting the farm and reviewing the different components of the project, and paying particular attention to the technology proposed. If they found a problem, they had to talk to the agronomist who designed the project and ask him to introduce changes in the project. Only after these professionals “cleared” the project, bank managers would then approve the loan.

While the bank professionals assessing project proposals had often received very good training in irrigated agriculture, their knowledge came mainly from on-the-job training. Visiting agricultural firms to assess their project proposals allowed them to become some of the first agronomists in the region to know about the innovations applied by the firms. Soon after innovative firms introduced new technologies, such as the application of new pesticides or the use of new pruning techniques, bank technicians started to require the application of these technologies as standard requirement, or they would not approve the project. Thus, their role in assessing project proposals of both *colonos* and firms turned them into truly intermediaries in the transference of technology.

While these interventions were very important for *colonos* to learn about new crops and technologies, *colonos* continued to face problems associated with growing perennial crops for export. As it happens with small farmers elsewhere, *colonos* are often excluded from exporters' associations that serve to gain access to foreign markets. However, I will show in the next section that Valexport has been increasingly interested in incorporating *colonos*, partly as a result of their increasing weight in the production of export crops and the great importance of the domestic market--even for export producers.

Incorporating *colonos* and their agendas in the exporters' association

Colonos not only often face difficulties to grow export crops, but also they are frequently excluded from associations that represent exporters. Like in many other agricultural export regions in Brazil, the exporters' association in Petrolina-Juazeiro (Valexport) initially included commercial firms and did not include *colonos* from CODEVASF's irrigation projects. As I explained in chapter 4, a group of firms created Valexport in 1986 and the membership initially included firms only. More importantly, larger firms were the ones that have held most of the positions of the board of directors, so they were able to dominate the agenda of the organization. In addition, *colonos* were not interested in becoming members of Valexport for several reasons. First, they had to pay a US\$ 300 monthly fee, which was the normal fee that any member had to pay independently of its size until 1995. Second, the organization focused on crops that they used not to grow. Third, the organization focused on issues related to exporting that were not the most crucial for *colonos*. In contrast to exporters, *colonos* were more interested in the problems of marketing in the domestic market, such as the high profits obtained by

middlemen or the entrance of products like onions from other countries as a result of liberalization policies, and in negotiations with CODEVASF to address debt repayments of water fees.

Interestingly enough, Valexport became interested since the mid-1990s in incorporating *colonos* and their agenda for two reasons. First, *colonos* have been increasing their areas with export crops (mango and grapes). Thus, members of Valexport became concerned that if *colonos* did not produce with high quality, they may damage the image of exporters. Second, exporters have been increasing the proportion of table grapes and mango sold in the domestic market in the last few years. Thus, they have become concerned for finding ways to reduce the role of middlemen and other problems similar to the ones that *colonos* have had because they precisely sell all their production in the domestic market. Third, with the increase in the weight of grapes and mango grown by *colonos*, Valexport needed to attract them to the organization in order to continue to claim its representativeness as a regional association of grapes and mango producers.

In 1995, Valexport extended an invitation to CAMPIB, the cooperative of *colonos* in the Bebedouro project, to join the organization. CAMPIB included a total of 142 members, where 112 grew a total area of 535 hectares of table grapes, accounting for 12 percent of the total area with table grapes in Petrolina-Juazeiro. To facilitate the participation of *colonos*, Valexport decided that CAMPIB could pay the fees equivalent to one member rather than for all its members.

In addition, Valexport became interested in one of the most important issues that concerned *colonos*, namely the problems associated with the domestic market of grapes. As I will show in chapter 6, firms growing table grapes started in 1994 to program their production technology in order to harvest all-year-round rather than a few months a year, increasing their sales in the domestic market up to half their total production. Selling in the domestic market, they faced several of the problems that *colonos* had, especially the great variation of prices and the domination of the market by large buyers in the main markets (São Paulo and Rio de Janeiro). Incorporating *colonos* into Valexport would give the organization more power before government agencies to negotiate mechanisms to improve the marketing in the domestic market.

Soon after CAMPIB became a member of Valexport, the organization started to collect information about the domestic prices of grapes. In addition, it created a new department within the organization to deal with the problems of the domestic market of grapes, inviting members to weekly meetings to discuss possible alternatives of action. At the same time, Valexport asked some of its technicians with great experience in the marketing of grapes in other countries to prepare a document presenting and analyzing the advantages and disadvantages of different types of marketing organizations, such as the use of marketing boards, stocks, and public bidding. Based on the discussion of this document, Valexport decided to look for the support of government agencies like the Bank of Brazil to promote the use of public bidding for domestic sales, in which one or several producers would sell their fruit in public bidding in Petrolina.¹¹

¹¹ This marketing system was still not in place at the end of my field work in August 1997.

Although Valexport has been taking some steps to incorporate *colonos* and their interests (at least those growing export crops) in its agenda, most *colonos* do not participate in Valexport and most of them still face many problems. The next section will focus on how *colonos* face difficulties in obtaining high quality and how because they lack connections and knowledge about foreign markets, they have problems to accessing the most profitable markets.

Some remaining problems for *colonos*

Although *colonos* in Petrolina-Juazeiro have been able to incorporate perennial and export crops, they continue to face important problems. First, *colonos* have not been able to obtain a high quality production for at least two reasons: a) the production technology of export crops is often complicated and the extension services have emphasized incorporating the new crops rather than improving quality; and b) *colonos* have difficulties securing working capital, so they frequently delay the implementation of treatments that are essential for obtaining high quality. Second, *colonos* often sell their production to middlemen who buy their production on the farm, selling it in the domestic market.

The public sector strategy to support *colonos* has had some additional problems:

a) The costs involved in supporting *colonos* have been significantly high. First, they involved the provision of highly subsidized land and irrigation infrastructure.

CODEVASF has estimated that it spent an average of US\$ 13,000 to settle every family in its irrigation projects, considering the costs of land and irrigation infrastructure but not the costs of training and extension services that the agency continued to provide for free.

Second, the agency has tolerated very high default rates in the collection of water fees from *colonos*—something that it has not done with firms. Default has been high for most projects—though it has been falling as a result of the agency turning project administration to user associations. For example, default (defined as the proportion of producers who owe at least one monthly bill) among producers in the Senador Nilo Coelho perimeter was about 65% by the end of 1996, but it had reached close to 80% at the end of 1995.

In addition to these problems, the number of *colonos* in irrigated projects in Petrolina-Juazeiro and who were the target of a wide range of interventions from several government agencies is relatively small compared to the number of wage workers engaged in irrigated agriculture. The five irrigation projects that CODEVASF has built in Petrolina-Juazeiro include a total of 2,500 families, quite small if compared with the number of jobs provided only by the two major export crops, grapes and mango—about 29,000 only at the farm level. The effects of growth of irrigated agriculture, and in particular of non-traditional export crops, in employment, wages, and labor standards will be the focus of the next chapter.

CHAPTER SIX
IRRIGATED AGRICULTURE, AGRO-EXPORT GROWTH,
AND RURAL WAGE WORKERS

This chapter focuses on how the growth of irrigated agriculture in Petrolina-Juazeiro, and in particular of non-traditional agricultural exports (NTAEs), have affected the rural labor market, leading to an increase in employment and wages and to the improvement of labor standards of rural workers.

The literature analyzing the modernization of agriculture and the recent growth of NTAEs in developing countries often stresses its negative effects on wage workers. First, these analyses argue that some NTECs are frequently mechanized and only demand substantial amounts of labor during certain times of the year, mainly during the harvest.¹ Thus, although they may increase the demand for labor, NTECs are frequently associated with a high seasonality of employment. Second, critics of NTECs often argue that workers in these crops often receive low wages and enjoy poor working conditions.² Third, some critics argue that NTECs have emerged as a result of policies to promote exports that frequently focus on maintaining low wages, including limiting the influence of unions, dismantling measures protecting labor, and eliminating the government agencies that traditionally mediate labor negotiations. These policies are supported by arguments from neoclassical economists, who portray labor market institutions, such as unions, measures protecting labor, and government agencies mediating in labor negotiations, as damaging the capacity of exporting firms to compete in foreign markets.

In this chapter, I show that globalization and the growth of NTECs may under

¹ See Twomey and Helwege (1991). For the Brazilian case, see Barros et al (1977), Martine (1987), Martine and Beskow (1987).

² For the case of Petrolina-Juazeiro, see Assirati (1994), Barros (1987), and Marsden et al (1996)

certain circumstances bring widespread benefits for rural workers. In Petrolina-Juazeiro, NTECs have been associated with an increase in employment and wages, the upskilling of labor, and the improvement of labor standards, including the enforcement of prohibitions on child labor and better safety and health standards. Yet these positive effects on labor did not increase labor costs in a way that compromised the access of producers to export markets. In addition, the same positive effects on labor have spread to rural workers in the crops that small farmers grow for the domestic market.

In contrast to Petrolina-Juazeiro, irrigated agriculture in the *Baixo São Francisco* and the North of Minas Gerais did not bring increases in wages and labor conditions. Farmers who use irrigation in the *Baixo São Francisco* have specialized in growing rice for the domestic market and use mainly family labor, hiring mostly temporary workers during the harvest season. In addition, wages are substantially lower than in Petrolina-Juazeiro (frequently even lower than the legal minimum), most workers are not registered and do not receive fringe benefits, working conditions are very poor, and workers do not enjoy the rights that rural workers in Petrolina-Juazeiro gained through negotiations with growers. In the North of Minas Gerais, irrigated agriculture shows an intermediate pattern, with farmers often growing a mix of a few perennial and annual crops of intermediate quality levels, good enough for demanding markets in the cities of Belo Horizonte and Rio de Janeiro, but often not good enough to export. While irrigated agriculture in the North of Minas Gerais created a substantial amount of jobs because it substituted crops for livestock that used little labor, a high proportion of the workers employed in irrigated agriculture in the North of Minas Gerais are temporary and unskilled. These workers often earn wages lower than the legal minimum, are not registered, do not receive overtime wages, and do not receive fringe benefits. In addition, working conditions are poor and workers do not

enjoy the rights of their counterparts in Petrolina-Juazeiro.

I argue that the analysis of the employment effects of NTECs need to consider several issues sometimes overlooked by analysts:

- 1) Critics often analyze the characteristics of employment in NTECs without comparing with the situation prior to the introduction of these crops. In some cases in which they do make comparisons with a previous situation, NTECs may involve large plantations that took over land from small farmers--a situation in which they may create less jobs than the number of small farmers displaced.
- 2) Critics of NTECs frequently neglect the nature of the crop, the type of technology used, and the influence of climate conditions in the labor characteristics associated with the crop, especially its seasonality.
- 3) Some authors analyzing the employment characteristics of NTECs focus on the number of jobs created, neglecting the influence of the demands for a high quality product associated with NTECs on the choice of technology, and the skills required from workers associated with the application of that technology.
- 4) Critics of NTECs frequently do not pay attention to working conditions, or even when they do, they present cases in which workers face health risks and enjoy poor working conditions, neglecting the influence of government interventions and rural workers unions in determining these outcomes.

Although some studies have found positive effects of the growth of NTECs on rural poverty, they have tended to focus only on the capacity of small land-owning farmers to

grow export crops rather than on landless agricultural laborers.³ In addition, authors who have looked at the labor effects often focus simply on the number of jobs created, not paying attention to factors that may lead to the rise of rural wages, the upskilling labor, and the improvement of labor standards, all characteristic of agro-export growth in Petrolina-Juazeiro.

I argue that some features of the NTECs grown in Petrolina-Juazeiro led to a great rise in the demand for labor with specific skills that was in short supply in the Northeast. Such a change in the labor market affected the balance of power between workers' and growers' organizations in favor of the former. In contrast, because irrigated crops in the *Baixo São Francisco* and the North of Minas Gerais did not demand substantial amounts of skilled workers, they did not affect significantly the respective local labor markets and the relations between workers and employers.

The changes in the labor market had great effects in the composition and strategies of the local labor unions (*sindicatos de trabalhadores rurais*). The establishment of irrigation projects with a large number of colonos led to changes in the membership of the *sindicatos* in all three regions. In addition, upper-level organizations of the union structure played a dominant role in the changes of strategies of the local *sindicatos*). The existence of an upper level union with experience in organizing workers and negotiating with growers, resulted key in the outcomes of agro-export growth in Petrolina-Juazeiro in terms of wages and working conditions.

Moreover, the positive outcomes for labor in Petrolina-Juazeiro stem from the

³ See Carter and Mesbah (1993), Carter et al (1995), Schurman (1993), and Stanley (1994). These authors argue that the effects of agricultural export booms on rural poverty depend on specific characteristics of the crop and on government policies that affect the microeconomics of the specific crops involved.

important role of government agencies (state and municipal offices of the federal Ministry of Labor) mediating the relationship between growers and workers, participating as mediators in contract negotiations and monitoring growers' compliance with labor contracts.

The chapter is organized as follows. The first section explains how the growth of irrigated agriculture and in particular of NTECs in Petrolina-Juazeiro brought changes in the demand for labor, creating a large number of jobs and increasing the demand for workers with specific skills. The second section shows that firms growing NTECs in Petrolina-Juazeiro faced a short supply in Northeast Brazil of workers skilled for performing tasks common in the production of fruits and vegetables, so they ended up making changes in their organization of production in order to retain their skilled workers with more permanent employment. The third section focuses on how the growth of NTECs created possibilities for rural workers unions to organize labor and how it affected the strategies of unions and firm associations. This section also analyzes the role of unions, firm associations, and government agencies in wage negotiations. Finally, I explain how the gains for labor in NTECs had spillover effects on labor involved in crops grown in Petrolina-Juazeiro for the domestic market.

Changes in the demand for labor

Most cases of irrigated agriculture in Northeast Brazil have led to an increase in the demand for labor.⁴ Some critics of government-sponsored irrigation investments in the Northeast region have argued that irrigation projects displaced a large number of rural workers because the rural population previously living in the expropriated lands was often

larger than the number of families established in the irrigation projects.⁵ However, these negative effects only took place in the *Baixo São Francisco*, where irrigation projects established *colonos* who were tenants displaced from the change in the regime of the São Francisco River due to the construction of the Sobradinho dam. However, the *Baixo São Francisco* case was an exception, as the other government-sponsored irrigation investments in Northeast Brazil, including those in Petrolina-Juazeiro and the North of Minas Gerais, led to the substitution of crops for livestock. Although not all irrigated crops have the same land productivity and demand the same amount of labor, all of them have a higher output and productivity and require substantially more labor than the type of traditional beef cattle production and dryland agriculture dominant in Petrolina-Juazeiro before CODEVASF built its irrigation projects. Unlike the United States and European countries, where farmers often use a technology to raise dairy and beef cattle of high productivity and which uses a high number of workers to feed and take care of the animals, most landowners in Brazil's Northeast until the early 1990s raised beef cattle in large farms, feeding them with natural pastures of poor quality and using little labor to take care of the animals.⁶ In contrast to beef cattle and to dryland production of crops like manioc, beans, and corn, irrigated crops are intensive in the use of labor because they involve a technology that requires workers to perform a large variety of tasks, such as handling irrigation equipment, plowing the lands with tractors, making treatments against pests and diseases, and harvesting production. In addition, irrigation not only allows to increase yields, but also to

⁴ See Carvalho (1988), Maffei & Ramos de Souza (1986), and Ramos de Souza (1990).

⁵ Hall (1978a & b, 1983, and 1990).

⁶ Dairy production has become important in the semiarid Northeast during since the early 1990s, as a large proportion of medium-size and large landowners have turned into double-purpose (beef and dairy) livestock and made some investment in improvement natural pastures through the cultivation of *leucena*, *palma*, *braquiaria*, and other species of high productivity.

grow crops in the dry season, when the land is idle under dryland agriculture, thus obtaining several harvests per year, and to substituting high-value for low-value crops. The following table shows the amounts of labor required by livestock and different irrigated crops (only at the agricultural stage, not including packing and related service activities) in Petrolina-Juazeiro.

Table 18. Labor required by livestock and different crops per year (in working days)*

		Number of working days/hectare			
	Livestock	6			
Annual crops					
<u>Dryland farming</u>					
	Manioc	83			
	Beans	38			
	Corn	36			
<u>Irrigated crops</u>					
	Onions	140			
	Tomatoes	129			
	Melon	113			
	Watermelon	67			
Perennial crops					
		Number of working days/hectare			
		Year 1	Year 2	Year 3	Year 4 and +
	Grapes	654	689	1,135	1,265
	Banana	295	245	245	245
	Guava	160	200	273	333
	Mango	111	105	146	202
	Coconut	80	70	104	110

* Note: Values for all crops assume sprinkler irrigation. Employment only at the farm level, not including packing (though it is sometimes carried out at the farm level), transportation, and other service activities, all very important in terms of employment.

Source: Based on information from the Bank of Northeast Brazil, EMBRAPA, Distrito de Irrigação Nilo Coelho, and interviews to agricultural firms and *colonos*.

Labor costs are an important component of the production costs of irrigated crops, ranging between a minimum of 45 percent in tomato to a maximum of 60 percent in

grapes.⁷ If worried about the increasing costs of labor, a grower has two main options. First, he can introduce labor-saving technologies, basically mechanizing some tasks. For example, a mango grower can apply pesticides by using sprays connected to tractors rather than doing it manually. Second, a grower can shift to a crop in which it is more feasible to mechanize tasks, as some crops have more possibilities of using machines than others. For example, while a grower of pineapple can mechanize almost all tasks, a grower of grapes cannot mechanize some tasks like pruning or picking. Third, several crops give growers the choice of producing with different technologies, depending on the market which he wants to sell and the quality that he aims to obtain, with low quality often being associated with lower labor requirements. For example, growers of table grapes could shift to wine grapes, a choice that would save them up to 75% of the costs of labor because wine grapes do not require labor-intensive care of the bunches. Likewise, growers of table grapes of low quality need to employ an average of one worker per hectare, compared with six workers per hectare if he produces table grapes of high quality.

Firms in Petrolina-Juazeiro have often introduced the use of machinery for tasks in which it is possible to do it, such as soil preparation. However, most of the crops that have become popular in the region have little possibilities of mechanizing tasks because they involve a variety of activities that require a lot of care and have an important influence in the quality of the product, including harvest, weeding, disease treatment, and irrigation. These tasks involve the application of manual skills for which no machine has been yet available. One of the main tasks which employ a large number of people, require a lot of

⁷ The figure for grapes corresponds to the third year after plantation. The first two years require less labor (35 percent of total costs) because the crop is not yet under production.

care, and cannot be mechanized, has been the harvest of crops like industrial tomato, grapes, and mango, which require 28% of the total labor costs in industrial tomato, between 13.4% and 22.5% in grapes, and between 12% and 18% in mango. Other specialized tasks that characterize the production of high quality table grapes and cannot be mechanized are pruning and bunch picking, which require between 34% and 40% of all labor costs.

In addition to generating employment, NTECs in Petrolina-Juazeiro required higher skills from workers. Workers in NTECs not only need more complicated skills than in traditional cattle raising, but also than in dryland crops like manioc, corn, and beans. Workers have to perform a wide variety of tasks, such as driving tractors to prepare the land, using and maintaining irrigation equipment, and applying pesticides and herbicides. While the irrigated crops characteristic of the North of Minas Gerais did require workers with these skills, they did it to a lesser degree. NTECs required special skills from workers for tasks designed to improve the appearance of the fruit, and workers need to harvest and pack the fruits with great care in order to ensure a high quality. In contrast, growers in the North of Minas Gerais sold their crops in the domestic market—mainly Belo Horizonte and Rio de Janeiro—which required less quality and thus needed less of the above mentioned tasks.

Firms producing NTECs in Petrolina-Juazeiro have had to face the problem that the Northeast region offered a short supply of workers with the required skills. The next section will explain how firms had to train workers to perform the tasks needed in producing NTECs and why and how they had to implement changes in their production schedules in order to provide more permanent employment to their skilled labor.

The short supply of skilled labor and changes in the organization of production

The introduction of irrigation led to a higher demand for workers with specific skills that were not common among rural workers in the Northeast. This section focuses on how government agencies and firms dealt with this shortage of skilled workers, showing that while the former focused on training *colonos*, firms were the ones that trained their workers. In addition, I will show that because training workers was costly to firms, they had to implement changes in their organization of production in order to keep their trained workers, and avoiding additional training costs every year.

Although irrigation led to a higher demand for skilled workers in all three regions, the type of products produced in Petrolina-Juazeiro demanded a much larger number of skilled workers and was the only of the three regions in which irrigated agriculture led to great changes in the labor market. In all three regions, CODEVASF trained *colonos* in the use of irrigation equipment and the management of some irrigated crops. This training was enough to satisfy the needs in the Baixo São Francisco, where *colonos* hire small amounts of labor during the harvest season. However, firms that established in the Petrolina-Juazeiro and the North of Minas Gerais faced the problem of hiring a large number of workers without the skills required to work in irrigated agriculture.

When the first firms arrived in Petrolina-Juazeiro and the North of Minas Gerais, they found a scarce presence of rural wage workers. Both regions were similar in the predominance of large landowners raising beef cattle and low population density. While workers could migrate from other areas in the rural Northeast, they did not have the skills required in irrigated agriculture. Because land distribution in the Northeast has been traditionally highly unequal, most of the rural population in the Northeast is comprised of landless tenants without titles. These tenants have traditionally grown cotton (the main

cash crop in the Northeast until the late 1980s) as sharecroppers, along with subsistence crops like corn and beans. Sharecroppers usually received from the landowner the land already prepared and had to take care of the crop until the harvest, and in return give the landowner half the production. At the same time, landowners raised beef cattle in natural pastures using cotton leftovers.⁸ Irrigated agriculture was limited to small farmers in the margins of the São Francisco River who had started to grow crops with small-scale irrigation equipment during the late 1950s as a result of the advice from SUVALE's extension services. However, these farmers concentrated on crops like onions and corn, which required much less care than fresh fruits and vegetables. In addition, these farmers sold their products in nearby towns and cities, markets that were less demanding in quality than those of fresh fruits and vegetables in European countries or cities like São Paulo and Rio de Janeiro.

In order to solve the problem of workers' lack of experience with irrigation, firms had to train them. However, the situation has been different in Petrolina-Juazeiro than in the North of Minas Gerais. First, the number of firms is substantially larger in Petrolina-Juazeiro. Second, firms in Petrolina-Juazeiro grow crops for markets more demanding in quality, hence they require a much large number of workers with more complex skills. Thus, firms in Petrolina-Juazeiro generated a much larger demand for skilled workers than in the North of Minas Gerais.

Firms in Petrolina-Juazeiro often hired agronomists from the south of Brazil with experience in the production of irrigated fruits and vegetables, as well as local agricultural technicians. These agronomists often were in charge of planning production tasks and in

⁸ For a description of sharecropping relations in Northeast Brazil, see Johnson (1978).

training the firm's agricultural technicians. After an initial period of a few months, the best workers would become supervisors and start helping technicians to train new workers.

Training is expensive in terms of time and money because even though a worker may learn a particular task in a few days or weeks, it may take him/her a whole season to reach an average level of productivity. For example, it takes about a week for a worker to learn tasks related to taking care of the grape bunches, taking her/him at least four months to achieve the average levels of productivity. In addition, employers stress that searching for workers is also difficult because the selected worker may turn out not to meet employers' expectations in terms of productivity levels and must be laid off after months of training. According to grape growers whom I interviewed, "only one out of seven or eight workers turns out to be good for specialized tasks, working carefully at a reasonable speed. In the other cases, you have to lay them off or use them for something else, trying with another worker."

Because the supply of workers in Petrolina-Juazeiro with the skills required by the NTECs is scarce and the costs of searching and training workers are high, firms do not want to lose their skilled workers. Thus, firms often give skilled workers higher wages, incentives for higher productivity than the average, and additional benefits like free housing in the farm. While these measures decreased turnover among workers, they were not enough to maintain a high proportion of their workers. Growers complained that after spending time and money teaching their workers how to carry out specific tasks, they lost them because they could not provide them with permanent employment. Meanwhile, trained workers complained that agricultural production only provided a job during a short period of the year, so they had to search for jobs in urban areas to obtain an income during

the rest. As a result, firms had to train new workers every year. This was not only costly, but it also affected the quality of the part of the product sold in foreign markets.

Thus, firms ended up introducing substantial changes in the organization of production in order to provide their workers with more permanent employment. Grape producers, for example, started to export in the late 1980s. At that time, they programmed the production to concentrate the harvest in the times of the year in which the export prices were higher, i.e. when their production faced the least competition from producers from other countries (between May and July). However, they lost workers for whom they had invested heavily in training for the reasons I explained above. In order to provide workers with more permanent employment, firms started to program their production to harvest all-year-round rather than concentrating it in two or three months of the year. By changing their production schedules, firms not only were able to provide permanent employment to most workers, but were also able to obtain revenues throughout the year by selling in the domestic market.

These changes in production were possible for two additional reasons:

- 1) Starting in mid-1994, the federal government started a successful stabilization program (the “Plano Real”), which led to a substantial increase in the domestic demand for food and to better prices in products like grapes and mango.
- 2) Unlike the *Baixo São Francisco* and the North of Minas Gerais, Petrolina-Juazeiro has a climate that allows farmers to grow various crops all year round rather than in a particular season. For example, because of the greater seasonal variation, farmers in the North of Minas Gerais, Chile, or California grow grapes during a four month cycle and obtain one harvest per year from each plant at the end of the summer. Thus, production in these places has a fixed schedule within each year. While irrigated agriculture generates a

lot of employment, jobs are highly seasonal. In contrast, farmers in Petrolina-Juazeiro can obtain between two and three harvests a year from each plant and can program their production tasks to harvest almost every week during the year. Thus, in any time of the year there is a part of the crop that needs to be pruned, another one that needs to be harvested, etc.

As a result of these changes, a great proportion of the workers in NTECs (close to 60 percent) became both skilled and permanent. The next section will show that the scarce supply of skilled labor, along with the strategy that firms followed in Petrolina-Juazeiro to face it, played in favor of the capacity of rural labor unions to organize workers and negotiate with farmers improvements in wages and labor conditions.

NTECs and improvements in wages and labor standards

The role of rural workers unions

The changes in the labor market brought by NTECs do not explain by themselves an increase in wages and the improvement in working conditions. This section shows that the dramatic changes in the demand for labor brought by the growth of NTECs led to great changes in the views and organizing strategies of rural labor unions. Rural worker federations at the state level, notably the Pernambuco Rural Workers' Federation (FETAPE), played the dominant role in the changes of strategies of the local *sindicatos* in the Petrolina-Juazeiro region. In contrast, the *Baixo São Francisco* and the North of Minas Gerais did not have a large number of wage workers that attracted state level unions there and Rural Workers Federations in Alagoas, Sergipe, and Minas Gerais were weak.

Similarly to most of the Northeast's semiarid region, the *sindicatos de trabalhadores rurais* in the three cases study regions had traditionally worked not with

wage workers, but mainly with small landowners and landless tenants who produced as sharecroppers. The work of the *sindicatos* concentrated on issues that interested these members, such as intervening in conflicts over land or the distribution of the product in sharecropping, and in helping small farmers to collect the documents necessary for retirement. As it is characteristics in most of the semiarid Northeast, the *sindicatos de trabalhadores rurais* in the three regions were also weak and had little financial resources.

In contrast to the *sindicatos de trabalhadores rurais*, as well as the Rural Workers Federations (the second-tier, state level rural workers organizations to which all municipal-level rural workers unions are affiliated to) in Alagoas, Sergipe, and Minas Gerais, the Pernambuco's Rural Workers' Federation (*Federação de Trabalhadores Agrícolas de Pernambuco*, FETAPE) did not focus on small farmers but on organizing wage workers. However, FETAPE had focused its work not in Petrolina-Juazeiro but in the sugarcane zone, where most of the wage workers lived and most leaders of FETAPE came from. Sugarcane growers in Pernambuco have often been considered as tough employers, having used slave work extensively until the abolition of slavery in 1898 and having paid low wages long afterwards. Thus, FETAPE had long concentrated efforts on organizing wage workers, struggling for higher wages, and better working conditions for sugarcane wage workers. FETAPE had become one of the strongest rural unions in Brazil since the late 1970s, having a large membership, a capable leadership, and experience with organizing wage workers and negotiating with tough employers. Among other achievements, FETAPE had organized the first strike in rural Brazil in 1978 (i.e., during the repressive conditions of a military government), it had negotiated with growers agreements that increased wages, and had played a dominant role in the founding of the National Confederation of Rural Workers (*Confederação Nacional de Trabalhadores na*

Agricultura, CONTAG), the national organization comprising all state-level federations Brazil.

With the emergence of irrigation, the *sindicatos de trabalhadores rurais* in the three regions experienced important changes in their membership. *Colonos* in CODEVASF's irrigation projects started to take over from small farmers the *Sindicatos de Trabalhadores Rurais* in municipalities of the *Baixo São Francisco*, the North of Minas Gerais, and the Petrolina-Juazeiro region. Most *colonos* in irrigation projects signed as members of the *sindicatos*, becoming the majority of membership in all three regions by the early 1980s. At the same time, several *colonos* became leaders of the *sindicatos* and brought with them a number of new issues. For example, negotiations of the *sindicatos* with CODEVASF for lower water fees or for extensions in the payment of these fees in years of poor harvests became common until the late 1980s.

During the second half of the 1980s, further changes occurred in the composition of the *sindicatos de trabalhadores rurais* in Petrolina-Juazeiro, but not in the *Baixo São Francisco* and the North of Minas Gerais. These changes took place as a result of the establishment of commercial firms engaged in irrigated agriculture, which hired large numbers of wage workers. As a result, membership of the *sindicatos* in Petrolina-Juazeiro started to change as wage workers became members.

The presence of a large number of firms hiring rural wage workers and the changes in the membership of the *sindicatos de trabalhadores rurais* in Petrolina-Juazeiro since the mid-1980s made FETAPE become interested in working more actively in the region. In 1988, the organization participated in a congress of rural unions all over Brazil that CONTAG organized in Brasilia. In this congress, union leaders discussed future strategies and agreed that rural unions needed to start organizing workers in areas of dynamic

agriculture that were emerging in the 1980s, such as Petrolina-Juazeiro, Barreiras in Bahia, and Vale do Assú/Mossoró in Rio Grande do Norte, rather than focusing exclusively on issues related to small farmers, such as obtaining from public banks credit lines for crops at low interest rates. Leaders from FETAPE were some of the proponents of this position, as they were convinced that FETAPE itself needed to expand its work to organizing wage workers in irrigated crops in Petrolina-Juazeiro for three reasons. First, in contrast to sugarcane, which was a declining crop, irrigated crops were dynamic, with growing areas and exports, new firms establishing in the region, and rural population migrating to work as wage workers in those crops. Second, FETAPE's leaders saw new opportunities to increase membership and fees collection, thus strengthening their organization. Third, although FETAPE's new President--elected in 1988--had been a sugarcane worker, he wanted to leave his "mark" by doing something new and different.

In 1991, FETAPE started to make an effort to provide organization skills to the local union in Petrolina, sending two important persons to work for the *Sindicato de Trabalhadores Rurais* of Petrolina permanently and paying their salaries. One was a leader from the sugarcane zone with a long experience in organizing sugarcane wage workers, the other one a lawyer specializing in labor legislation who had also worked in the sugarcane zone. They started to organize daily radio programs in Petrolina-Juazeiro that provided information about workers' rights and labor problems in different firms, arrange meetings in the weekends in neighborhoods of Petrolina where large numbers of rural workers lived, and provide legal advice in labor related problems to workers. At the same time, they started to train leaders in the Petrolina union and promote discussions with them about the importance of working not only with small farmers, but also with wage workers.

The attention to issues related to wage workers, such as wages and working conditions, promoted by FETAPE initially created conflicts in the *sindicatos* because several of the leaders were *colonos* from the irrigation projects who themselves hired wage workers, so they did not support the new agenda very strongly. To avoid this opposition, the organizers sent by FETAPE started to push for a less conflictive agenda at the same time that they worked on problems of wage workers. One of the most important issues that arose as a result of that strategy was the need to eradicate the use of child labor. At that time, the use of child labor was widespread both among *colonos* and firms, mainly during the harvest time. CONTAG was initiating in 1992 a program with the International Labour Organization (ILO) to eradicate the use of child labor in rural areas of several Brazilian regions.⁹ The main program consisted of providing a monthly contribution (US\$ 20 per child) to families who took their children out of work and sent them to a specialized school which provided meals, primary education, and training in horticulture. FETAPE was able to convince CONTAG and ILO representatives about including the sugarcane zone in Pernambuco and Petrolina-Juazeiro as two of the regions that would participate in the program.

In addition, FETAPE was able to bring ILO representatives to Petrolina and to elicit great attention from the public to the problems associated with child labor. In 1993, ILO and FETAPE representatives met with the mayor of Petrolina and the authorities of Valeexport, asking for their cooperation in the implementation of the program and at the same time warning them that ILO could start pointing out to Petrolina-Juazeiro as a

⁹ The program initiated in Brazil was part of a larger ILO program, the International Programme on the Elimination of Child Labor, which the organization had started to implement in several countries in the end of 1991.

“problematic” region in terms of the use of child labor in public campaigns that the organization carried out at the international level. Firms feared that such type of campaign could jeopardize their access to export markets. Recalling these meetings, a firm owner interviewed said: “We were ashamed that these people were pointing to us as employers who hired child labor. Even though the use of children in the fields was not widespread, they sometimes helped their parents during the harvest of several crops. We felt terrified about the possibility of an international campaign that mentioned our region.” According to the interviews that I carried out in Petrolina-Juazeiro, these views reflected the feelings of most firm owners with respect to child labor.

In addition, the implementation of the ILO program in several regions of Brazil made the Ministry of Labor more eager to enforce the already existing legal prohibition of using child labor, increasing the inspections by both its municipal and state offices. As a result, firms doing irrigated agriculture in Petrolina-Juazeiro effectively eliminated the use of child labor. One employer said: “It became much cheaper not to use child labor, as the fines were big and losing lucrative markets could have led to heavy losses.” All the interviews that I made to union leaders and to officials from the local and regional offices of the Ministry of Labor confirmed that they have not seen cases of firms using child labor since 1993. However, they recognized that the use of child labor is still common among *colonos*--though it has decreased since the implementation of the program. These *colonos* usually make their children work in periods in which crops require a lot of labor, such as the harvest season.

In 1993, FETAPE also decided that it was time to start organizing workers for a possible strike towards wage negotiations. With the active help of FETAPE, leaders of the *sindicatos* in Petrolina-Juazeiro started to mobilize workers in the larger firms growing

NTECs, which employed on average 300 to 400 permanent workers, starting strikes in several of them. The mobilization was limited to these larger firms partly because union leaders did not want to create conflicts with *colonos*, many of whom were still members and even leaders of the *sindicatos de trabalhadores rurais* of the region. In addition, organizing workers in larger firms is usually easier than in smaller ones, especially in rural areas, where farms (and workers) are dispersed. Because most of the larger firms grew NTECs, they employed increasingly higher proportions of skilled and permanent workers. The presence of permanent and skilled workers facilitated the organizing work for many reasons. First, firms had to register their permanent workers but not their temporary workers. Thus, union organizers found easier to obtain through the local offices of the Ministry of Labor lists with the names of permanent workers to visit and convince them of becoming members of the *sindicatos*. Second, most workers involved in NTECs worked in tasks in which delays in performing them could greatly affect the quality of production. Crops like beans, corn, and onion can survive unattended without great trouble for short periods of time. In contrast, most NTECs require permanent care and a short strike may lead to great losses. For example, a delay of only one week in pruning or picking grape bunches would have such devastating effects in the quality of table grapes that the resulting harvest could not be exported and would have to be sold in local markets at substantially lower prices.

In contrast, the union had a harder time organizing workers employed by *colonos* growing annual crops like tomato, melon, beans, and corn. Annual crops employed mostly temporary and unskilled workers. First, the supply of unskilled workers in Petrolina-Juazeiro was high, and these workers were eager to work even without being registered and accept lower wages and poor working conditions. Second, these workers were migrating

usually from several Northeast states like Ceará, Piauí, Paraíba, Pernambuco, and Rio Grande do Norte, going from one place to another to work in the harvest of usually irrigated crops.¹⁰ Thus, they did not have a permanent residence in Petrolina-Juazeiro and the union found it difficult to both locate them and make long-term organizing work. Although one may argue that these workers were the ones who needed unions the most because their wages were the lowest and working conditions the worst, they were often not very interested in participating, sometimes because they would leave soon, and often because they came from areas with no tradition of unions, so they were afraid of getting involved.

Starting in 1993, the *sindicatos de trabalhadores rurais* in the Petrolina-Juazeiro region started to negotiate and sign contracts valid for one year each with Valexport itself instead of with individual growers. FETAPE participated directly in the negotiations, often with the presence of its President leading the workers' representation. The contract that year involved the *sindicatos* of Petrolina and Santa Maria da Boa Vista, but the ones in Juazeiro and the other municipalities of the region (seven in total) soon followed them. In addition, the wage increases and other benefits obtained, which were already unusual for rural workers in Northeast Brazil in the first contract, improved greatly with each subsequent contract. Some of the most important gains were:

- 1) By January 1998, the contract set a minimum wage 21.7 percent higher than the

¹⁰ These temporary workers are known in Northeast Brazil as "boias frias". Hundreds of these workers concentrated early in the morning every day in a gas station in the outskirts of Petrolina, waiting to be hired. From time to time, a field supervisor would come with a truck and pick up several workers to work for one or a few days in tasks such as the harvest of tomato, the weeding of melon, or whatever task that does not require much skill.

legal minimum set by Brazilian laws (equivalent at that time to US\$ 130).¹¹

- 2) An overtime hourly wage 80 percent higher and an additional 45 percent for night work;
- 3) A 20 percent higher wage for workers manipulating pesticides and the obligation for employers to give these workers medical exams every six months.
- 4) Provision of free transportation between workers' homes and the workplace, as well as within the farm.
- 5) Supply of clean water in the workplace, as well as availability of bathrooms.
- 6) The obligation to have available medical equipment and medicines for emergency care.
- 7) A free-day per month for female workers to attend routine medical exams.
- 8) A two month-period leave and the right to keep the job for women workers after giving birth.
- 9) The obligation for employers to establish day-care centers when they employ more than 20 women.
- 10) Protection to union leaders from losing their jobs and authorization to the union to work inside the firms.

Leaders of FETAPE whom I interviewed stressed that the agreements in Petrolina-Juazeiro were a great achievement in their struggle. Ironically, these agreements, they said, were better than the ones signed in Pernambuco's sugarcane zone, where the *sindicatos de trabalhadores rurais* were stronger and FETAPE had long worked in organizing workers. Among other things, the contracts in Petrolina-Juazeiro contain much higher overtime

¹¹ The minimum wage agreed in the first contract was 10 percent higher than the legal minimum.

wages and other provisions absent in the sugarcane contracts, such as transportation for workers, provisions favoring women workers, and authorization for the unions to work inside firms.

In addition, leaders of FETAPE stressed that firms in Petrolina-Juazeiro complied with the agreements much more than in any other region in the Northeast, including the sugarcane zone. My interviews with workers and employers showed that firms often comply with wages and premiums. The compliance with improving working conditions has not been as high as with wages, but has been improving substantially every year. Both employers and union leaders recognized that several of the obligations concerning working conditions require investments for the construction of facilities (bathrooms, cafeterias, daycare centers) and the purchase of equipment for them. Thus, union leaders argued that they had to be flexible enough not to demand full compliance right away. The solution that they found was to negotiate improvements over time with individual firms, often signing written agreements in which the firm committed to meet some deadlines to comply with specific improvements.

Compliance has been high partly because the *sindicatos de trabalhadores rurais* have played a key role in monitoring the agreements. The *sindicatos* in the six municipalities of the Petrolina-Juazeiro region actively disseminate information about the terms of the agreements among workers, distributing published materials, having talks in the radio, and giving talks to workers in the larger firms. In addition, because they have been able to increase their collection of union fees, they have been able to organize a system to monitor firms. While the *sindicatos* normally have difficulties collecting fees, contracts set higher union fees and the obligation of firms to collect monthly union fees from the workers' wages and deposit them in the bank account of each *sindicato*. Thus, the

sindicatos were able to purchase cars and pay a salary to several of its leaders to permanently work in a monitoring team. This monitoring team organized a weekly program of visits to firms (about two firms a day), in which they inspected the compliance with labor agreements. If they found a problem, they would complain to the local branches of the Ministry of Labor in Petrolina and Juazeiro.

The collaborative links between unions and the Ministry of Labor: mediation, monitoring of labor agreements, and spillover effects

Although Brazilian laws establish negotiations between firm associations and unions as the main mechanism to agree on wages, the relationship between these two actors is often bitter, making it difficult or even impossible to come to an agreement. Once a contract is signed, although rural unions may pressure firms to respect it, firms frequently do not comply, having unregistered workers or ignoring some of its provisions. In order to deal with these problems, Brazilian laws established that the Ministry of Labor had to participate as a mediator in wage negotiations between unions and firm associations, eventually setting the wage level in case of not reaching an agreement, and to monitor the compliance with contracts signed. However, both mediation and the monitoring of contracts frequently do not work very well. Similarly to other government agencies, local branches of the Ministry of Labor are poorly funded and often lack staff, vehicles, and even fuel to make inspections. In addition, influential firm associations may pressure officials at the local offices of the Ministry of Labor to be on their side during negotiations, or may use their connections at the federal level to remove local officials who play their monitoring role too seriously.

In contrast to what I expected, the regional office of the Ministry of Labor located in Recife and the local offices of the agency in Petrolina and Juazeiro played an important role both in wage negotiations and in monitoring the contracts. Petrolina-Juazeiro had already come to the attention of officials of the Ministry of Labor in Brasilia in the late 1980s because of the increasing presence of firms with large numbers of wage workers, and especially since 1990, when FETAPE and the *Sindicato de Trabalhadores Rurais* in Petrolina addressed the problems of child labor in that region. When wage negotiations started, officials in Brasilia considered them as very important because they became the first ones in Brazil comprised of rural workers in irrigated agriculture. In addition, they took the negotiations even more seriously because they knew that leaders of FETAPE—which they respected highly for their involvement in wage negotiations in the sugarcane zone—were involved in them. Thus, the Ministry of Labor has sent to every wage negotiation in Petrolina-Juazeiro the head of its regional office in Recife to act as mediator. This person was an experienced mediator who had participated in negotiations in the sugarcane zone for several years. In addition, the central offices in Brasilia closely followed every negotiation, and when the first contract was agreed upon, the Minister of Labor himself traveled to the city of Petrolina to witness its signature.

In addition, the heads of Pernambuco's branch of the Ministry of Labor since the late 1980s acquired experience in mediation, and had been traditionally progressive professionals, sociologists and labor specialists who taught at the Federal University of Pernambuco, and who used all their prestige to support workers' rights. For example, one of these officials used his connections with firms to start making them know with six months in advance that the local *sindicatos de trabalhadores rurais* and FETAPE were planning to propose contract negotiations. Another one organized inspections using

officials from Recife, who were not influenced by local politics and did not fear any punishment for punishing a firm.

The local offices of the Ministry of Labor in Petrolina and Juazeiro have also played a key role in monitoring the labor contracts. I found that the field workers from the Ministry of Labor were very committed to their work and employers actually disliked them, complaining that they looked for even minimal faults to fine them heavily. In doing their jobs, they worked in close collaboration with the *sindicatos de trabalhadores rurais*, especially with the monitoring teams that they had put together. As I explained in the previous section, the contracts have allowed the *sindicatos* to increase substantially the collection of membership fees from workers, so they have been able to purchase vehicles and put some of its leaders to concentrate a large part of their time in monitoring firms' behavior with respect to the contract. In fact, each of the *sindicatos* in the municipalities of the Petrolina-Juazeiro region have organized a monitoring team with three directors. These monitoring teams organize weekly programs of visits to firms to find out about registration of workers and the compliance of firms with wages and working conditions established in the contracts. Even though firm owners and managers dislike these monitoring teams, they must allow them to talk with workers and visit facilities because they agreed to the free entrance of union leaders in the contracts. The costs of monitoring tasks, including the purchase of the vehicles, gas, and salaries of the directors, is paid entirely by the *sindicatos* with funds coming from membership fees.

When they find a problem, the *sindicatos* present a complaint at the local offices of the Ministry of Labor in Petrolina or Juazeiro (depending on where the firm is located) with detailed information, including the name of the firm, the problems that they find, and the names of the unregistered workers if any. Most inspectors like this way of working

because the local offices of the Ministry of Labor often lack cars and funds for fuel, so the complaints presented by the *sindicatos* help them plan carefully their work and visit firms with problems. In the words of one Ministry of Labor's inspector:

"My work consists basically of visiting firms for which the *sindicatos* have presented complaints, identifying problems, and eventually fining those that do not comply or working out a compromise to put everything in order in a few days. If I did not count with the complaints from the *sindicato*, I would have to do the monitoring work that the *sindicato* does, with the disadvantage that I do not have delegates inside the firms like they do who could pass out information about possible problems."

In addition, the Ministry of Labor facilitated spillover effects of the wage increases from NTECs to crops for the domestic market. In other regions with NTECs, such as the Mossoró-Vale Assú region in Rio Grande do Norte, wage contracts include only the firms that grow NTECs (melon in the case of that region) and the wage workers in those crops. Thus, even though the contracts may include most or all of the firms and workers involved in those crops, the benefits for workers are limited to them. In addition, contracts include medium-size and large firms, but not small individual farmers and land reform settlements growing melon for the domestic or export markets. In contrast, the contracts in Petrolina-Juazeiro benefit all wage workers working in irrigated agriculture in the whole Petrolina-Juazeiro region, including crops for export and the domestic. In addition, they include all types of producers doing irrigated agriculture, including firms and *colonos* in irrigation projects.

This unusual outcome has a lot to do with an peculiar coincidence of interests between different players that participate in the wage negotiations—the firm association, unions, and the regional offices of the Ministry of Labor. The directors of Bahia's and Pernambuco's regional offices of the Ministry of Labor strongly pushed for "regional" rather than crop negotiations because negotiating a regional contract demanded

substantially less time and effort than several contracts for individual crops and, in addition, it was much more "prestigious" for negotiators before the eyes of their superiors in Brasilia. Leaders of Valexport and FETAPE agreed with officials of the Ministry of Labor that negotiating one contract was already too complicated to start negotiating around individual crops. In addition, leaders of FETAPE also wanted to represent a whole region rather than just workers involved in a few crops, so a contract covering all irrigated crops in Petrolina-Juazeiro was quite a good achievement. On the firms side, grape and mango growers—who were the most organized and dominated Valexport—strongly opposed negotiations focused on individual crops. The reason was that they felt that by negotiating all crops together, they were able to negotiate lower wages because they were able to argue that farmers or *colonos* growing crops like tomato or onion could not afford a large wage increase.

Positive outcomes in wage negotiations do not stem only from a strong federation (FETAPE) that provided skills in organizing workers and negotiating with the local *sindicatos de trabalhadores rurais* nor from the active mediating role of regional and local offices of the Ministry of Labor, but also because employers did not adopt a hard line in negotiations—in spite of not being completely satisfied with the contracts. The next section will show that firm owners growing NTECs rather than those growing crops for the domestic market were the ones who led the negotiations representing the employers, and that they held open views and positions when facing problems with organized labor partly because they had had previous experience in working with unions in other activities different than agriculture.

Firms as “progressive” employers

Recent literature analyzing successful cases of innovation and growth in industries in developed countries has stressed that employers and workers in those cases develop collaborative rather than antagonistic relationships. However, unionized workers and employers both in developed and developing countries often have a conflictive relationship. This has been traditionally the case of the Northeast Brazil, where the production of sugarcane (the main crop with widespread use of wage labor until the late 1980s) has been traditionally dominated by rural elites with a long history of domination over workers. In this section, I argue that the strategy that CODEVASF implemented of attracting entrepreneurs from other regions of Brazil to their projects, many of whom had investments in the industrial sector, had the unintended effect of creating a substantially less antagonistic worker-employer relationship. Although these entrepreneurs often disliked the unions and tried in many ways to reduce the costs of labor, they were less resistant to negotiate with the unions because they had frequently dealt with unions in other regions and in other sectors.

Firms negotiating contracts with unions were represented by Valexport, which often sent a group of the largest employers to the negotiations. The FETAPE leaders whom I interviewed argued that they found much easier to negotiate with employers in Petrolina-Juazeiro than in the sugarcane zone in Pernambuco. They argued that while sugarcane producers have been traditional rural elites with a long history of domination over workers, employers in Petrolina-Juazeiro were completely different. Most of the employers in NTECs often came from states in the southeast and south of Brazil and most of them usually had investments in other sectors like metal-mechanic, construction and

transportation. Thus, they already had experience dealing with unions. In the words of a FETAPE leader:

“There is no doubt that entrepreneurs in Petrolina-Juazeiro are much more progressive than in the sugarcane zone. Many firms in Petrolina-Juazeiro come from São Paulo, where they have dealt with the unions in the industrial sector for years. Many of them--even coming from Recife and Salvador--had no experience with agriculture, but they also come from the industrial sector, where dealing with unions is also more common than in the rural areas.”

In addition, growers in Petrolina-Juazeiro often tried to portray through Valexport a “progressive” image of the region in foreign markets--one showing it as modern, where irrigated agriculture not only produced fresh fruits and vegetables of high quality with the latest technologies, but one which also paid good wages, provided good working conditions to workers, and had widespread social impacts in the region. Most growers frequently even contrasted the labor situation in Petrolina-Juazeiro to the sugarcane zone, arguing that they were proud to be much more “progressive”. One of these growers said:

“Petrolina is different than the sugarcane zone. We do not fight with workers because we do not feel that we own them, like most sugarcane growers do. We have to negotiate with them and provide decent jobs because we are all in the same boat”.

In addition, most of these growers shared the view that such an image was increasingly important for their buyers in Europe and the United States. Another grower, also one of the top leaders of Valexport, said:

“We have to turn the labor contracts to our own advantage. We show our buyers abroad that they not only buy fruits of great quality, but also that they benefit a lot of people who work in the fields. Buyers do care about this and we expect that they will care even more in the future.”

FETAPE’s negotiators were able to make these views work to their advantage, warning that if negotiations failed, they would present complaints in international organizations like ILO about the lack of growers’ respect for workers’ rights. Growers found the warning credible and became very worried about the possibility of attracting national and international attention with negative effects on their image.

In addition, growers found it easier to accept higher wages and better working conditions because the investments in the crops that they grew and their profitability were high. Thus, wage increases and investments that they needed to make to comply with the contracts, were relatively low in terms of their fixed capital investment and their profits. In contrast, small farmers growing mainly annual crops for the domestic market were the ones who opposed the most to wage increases. The small farmers who I interviewed argued that they were not able to pay higher wages because their crops were not that profitable.

The presence of these entrepreneurs would have not been possible if CODEVASF had not implemented a strategy that aimed to attract firms from out of Petrolina-Juazeiro. As I explained in chapter 4, CODEVASF established in its irrigation projects in Petrolina-Juazeiro a mix of *colonos* and medium-size firms, in contrast to other government agencies working with land settlements, such as DNOCS and INCRA, which only provided land to landless people. In bringing these firms from outside Petrolina-Juazeiro, CODEVASF targeted mainly states from the more developed area of Brazil and selected firms that had know-how about crop technology and marketing, providing them with subsidized land and irrigation infrastructure.

As I explained in chapter 4, although CODEVASF's strategy of mixing firms and *colonos* received criticism from economists of different schools of thought, it played a key role in the success of irrigation projects because firms were the ones that brought new crops and technologies, as well as connections to foreign and domestic markets. As I showed in this section, this strategy had the additional unexpected positive effect of generating an economic and social structure conducive to a non-antagonistic relationship between employers and their workers. This economic and social structure is characterized by the key role of entrepreneurs with "progressive" views of the world if compared with those of

the traditional elites in the rural Northeast.

This chapter has shown that the growth of NTECs may under certain circumstances bring improvements to rural wages and labor conditions. The next chapter will review the main findings from the previous chapters and offer conclusions and policy lessons for governments attempting to promote the transformation of poor rural regions like Petrolina-Juazeiro.

CHAPTER SEVEN

CONCLUSIONS

This dissertation has addressed the role of the state in promoting agricultural change and in alleviating rural poverty by analyzing the economic transformation of Petrolina-Juazeiro, a region in the semiarid Northeast of Brazil that has become one of the most successful agro-export growth poles in the country since the early 1990s based on the production of high quality fruits exported fresh to Europe and the United States. This chapter reviews the findings presented in previous chapters and offers insights to their policy implications.

A great deal of the development literature of the 1990s analyzing the role of the state in economic development has focused on the export-oriented industrialization of East Asian countries that took place since the 1950s. In contrast, it has paid substantially less attention to cases like Petrolina-Juazeiro, in which the economic transformation has been based on the development of agriculture. Understanding the role of the state in the successful development of Petrolina-Juazeiro and other cases of agricultural-based growth in developing countries is relevant in the context of the development literature for several reasons:

- 1) Rural poverty remains a major problem in most of the developing world. For this reason, governments of developing countries and international donors have long implemented programs to improve the living conditions of the rural population, such as

employment programs, land distribution, and the promotion of the modernization of agriculture among small farmers. Thus, it is important to identify and understand what type of interventions targeting the agricultural sector are likely to promote growth and alleviate rural poverty at the same time.

2) Many developing countries have natural resources appropriate for agriculture, so they are more likely to be able to grow based on new agricultural export sectors and processing industries. Because the development literature has not paid great attention to what the public sector has actually done to develop successful cases of NTAEs, it does not help governments in developing countries in their efforts to support the development of agricultural export-oriented sectors.

3) Several developing countries, such as Argentina, Brazil, Chile, Costa Rica, and Guatemala, among others, have been able to create dynamic agricultural export sectors, frequently based on non-traditional, high-value crops, which have frequently become an important source of rural employment. These successful cases represent an opportunity to understand the role of policies and other government interventions in generating the conditions necessary to promote growers to grow new crops, adopt new technologies, and gain access to new markets.

Interpretations about the economic transformation of Petrolina-Juazeiro and other cases of agro-export growth have varied greatly, from giving a key role to the state to arguing that it relates mainly to the initiative of the private sector. Many analysts have

argued that the growth of an export-oriented agriculture resulted from a growers' natural response to the opportunities brought by globalization and the increase in the world demand for fresh fruits and vegetables. Others have stressed that while these conditions were important, the state played an important role in promoting the modernization of agriculture. However, these analysts have often disagreed in what the key government interventions were, ranging from viewing the state as providing a "market-friendly" policy environment and public goods (like agricultural research and roads, electrification, and irrigation infrastructure) to more active roles, such as providing subsidies to newly established firms or helping growers find new markets.

In this dissertation, I have offered a set of arguments on how the nature of government involvement differed in Petrolina-Juazeiro with respect to two other regions of irrigated agriculture in the São Francisco River Basin, the *Baixo São Francisco* and the North of Minas Gerais. Such differences, I argued, led to different patterns of agricultural transformation and to different outcomes in terms of wages and working conditions of rural workers. I have stressed that government investments in infrastructure, especially in large-scale irrigation investments (reservoirs, delivery canals, and land settlement-like irrigation schemes) carried out by CODEVASF—a federal government agency created in the late 1940s to promote the development of the São Francisco River Basin—were an essential first stage in the development of Petrolina-Juazeiro. Without these early public investments, out-of-the-region private agricultural and agro-processing firms—which were

key actors in bringing new crops, modern irrigation and production technologies, and marketing connections—would have not established in Petrolina-Juazeiro to grow irrigated crops in the first place, as experience with irrigation was almost absent and most of these actors did not believe it could be carried out successfully. However, investments in irrigation infrastructure do not solely explain why Petrolina-Juazeiro developed and was eventually able to become an exporter of high value crops, as CODEVASF also carried out similar investments in the other two regions studied here without leading to the same type of dynamic, export-oriented, high-value crops.

The development of Petrolina-Juazeiro resulted from heavy involvement of the state through federal government agencies implementing a sequence of innovative practices in several areas, as I summarize below. These practices, some of them unintentional, were combined with specific characteristics of the surrounding natural resources and particular local politics, which all came together at a particular historical time. This unusual combination of factors makes highly unlikely that the Petrolina-Juazeiro case could be replicated. In other words, governments in Northeast Brazil or elsewhere should not replicate what happened the Petrolina-Juazeiro case as a whole. However, it is possible to apply some of the principles that characterized the nature of state involvement and the sequence of interventions through time.

Picking winners and demanding performance in exchange for subsidies

The development literature has shown that a key government intervention that led to the successful industrialization in East Asian NICs was the provision of targeted subsidies and protection from imports. In exchange for these benefits, governments required firms and industries to meet productivity and export targets, withdrawing subsidies and protection when firms did not comply. In contrast, governments in Latin American countries provided similar subsidies and protection to industries, but they did not target selected industries and did not demand them to perform in exchange for these benefits. These different industrial policies could be explained, as some political scientists have argued, by a different nature of the state and its relations with civil society in Latin American and East Asian countries and even by cultural differences—making the East Asian experience a model unique to East Asian countries and difficult to replicate in Latin America.

In contrast to these views, the successful economic transformation of Petrolina-Juazeiro relates partly to CODEVASF managing subsidies to land and irrigation infrastructure in a way that resembles government interventions of East Asian countries with respect to the industrial sector. The main principles applied by CODEVASF in the provision of subsidies included: a) providing subsidies to land and irrigation infrastructure to attract agricultural and agro-processing firms from outside of Petrolina-Juazeiro and selected according to their know-how about technology and marketing, while at the same time making firms compete for subsidies; and b) monitoring firms' performance and

demanding from them production targets in exchange for government support. These interventions became crucial to bring new crops, technologies, and marketing connections to a backward region in which firms would not have established otherwise because of the lack of precedents in irrigated agriculture.

While industrialization policies in East Asian NICs had already showed the effectiveness of demanding performance from firms in exchange for subsidizing resources, most analysts of Latin American industrialization argue that demanding performance was difficult or impossible in the Latin American context, where government was associated with corruption and mismanagement. The case of Petrolina-Juazeiro shows that this policy was possible in the context of the Latin American state—even in a Northeast region of Brazil long characterized by clientelistic relationship at the local level. In addition, it shows that these policies were not unique to the industrial sector, but also present in the agricultural sector. It is also important to note that demanding performance from firms receiving subsidies in Petrolina-Juazeiro was possible because local politicians—who had a great influence in how CODEVASF worked at the local level—distrusted firms coming from outside of the region, so they were interested in monitoring their performance. This is surprising because some of the development literature has highlighted the relevance of trust relations in economic development (for example, between workers and firms, or between firms buying and selling inputs and products, or between firms and government agencies) because it decreases transaction costs associated with establishing contracts and monitoring

compliance.

Medium-size agricultural firms as key players in the introduction of new crops and technologies

Brazilian rural development analysts have criticized government-sponsored irrigation and land reform projects in the past because their beneficiaries often continue to grow subsistence crops (mainly corn and beans) rather than high-value crops like fruits and vegetables, they obtained too low yields, and had great problems accessing profitable markets. In contrast, CODEVASF's irrigation projects were largely successful in the cultivation of high-value crops and in selling in high-income markets both in the domestic and foreign markets. I argued that the better performance of CODEVASF's irrigation schemes related partly to the agency's practice of including a mix of *colonos* and firms—a radical departure from the usual practice and thinking in Brazil and elsewhere in the management of land settlement projects, in which the main beneficiaries are former landless farmers who eventually end up growing the usual traditional crops.

Such a practice shows that land settlement interventions, including resettlement, land reform, and irrigation schemes, could benefit from an approach of not including just former landless farmers, but making explicit efforts to attract firms that could bring innovations and know-how that even government agencies have difficulties accessing. In addition, CODEVASF's practice of promoting medium-size agricultural firms—though

many of them were part of larger corporations—contradicts another argument common in Brazil regarding the type of innovative economic actors that are supposed to be key in the economic transformation of underdeveloped regions. Current thinking views large agricultural firms as “anchors”, bringing capital and know-how about production and marketing and promoting the development of the region by a sort of “trickle-down” effect. Thus, according to this view, governments aiming to promote economic development of poor regions should focus on measures that attract these large firms. Meanwhile, interventions targeting small producers, such as land reform and traditional rural development programs, are viewed as “socially-oriented”, pursuing objectives like employment creation and poverty alleviation rather than economic development.

Although most of the agricultural firms that CODEVASF attracted were part of large business groups, the agency set ceilings in the provision of land in irrigation schemes. By imposing land ceilings, the agency was able to avoid land concentration by a few firms, helping create a structure dominated by commercial firms of medium-size rather than one dominated by a single “anchor” firm of large size. In addition, the strategy focusing on mixing landless farmers and medium-size firms was partly responsible for the widely-distributed economic growth characteristic of Petrolina-Juazeiro. Such strategy implicitly determined that small tenants had the chance to learn about new crops and technologies, and eventually grow non-traditional export crops and obtain similar yields than firms.

Finally, the practices of CODEVASF in Petrolina-Juazeiro suggest that

governments should not view their interventions towards landless and small farmers as “social”. In contrast, they should attempt to implement interventions that integrate them to larger firms—both agricultural and processing firms. For example, land settlements could include both landless peasants and medium-size firms, with government agencies carrying out specific actions so that small tenants learn about new crops, technologies, and marketing methods used by firms. In addition, the experience of CODEVASF suggests that governments should focus on medium-size firms instead of large “anchor” firms if they aim to promote a model with better distributional impacts.

Applying an “administered” turnover in irrigation projects

The literature about land settlements has a negative view on turnovers, portraying them as an indicator of “failure” or at least low performance. For this reason, agencies managing land settlements in Brazil and elsewhere often forbid selling land, and implement complementary measures to prevent turnover. In contrast, CODEVASF allowed and even encouraged turnover in Petrolina-Juazeiro both among *colonos* and firms—a practice that even contradicted what the agency was doing in the other regions studied here.

I argued that turnover in land settlement projects should not be considered as a negative process. Because CODEVASF had very limited ways to push *colonos* to perform better—it could evict them only under exceptional circumstances and could not cut off their supply of water—turnover became an unplanned process to improve the performance of

irrigation projects, as those who entered often had more experience and capital than the ones who exited the projects. While this policy had some negative distributional effects—as it did lead to a certain degree of land concentration and the substitution of wealthier farmers and even professionals for poor former landless peasants—turnover improved substantially the performance of agriculture in CODEVASF's projects because the incoming producers managed their farms more successfully than the *colonos* who quit.

Thus, the case of Petrolina-Juazeiro sheds new light on turnover, suggesting that when a government agency closely monitors the process and controls the characteristics of the newcomers, turnover may work as a “natural selection” process that pushes bad producers out of land settlements. These newly entering farmers usually brought capital, had marketing connections, showed commitment to their farms and the development of the region, and often provided higher wages and better working conditions to their rural workers.

Engaging in joint efforts with growers' associations

Exporters of high quality fresh fruits in Petrolina-Juazeiro and elsewhere often need to carry out tasks that require a high degree of compliance from all producers in a region, in order to comply with minimum quality standards, avoid harvest concentration, and control pests that may decimate the crops or even jeopardize access to foreign markets. While exporters need to act jointly in order to solve these constraints, they often fail because of

several problems associated with collective action. I showed that one of the strategic government interventions in Petrolina-Juazeiro involved CODEVASF engaging local producers in joint efforts to build private sector cooperation institutions in which farmers dealt with collective action problems and, in addition, signaled government toward the local needsd.

The case of Petrolina-Juazeiro not only shows that there is a wide space for government to work with producers' associations to address collective action problems common in exporting high quality fruits. It also demonstrates that government agencies can play an important role in the emergence of collective action. Just like CODEVASF did when it provided funding to Valexport and lent one of its technicians to perform as manager during the initial period of life of the organization, governments may not only push producers to create growers' associations and other institutions of collective action, but they may also provide funds and even personnel with managerial skills without associations necessarily becoming permanently dependent on government funds or unrepresentative of producers' interests. In addition, the specific time when CODEVASF succeeded in convincing growers of creating Valexport suggests that government agencies may take advantage of crisis and view them as opportunities—such as the near collapse of the melon crop in Petrolina-Juazeiro or the great difficulties that growers experienced trying to enter the US—to push for the creation of associations and the promotion of collective action.

On commodity chains and learning

Recent literature analyzing export-oriented industrialization has stressed that exporting firms in many countries relied heavily on linkages with buyers or multinational firms to learn about technological and organizational innovations. Some industries, such as automobiles, may be characterized by large—usually multinational—manufacturers playing the central role in coordinating the production networks, setting product specifications, and in teaching local firms about technology and organization of production. In other industries, such as apparel, large retailers and trading companies may play these key roles.

The process through which growers in Petrolina-Juazeiro were able to start selling and successfully maintain their access to the profitable US market shows that while trading companies may be important in transferring product specifications in high quality agricultural products, the crucial role corresponded to government agencies in both importing countries (United States Department of Agriculture in this case) and exporting countries (the Ministry of Agriculture)—actors understudied in the commodity chains literature. Exporting mango to the US required an active participation of Brazil's Ministry of Agriculture and the US Department of Agriculture, setting product specifications, enforcing the use of specific production and post-harvest technologies, and helping growers to learn how to produce for export.

On promoting the modernization of small farmers' agriculture

Governments and international donors have long implemented programs to modernize small farmers' agriculture. Most of these programs attempted to deal with the difficulties of small farmers to access to credit and extension by supporting the provision of these services through government agencies and more recently through Non-Governmental Organizations or private firms. Unfortunately, these programs were often unsuccessful for many reasons, such as poor performance and coordination problems affecting the agencies implementing them, promotion of agricultural technologies inadequate for the particular characteristics of farmers, and insufficient attention to the great difficulties of small farmers to sell their production, among others.

Most *colonos* in CODEVASF's irrigation schemes in Petrolina-Juazeiro still obtained a low-quality product in most crops and faced difficulties to access profitable markets both at the domestic and foreign levels. However, CODEVASF and the Bank of Northeast Brazil implemented interventions that were instrumental in promoting the adoption of export crops and new technologies among these small tenants. The following were the key interventions implemented by CODEVASF and the Bank of Northeast Brazil.

a) While the Bank of Northeast Brazil played the key role in providing investment credit, CODEVASF dealt partly with the other problems by promoting a sequence of crops over time, starting with crops of simpler technology and marketing, lower investment costs, and short-term revenues, such as onion, watermelon, and melon, all for the domestic

market, and gradually introducing crops of more complex technology and marketing, higher investment costs, and which generated the first revenues in longer periods of time, such as mango and grapes. In addition, CODEVASF not only tolerated, but also started to promote production systems adapted by *colonos*, which grew high-value crops like mango and banana interplanted with beans and other crops. In this way, they were able to obtain rapid revenues for some crops while they waited for the slower revenues of the newly introduced ones.

Programs to modernize small farmers' agricultural production have often obtained poor results because the technologies and new crops promoted were too complex or inadequate for the specific characteristic of small farmers. In Petrolina-Juazeiro, the export crops that became popular in the region (table grapes and mango) had some characteristics that made difficult for *colonos* to start growing them. First, export crops were perennial and they could be harvested only two to three years after plantation, so *colonos* had to wait a long time to obtain their first revenues. Thus, they often preferred to keep growing annual crops to obtain a constant flow of revenues to support their families. Second, export crops required high investments, so growing them was difficult for small tenants with difficulties accessing investment credit. Third, export crops required the use of irrigation and technologies to obtain high quality that were complicated for *colonos*, most of whom had no previous experience with irrigated agriculture.

CODEVASF's promotion of a sequence of crops over time allowed *colonos* to

gradually learn irrigation technologies and how to program the timing of production and harvesting. This experience suggests that programs and projects aiming at modernizing small farmers' agriculture should implement gradual strategies when introducing new crops that allow for farmers learning, first promoting crops whose technology and marketing are simpler, and only later introducing crops with more complex technologies and marketing. In addition, those strategies should not overlook the relevance of traditional crops and the possibilities of incorporating them in production systems that include both new and traditional.

b) CODEVASF promoted backward linkages from tomato-processing industries, attracting them from the south of Brazil to build facilities in Petrolina-Juazeiro and to initiate contracts with *colonos* in CODEVASF's irrigation schemes. The literature on linkages between agriculture and industry has often stressed that agriculture has a high potential to generate forward linkages, arguing that increased agricultural production induces the growth of non-agricultural output and employment through the demand of agricultural producers for inputs, and from the supply of agricultural products like tomato that must or can be processed before their consumption. CODEVASF's strategy allowed *colonos* to start growing an irrigated crop of a relatively simple technology, helping them to learn about irrigated agriculture, to have a safe market for the product, and to have access to inputs and technical assistance provided by the industries. CODEVASF's strategy shows the effectiveness of promoting backward linkages from processing industries through the

active negotiation with firms, farmers, and financial institutions, rather than pushing for the growth of areas with crops that could be processed as the main way of attracting the processing industry, i.e., promoting forward linkages.

c) The Bank of Northeast Brazil played an important role in mediating in technology transfers from medium-size firms to *colonos*. Such a role resulted as an unintended outcome of the application and appraisal of investment loan applications that the agency had as a part of its credit management operations. Agronomists who assessed investment proposals of agricultural firms and small tenants learned about innovations, such as different pesticides for mango or new pruning techniques for grapes, applied by firms and soon required that these innovations be included in the proposals of small tenants. In addition, the Bank of the Northeast gave agronomists in charge of designing the small tenants' project proposals the details of these new technologies. Thus, their role in assessing project proposals of both small tenants and firms turned them into truly intermediaries in the transference of technology.

The unintended effects of the Bank of the Northeast's procedures suggest ways in which government agencies could promote the transfer of technology from producers who apply the latest technologies to small tenants. In particular, they suggest the potential of centralized credit to promote technical change among small farmers, in contrast to the current emphasis on decentralized microcredit.

One of the main objectives of CODEVASF of promoting a model of settlement that

included a mix of *colonos* and medium-size and large firms was to promote technical change among *colonos* and their incorporation of new crops through their learning from the experience of large farmers. However, this process of learning does not occur automatically, and CODEVASF did not carry out any specific intervention to facilitate the exchange of information and experience between *colonos* and firms. The experience of the Bank of the Northeast suggests that credit and extension agents could turn into important intermediaries in such a process. Agencies providing credit could even have more leverage because they may require the adoption of latest technologies—though they must be careful to evaluate if the characteristics of the technology are appropriate for small tenants. Such interventions could not be possible in the currently popular decentralized microcredit schemes.

On rural employment, wages, and working conditions

Part of the literature analyzing the modernization of agriculture and a great deal of the analysts who have focused on the recent growth of NTAEs in many developing countries have stressed their negative effects on rural wage workers. In contrast to this view, the growth of irrigated agriculture in Petrolina-Juazeiro, and in particular of NTAEs, was accompanied by widespread benefits for rural wage workers, leading to an increase in employment and wages, and to the improvement of labor standards of rural workers. These positive outcomes relate partly to the type of changes that the growth of irrigated agriculture

caused in the labor market. By investing in irrigation infrastructure in a region in which farmers had used the land primarily for a low-productivity livestock production that used little labor, CODEVASF was directly responsible for the great increase in the demand for labor spurred by the expansion of irrigated agriculture. Such positive effects of irrigated agriculture in employment when the dominant production is not very labor intensive are well-known and many authors have pointed out to the potential of irrigation investments in such cases.

However, the introduction and growth of irrigated agriculture does not necessarily result in a rise of wages. The great improvements in wages and working conditions in Petrolina-Juazeiro relate to the decisive role played by rural workers' unions at the local (municipal) and upper (state) level, which were able to negotiate with growers' associations in a way that was not possible in the North of Minas Gerais and the *Baixo São Francisco*.

Workers' unions were able to obtain improvements for the following reasons:

a) The changes that took place in the labor market affected the balance of power between workers' and growers' organizations in favor of the former. The NTECs that became popular in Petrolina-Juazeiro had specific technological characteristics—all-year-round production, use of complicated technology, and little possibilities of mechanization—as well as quality requirements from consumers that led to a great rise in the demand for labor with specific skills. Because skilled labor was in short supply in the Northeast, it was easier for unions to negotiate improvements in wages and working conditions.

b) A strong upper (state) level organization of the union structure, the Pernambuco Rural Workers' Federation (FETAPE), with a long experience in organizing rural wage workers in Pernambuco's sugarcane zone, had a great influence in the dynamics of wages and working conditions once it decided to provide its organizing and negotiation skills to the local unions. Irrigated agriculture created a large mass of wage workers, which had great effects in FETAPE's strategies, pushing it to step into the Petrolina-Juazeiro region to increase its power and membership. Such decisions and outcomes would have not been possible without the corporate union structure characteristic of Brazil.

c) Improvements in wages and working conditions relate partly to non-antagonistic relations between growers' and workers' organizations, in contrast to other regions (notably Pernambuco's sugarcane zone), where the relationship between these organizations is highly conflictive and negotiations often bitter, deadlock, and even marked by violence. These non-antagonistic relations were partly possible because CODEVASF unintentionally brought a new economic and social structure through its strategy of mixing *colonos* with agricultural firms in its irrigation projects.

d) The market characteristics of the crops grown in Petrolina-Juazeiro had a great influence in the ability of unions to negotiate improvements in wages and working conditions. Because NTAEs reached consumers in Europe and the US who worry about the environmental and labor conditions of production, unions used their connections with national-level organizations in the union structure to reach international organizations like

the ILO, warning growers to initiate campaigns in foreign markets if some of their demands were not met. Growers' concerns for the possible negative effects in their product demand from these types of campaigns influenced a great deal their willingness to agree on higher wages and improvements in labor conditions, and led to a successful campaign to eliminate child labor.

e) Finally, the positive outcomes for labor in Petrolina-Juazeiro stem from an important role of government agencies (offices of the Ministry of Labor at the state and municipal level) mediating the relationship between growers and workers, participating as mediators in contract negotiations and monitoring growers' compliance with labor contracts. The active role of this government agency in Petrolina-Juazeiro can be explained by the pressures from the unions to perform better.

These findings suggest that the effects of globalization on the rural poor and the growth of NTAEs are not necessarily negative, as argued by a considerable portion of the literature focusing on the features and consequences of globalization in agricultural production. Such literature has argued that promoting strategies based on promoting food exports in developing countries often leads to an increasing marginalization of the rural poor and to potentially dramatic social and political consequences. The positive outcomes of the growth of NTAEs in Petrolina-Juazeiro are more in line with the opinion of analysts who hold more positive views on the possibilities of developing the exports of certain crops, such as fresh fruits and vegetables, for which the demand in the industrialized world

is increasing due to the value placed in “healthy”, low cholesterol, high-fiber, and preferably organically-grown type of foods. These authors argue that these “niche” food exports are a valid alternative to the traditional strategy of exporting raw materials and food commodities. In addition, they have presented such as strategy as a way of promoting local growth and generating employment in the rural areas.

While these academic works have improved the understanding of the effects of agro-export growth and globalization in developing countries and regions, they have focused on the capacity of small land-owning farmers to grow export crops, rather than on agricultural laborers—i.e., who do not own or operate farms. In addition, even when they look at the labor effects, they often focus simply on the number of jobs created, not paying attention to factors that may lead to the upskilling labor, the rise of rural wages, and the improvement of labor conditions. The analysis of the Petrolina-Juazeiro case show positive effects of the growth of NTAEs on rural wage workers. These effects depend on the specificity of the technology of crops involved, characteristics of the labor market, and government interventions affecting the balance of power between growers and wage workers and their respective organizations.

In addition, the negative views of NTAEs have emphasized that actors in the consumers’ end of the production chain--retailers, food processing, and trading firms in industrialized countries--have the power to define the location of sourcing, technology, and patterns of quality, stressing the marginal role of governments in developing countries to

shape such decisions and in general the effects of NTAEs in the rural poor. The case of Petrolina-Juazeiro shows that governments may greatly influence the labor effects of local processes of economic growth in unexpected ways. Attracting outside entrepreneurs to establish in a backward region may relate not only to objectives of promoting economic growth, but also to bringing new values and institutions, as well as a less antagonistic social structure. Consumers' views have a great weight in decisions that firms make with respect to labor and technologies. This provides opportunities for governments and NGOs to carry out campaigns to inform consumers and buyers (supermarkets, etc.) about the labor effects related to different crops. Such campaigns and the subsequent attitudes of consumers may have better influence on the result of negotiations between workers and firms than laws and regulations.

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