Farming for Supermarkets:
Its collective good problems and what Brazilian growers have done about them

by

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ABSTRACT

This dissertation analyzes the conditions under which growers have effectively resolved collective good problems associated with the rise of supermarkets. It answers two questions: What institutional arrangements have growers used to resolve collective problems and what explains the differences in these arrangements in terms of what they achieve and whom they benefit.

Brazilian fresh fruit growers have turned to a variety of institutional arrangements in resolving collective good problems, including growers's associations, cooperatives, trade groups; closer ties with public sector agricultural research and extension agencies; and closer ties with their buyers and input suppliers. Economic incentives and constraints are at the basis of which strategy growers pursue and its effectiveness. Yet findings suggest that growers' responsiveness to the rise of supermarkets are also a function of incentives and constraints embedded in 1) the form of government support in the 1970s and 1980s which led to varying structures of production and government-grower relations that still predominate today, 2) crop characteristics that affect how growers organize, where more complex crops (costlier, riskier) are associated with greater collaborative efforts, and 3) Japanese-Brazilian ethnic ties that have facilitated the resolution of collective good problems among groups of medium growers. Interpreting the recent development of fruit production across these cases as a reflection of these locally-embedded factors suggests that developing country governments often have greater margin for action than that which is often portrayed.

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CHAPTER 1. INTRODUCTION

The restructuring of food retail in the 1990s has made production and marketing of fruits even more difficult.[1] Buyers, especially supermarkets, have increased their demands for quality and consistency, reliable supplies, and improved varieties. This, in addition to the demands of importing country governments, such as the pest management and pre-clearance programs of the USDA and the pressures for integrated production from the EU to further reduce pesticide residues. Meeting many of these norms and standards generate collective good problems because of the need for agricultural research (such as for improved varieties and the development of integrated production practices), the need for mediation with importing country governments (such as the pre-clearance programs imposed by the US Department of Agriculture), and the rising costs of non-compliance, where the failure of one firm can hurt the reputation of the entire cluster.[2] For all but the largest growers, the demands for quality and consistent supplies also require joint post-harvesting and marketing.

The need for collaborative responses is clear.[3] How growers get there is another story. This dissertation is about the ways Brazilian growers gave responded to these demands, and asks two questions: What institutional arrangements have growers used to resolve collective problems and what explains the differences in these arrangements in terms of what they achieve and whom they benefit?

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[1] See Carter et al (1996), Dolan and Humphrey (2004), Henson and Loader (2001), Reardon and Farina (2001), Thrupp (1994), and Unnevehr (2001).

[2] Others stress the need for collaborative responses because of the public good natures of certain kinds of hazard control (Calvin et al 2002, Unnevehr 2001), and the setting, implementing and certifying of grades and standards (Nadvi and Kazmi 2001, Reardon and Farina 2001). A classic case of the common good problem of reputation is that of the Guatemalan raspberry crises, where the 1996 cyclospora outbreak in the US linked to Guatemalan raspberries decimated the number of growers in the sector and their exports, and ruined Guatemala's overall reputation as a supplier of raspberries and other fresh berries (Calvin et al 2002).

[3] Some scholars have begun questioning this logic, arguing that the restructuring of value chains has changed the logic of collective action in precisely the opposite direction. Meyer-Stamer and Seibel (2002), for example, drawing from the tile industry in Santa Catarina, Brazil, argue that higher costs of joint action along with higher uncertainties of returns from these actions dissuade firms to collaborate with each other even when they had done so in the past. Schmitz (1999) presents a similar argument in which quality-driven pressures led some of the leading firms to strengthen their vertical ties with their foreign buyers, while withdrawing from local collaborative efforts that could have potentially benefited the entire cluster. In the case of Brazilian fresh fruits, however, the expected returns from resolving these collective good problems are substantial since they often underlie growers' upgrading efforts, without which they would be unable to remain in the market.

Evidence from the Brazilian fresh fruit industry suggests that growers have turned to a variety of institutional arrangements – including growers's associations, cooperatives, trade groups; closer ties with public sector agricultural research and extension agencies; and closer ties with their buyers and input suppliers – to resolve common good and other problems associated with competing in a globalized market. Economic incentives and constraints are at the basis of growers' decision-making of which strategy to pursue and its effectiveness, but so are incentives and constraints embedded in 1) the structure of production and historical patterns of grower-state relations, 2) the technical characteristics of crops growers produce and their markets, and 3) ethnic ties among groups of Japanese-Brazilian medium growers.

I arrived at these conclusions by examining three of Brazil's largest clusters[4] of fresh fruit in terms of production, number of growers, and employment: apple production in Santa Catarina (SC), mango and grape production in Petrolina-Juazeiro (PJ), and melon production in Rio Grande do Norte (RN). Brazilian exports of these fruits have more than trippled in value in the past decade, increasing by 306%, compared to an 80% increase in the case of Latin America and 35% for the world.[5] Together, they represent about half of Brazil's total fresh fruit exports between 1990 and 2000.[6] Importantly for an export success story, most of this production is sold to the Brazilian domestic market.

The cases[7]

The three cases chosen for this study have been recognized elsewhere as "success stories" because of their outperformance (on average) of other municipalities in their respective states in terms of agricultural production, and the associated increase in quality

[4] The term "cluster" is used loosely throughout this dissertation to refer to a spatially-bound agglomeration of firms.

[5] Based on average annual value of exports for 1990-1992 and 2000-2002, estimated from data from FAO. The average annual value of exports of Brazilian apples, mangos, grapes, and melons was $32 million for the 1990-1992 period and $130 million for 2000-2002. For Latin America, the values were $827 million in 1990-1992 to $1.5 billion in 2000-2002. And for the world, $4.6 billion in 1990-1992 to $6.2 billion in 2000-2002.

[6] According to data from SECEX, average annual export values for Brazilian apples, mangos, grapes, and melons accounted for 52% of total fresh fruit exports. In the year 2000, the combined value of these exports was US$ 106 million, out of a total of US$ 169 million.

[7] This study defines each case based on the municipalities in each state that together account for most of that state's production. The selected municipalities are based on IBGE data on average annual hectares planted between 1998-2002, as listed in Appendix A.

of life indicators associated with this growth.[8] As described in Table 1, SC is Brazil's leading apple producer, with over 700 growers and 14,000 hectares, employing 30,300 workers and accounting for about half of Brazilian apple exports.[9] In PJ, over 100 growers produce 17,000 hectares of mangos, and 600 growers producing 5,000 hectares of grapes, in addition to hundreds of other growers cultivating bananas, coconuts, watermelons, and other crops.[10] The production of mangos and grapes alone employs over 29,000 workers in producing 90% of Brazil's mango exports, and 30% of its table grape exports.[11] Lastly, melon growers in RN produce 5,000 hectares of melons, employing 19,000 workers in producing about 40% of Brazil's melon production and 90% of its exports.[12] Their locations are shown in Map 1.

[8] According to Bonelli (2001), the average annual rate of growth of the primary sector between 1975 and 1996 in SC's apple sector was 8.7%, compared to 3.7% for the entire state of SC. Similarly, the growth rate for PJ was about 12.7% compared to an average of 3.2% for the states of Pernambuco and Bahia, and 4.8% for the melon producing area in RN compared to 1.8% for RN as a state. Bonelli further claims these growth rates explain most of the increase in the estimated increases in quality of life indicators across the municipalities.

[9] Production is spread across two subregions – one centered around the city of Fraiburgo (including the municipalities of Lebon Regis and Monte Carlo), the other around Sao Joaquim (including Bom Jardim da Serra, Bom Retiro, and Lages).

[10] This region covers an area of 20,500 square miles, including the municipalities of Petrolina, Santa Maria da Boa Vista, and Lagoa Grande in the state of Pernambuco, and Juazeiro, Curaçá, Casa Nova, and Sento Sé in Bahia.

[11] Data from Damiani (1999). Employment figure for 1996, export figure for 1997.

[12] Production is concentrated in the northwest municipalities of Mossoró and Barauna.

Table 1. Basic characteristics of cases

	Santa Catarina	Petrolina-Juazeiro		Rio G. do Norte
	apples	mangos	grapes	melons
Area planted (hectares)[a]	13,046	10,432	5,683	4,545
Tons produced[b]	511,000	84,000	108,00	206,000
Number of growers	700	150+	400+	100+
Total employment[c]	21,243	29,000		13,632
Employment per hectare	2			
Value of production (US$), 2001	$ 52 million	$ 37 million	$ 56 million	$ 13 million
Value of production (US$),1995	$ 23 million	$ 8 million	$ 45 million	$ 19 million
Share of national production[d]	51%	26%	8%	38%
Share of output that is exported[e]	7%	35%	11%	50%
Share of total exports[f]	96%	90%	30%	90%
Value of exports (US$),[g]2002	$ 31 million	$ 51 milion	$ 34 million	$ 38 million
Main buyers[h]	Holland (48%)	Holland (51%)	Holland (48%)	UK (44%)
	UK (18%)	US (25%)	Argentina (27%)	Holland (45%)
	Germany (10%)	Others (24%)	Others (25%)	Argentina (9%)

[a] Production data from IBGE/Producao Agricola Municipal (www.ibge.gov.br). Data are average annual values for 1998-2002.

[b] Data from Albuquerque (2001) and represent average annual value for 1995-1999. IBGE data not used since it measures volume by "thousands of fruits" instead of tons for three out of the four crops considered.

[c] Employment data for SC from Boneti et al (1999) and for PJ from Damiani (1999). Data for RN based on an estimated 3 jobs per hectare, according to Profrutas (1996).

[d] Refers to share in total production of each crop in Brazil. For example, apple production in Santa Catarina accounts for 51% of Brazil's total production of apples.

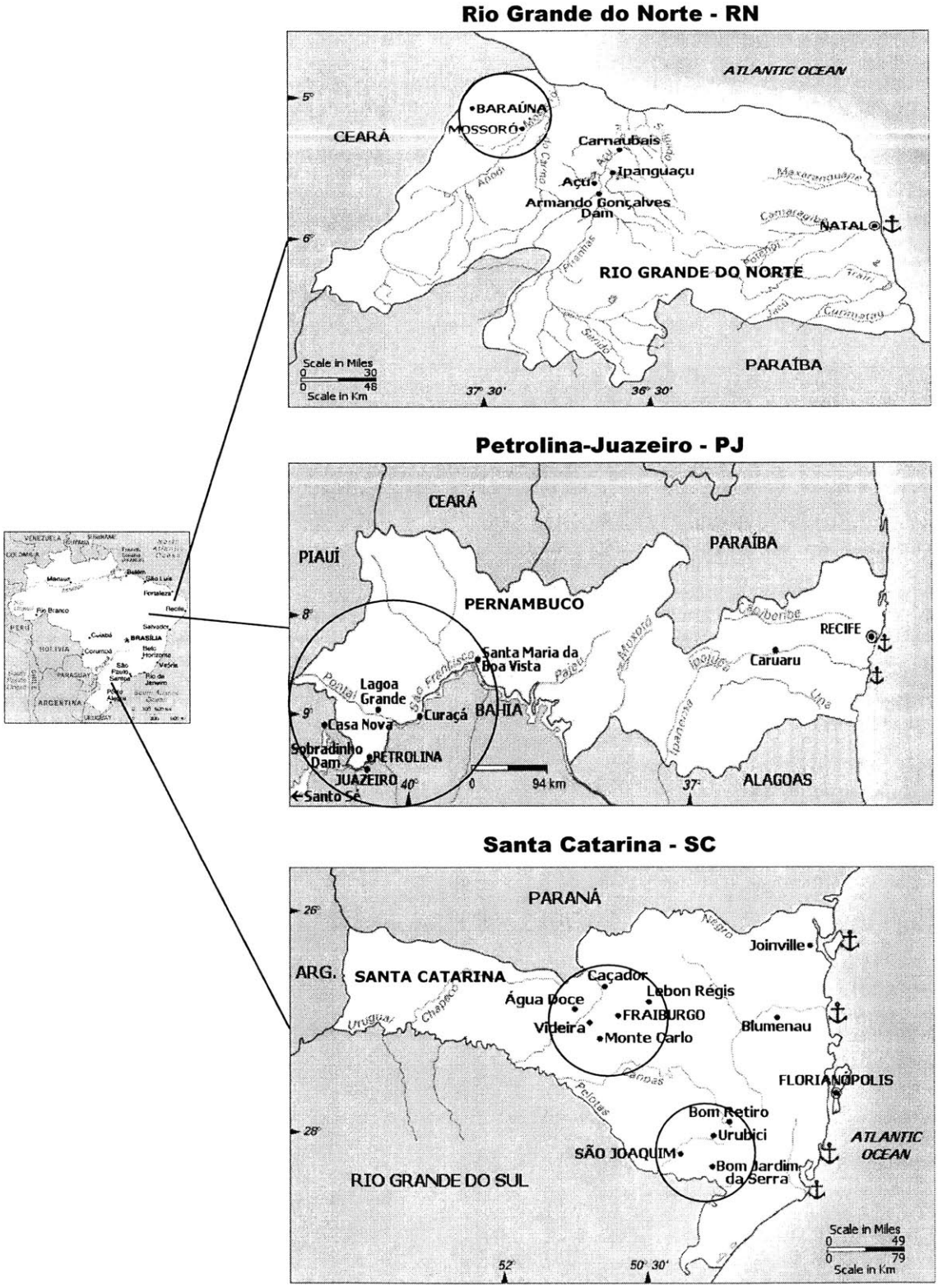
[e] Refers to share of total output in each case that is exported. For instance, 35% of the mangoes produced in PJ are exported. Year to which information refers and source: mangoes: 1998 in Agland (1998); grapes: 1997 in Agland (1998); melons: 1998 in Gomes (1999); apples: 2000 in FIESC (2001).

[f] Refers to the share of exports from each case in total Brazilian exports of that crop. Year to which figures refer and source: PJ:1997 in Damiani (1999); RN: 1998 in Gomes (1999); SC: 2000 in FIESC (2001).

[g] Data from Ministerio da Industria e Comercio, online at www.aliceweb.gov.br.

[h] Main buyers in 2000, as listed by Albuquerque (2001).

Map 1. Location of cases



These clusters started to grow in the 1970s and 1980s and have faced several adverse conditions since the early mid 1990s: reduced government support compared to that on which growers depended when they began producing in the 1970s and 1980s, an influx of imports from the 1994 stabilization plan, and the rapid restructuring of food retail. These pressures have contributed to the generation of the kinds of public and club goods listed in Table 2. Resolving public good problems generally justify government support – these problems thus raise the question of how growers have accessed the state, how the state has responded (or led), and the distributional outcomes. Club goods, in contrast, are a variation of private goods that lead to collective organizations. Throughout this dissertation, the term collective good refers to both public and club goods. The question that emerges then is why have some grower groups done better than others?

Table 2. Examples of collective goods across cases

Case	Public good	Club good
SC - apples	improved varieties, technology for more homogeneous blooming, integrated production	especially for small and medium growers: consistent volumes, reliable supplies, quality control
PJ - mangos	technology to control harvest, mediation with USDA for pre-clearance program, fruit fly monitoring program, integrated production	consistent volumes, reliable supplies, quality control
PJ - grapes	seedless grape varieties, integrated production	consistent volumes, reliable supplies, quality control, and brand-name
RN - melons	improved varieties, fruit fly monitoring program	consistent volumes, reliable supplies, quality control

Growers have thus faced a common set of pressures generating incentives for collaborative responses. These collaborative responses, however, have varied substantially across the cases. SC stands out for the convergence of uncommonly effective state-grower relations across agricultural research and extension, and a well-structured, representative, and capable growers' association, ABPM (Brazilian Apple Growers Association). These arrangements reflect both a deliberate strategy of the state government to engage with large and small growers in earlier decades, and the commitment of the pioneering firms and other larger firms thereafter to developing SC's

apple industry. Among other achievements, the state agricultural agency, EPAGRI, has worked closely with growers in making the apple sector the first in Brazil to develop and implement integrated production practices.

Similar to SC, growers in PJ have also benefited from research partnerships with a public sector agricultural research agency, in this case, an EMBRAPA regional center located in Petrolina, CPATSA[13] (*Centro de Pesquisa Agropecuária do Trópico Semi-Árido*). Unlike SC, however, the public-private partnerships in PJ have generally been limited to specific projects and to contacts between individual growers and researchers as opposed to the broader scope and scale of such partnerships in SC. Additionally, these partnerships have been less distributive in PJ than in SC in terms of their accessibility by small and medium growers. These differences can be explained by the form of public sector support in PJ, that focused on different crops for different growers, and a less representative grower association in PJ relative to that in SC.

Lastly, RN has only a nominal growers association and no direct access to a public sector agricultural research agency comparable to EPAGRI in SC or CPATSA in PJ, yet has managed to surge ahead anyhow. This weak tie has been partly the outcome of perverse policies that shaped a highly concentrated structure of production and promoted private over public research. The relatively easier nature of melon production along with the highly subsidized credit to the lead firms enabled growers to do much experimentation without the kinds of public sector support required observed in the other cases.

In short, particular market demands may generate incentives for growers to collectively seek government support with research, implement a local pest monitoring program, sell their products, or to enforce specific production guidelines, but may do little in the way of inducing the kinds of lasting and developmental institutions that can support growers' performance in the long run.

This dissertation argues that the arrangements growers have used in resolving common problems reflect:

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[13] EMBRAPA recently renamed the Centro de Pesquisa do Trópico Semi-Árido (CPATSA) as EMBRAPA Semi-Árido. I use the acronym CPATSA for the sake of brevity and to avoid confusion with the central EMBRAPA.

1) Institutional incentives embedded in public sector policies of the 1970s and 1980s that determined a) the number and size distribution of growers that would make up the sector, and b) the nature of the relationship between growers and public sector research and extension;
2) Incentives associated with particular crop and market characteristics; and
3) Among medium growers, incentives embedded in ethnic-based Japanese-Brazilian production and marketing networks.

These factors are described below and summarized in Table 3.

Table 3. Local factors affecting growers' responsiveness to buyer-driven demands

Case	Form of government support in 1970s-1980s	Production cycle and costs	Japanese-Brazilian ethnic ties
Santa Catarina apples	The state agricultural agency, ACARESC, learned from pioneering firm and promoted apple production by providing access to credit, agricultural extension and training, and highly rated apple research system. Thus created, from early on, institutional basis which continues supporting growers' upgrading efforts.	Perennial crop, with 3-4 years between planting and first harvest. Second only to grapes in terms of production costs.	COTIA growers pioneered small scale production in Sao Joaquim.
Petrolina-Juazeiro mangos and grapes	A federal engineering-based parastatal, CODEVASF, created irrigation projects including the provision of infrastructure, land, credit, water, agricultural extension, and support in forming growers association. Supported dual structure of production based on different mix of crops.	Perennial crops, with 3-4 years between planting and first harvest. Grapes are most labor-intensive and expensive crop, with per hectare production cost three times as high as that for mangos.	COTIA growers introduced table grapes in CODEVASFprojects.
Rio Grande do Norte melons	No single government agency coordinated the development of the melon industry. Instead, development banks provided substantial subsidized credit to two large pioneering firms, which invested in in-house capabilities rather than those that could support broader grower base.	Annual crop, harvested as early as 60 days. Lowest per hectare production costs.	Japanese immigrants participated in early melon trials and eventually became medium growers.

The early policies and politics of modern partnerships

The variations across arrangements reflect incentives or disincentives resulting from public sector policies in earlier decades when growers first began producing. More specifically, the institutions which have supported growers' upgrading efforts today are

largely a result of government policies in the 1970s and 1980s that influenced a) the number and size distribution of firms that adopted fruit production, and b) the earlier priorities and strategies of public sector agricultural research and extension agencies. Together, these policies shaped which kind of growers produced and the relationship between growers and the state.

The notion that the structure of production – the number of growers, their size, and the relationships between them - shape economic behavior is central in the literature on embeddedness and networks.[14] Locke (1995) argues that the divergent patterns of dynamism and decline across Italy reflect "divergent sociopolitical networks [that] create different mixes of resources and constraints that shape the strategic choices of local economic actors" (p. 21). Across my cases, the structure of production is central in explaining how growers have resolved collective good problems. Evidence from my cases further suggest that the variations in the structure of production are a function of the kinds of public support available in earlier decades. In other words, the state itself provided incentives (or disincentives) for cooperative behavior, including in relation to public sector research. [15]

The common good nature of many norms and standards justify public sector support through policy-making, and provision of information, quality control mechanisms, infrastructure, and research for technologies to improve production and post-harvesting practices.[16] In Brazil as elsewhere, governments have restructured their agricultural research and extension systems in the 1990s by reducing budgets, merging research and extension, and occassionally shutting down state-level support altogether.[17] As part of this restructuring, the federal and state governments have turned to forging

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[14] See, among others, Gertler and Wolfe (2002), Granovetter (1973, 1985), Kennedy (1999), Locke (1995), Powell (1990), Pyke, Becattini, and Sengenberger (1990), and Streek (1992). Raynolds (1994), Whatmore (1999), and Watts and Goodman (1997) discuss the role of embeddedness specifically in shaping the competitiveness of agrarian sectors.

[15] See Barzelay (1991), Evans (1996), Kenworthy (1997), Perez-Aleman (2000). For how the state itself influences the impact of demand-side pressures on the responsiveness of public sector research, see Tendler (1993), Hayami and Ruttan (1985), and Merrill-Sands and Collins (1994).

[16] See Unnevehr (2001) and Henson and Loader (2001).

[17] Expenditures by the Brazilian Agricultural Research Agency (EMBRAPA), Brazil's largest and most important agency in the field, for instance, peaked in 1996 then fell by 17% by 1999 (Beintema et al 2001), while federal expenditures on agricultural extension fell from 21% of total government spending in agriculture in the early 1980s to less than 6% by the late 1990s (Gasques 2001). For a discussion of the rise and fall of public sector agricultural extension in Brazil, see Olinger (1996).

research partnerships with the private sector, through which the private sector shares in defining, financing, and executing public sector R&D.

In theory, public-private partnerships in agricultural research benefit both governments and growers.[18] Public research agencies benefit from greater legitimacy and representation before central government decision-making authorities, and often from direct financial contributions from growers that compensate for budgets cuts. Growers, in turn, benefit from public research that is more focused on growers' pending needs and from increased engagement with public sector researchers that may help resolve other production-related problems. Most of this literature, however, is prescriptive and does not analyze the formation of these partnerships. Nor does this literature analyze the conditions under which these partnerships are more likely to contribute to economic performance or what makes them more or less inclusive.[19] The stories that emerge from my cases vary both in the process of building these partnerships and in their outcomes.

In SC, ACARESC first learned from the pioneering firms then aggressively supported production by hundreds of small growers while also commiting to research. In PJ, CODEVASF supported a dual structure of production, based on many large firms and hundreds of small growers. It then provided direct financial and management support in the formation of the growers association, VALEXPORT. The state thus supported many like-sized firms, then institutionalized a forum through which they could collectively pressure the state (Damiani 1999). In RN, government support in the form of subsidized credit benefitted especially two very large firms. This direct access to highly subsidized credit allowed these large firms to grow to many times the largest firm in PJ, allowing them to invest in R&D, laboratories, etc, thus crowding out the development of local, public institutional building.

Crops, markets, and their impacts on growers

The variations across the institutions supporting growers' upgrading also reflects characteristics of crops and their markets, particularly crops' production cycle (perennial

[18] See Alston, Pardey and Roseboom (1990), Echeverria (1998), and Hall et al (2001).
[19] I raise the issue of a constructive and inclusive public-private partnership in light of Tendler's (1999, 2001b) work questioning the assumptions behind the growing interest in these kinds of relationships between the private sector and the state.

versus annual cycle) and production costs, and the extent to which markets are actually demanding. By their very nature, some crops are more complex than others (costlier, riskier, more perishable, and so on), affecting how growers organize and which activities they undertake collectively (Collins 1995, Tendler 1984). Likewise, some markets are more demanding than others.

The idea that crop characteristics affects how growers organize and which activities they undertake collectively is not new. Perry et al (1997) explain the variations in the responsiveness of growers across five horticultural crops in New Zealand to the implementation of quality standards as partly a function of the nature of the crop. They argue that annual crops offer more opportunities for higher turn-over rates in comparison to perennial crops, implying that growers of annual crops may be relatively less committed to implementing more expensive quality control measures.[20]

Within the literature on cooperatives, Tendler (1984) argues that crops present particular characteristics that make problems they confront more or less complex to resolve and, consequently, influence how grower cooperatives respond to these problems and their outcomes. In particular, in explaining why a particular cooperative provided greater support to its grape growing members than to those that produced the comparatively lower-value potatoes or corn, Tendler notes that grapes pointed to a more focused problem (equipment and technical assistance), and one that was easier to resolve and more appropriate for donor financing than that associated, for instance, with the difficult and costly task of supporting storage and marketing for potatoes. Similarly, Attwood and Baviskar (1987) describe how the technical requirements of sugar production in Maharashtra supported the alliance of large and small growers who may otherwise by separated by caste, class, and power. In that case, the heavy industrial machinery needed to process sugar would be underutilized if it were not for the supply of cane produced by the small growers.

My argument extends this scope of analysis by considering the incentives or disincentives for growers to collaborate associated with a) the difference between annual

[20] Perry et al (1997), however, do not follow through with the implications of higher turn-over rates for the responsiveness of growers. Rather, they proceed to explain how the "different levels of understanding" of each crop, as reflected in the number of years which it has been growing locally, affects the responsiveness of growers. "Where understanding is less [as in the case of squash], enforcement of quality systems is harder."

and perennial crops in terms of learning cycles, b) the varying levels and structure of production costs, and c) the varying levels of competitive pressures across different crop-specific markets.[21] Apples, mangos, and grapes are perennial crops, with three to four years between planting and the first harvest. Melons, in contrast, are an annual crop that in RN is harvested in as few as sixty days. This means that within two short months, melon growers in RN see the results of a new variety or the outcomes of modifications to the production process, such as spacing, weeding, irrigation, fertilizer and pesticide use. Growers of the other, perennial crops, in contrast, must wait at least three years to observe any comparable results, making the learning process longer and more expensive both in terms of the actual research costs as well as the opportunity cost of having to wait years before arriving at some conclusion about improved production technologies.

Production costs also make a difference. Again, the annual versus perennial distinction is substantial: the per hectare cost of producing melons in RN is just over half the per hectare costs for apples in SC, and less than one-third that of grapes in PJ. This means that growers of perennial crops have a lot more at stake than do melon growers. This production cost also helps to explain the variations in institutional arrangements between two perennial crops: mangos and grapes in PJ. Large grower exporters produce about 60% of the mangos in PJ and are organized in the sectoral association VALEXPORT, which focuses on lobbying the state for support with research, marketing, and infrastructure. Sixty percent of grape production, in contrast, is produced mostly by small and medium growers, who are organized around the Brazilian Grape Marketing Board, which pools production and sells grapes under one brand name.

As for market characteristics, evidence from this study contrasts the commonly held assumption that export markets are necessarily more demanding than domestic ones. In fact, up until the mid 1990s, there was a negative association between how much of a crop was exported and the extent to which growers invested in improved production and postharvesting technologies. Conversations with European importers of Brazilian fruits revealed that melon growers in RN, who have historically exported about half of their production, have been the slowest to respond to the demands of buyers. Apple growers,

[21] Although I recognized from early in my research that melons were somehow easier than the other, perennial crops, I thank Richard Lester for explicitly noting the implications of crop cycle to the idea of learning. The limitations of the foregoing analysis are, of course, my own.

in constrast, who export only about 7% of their production, have outperformed growers in the other cases in terms of gains in productivity, overall quality, and the institutional arrangements that have supported this process. This difference is partly explained by the fact that melon growers had an exclusive window to the European market for over a decade (no competition), while apple growers from the very beginning had to compete with apple imports.

Collective ties among medium growers

Among the striking features of my cases is the continued participation of commercial medium growers (so defined relative to the range in farm size in each case, as reflected in Appendix B), ranging from 30% to 60% of total production, as shown in Table 4. The literature tends to emphasize the many reasons why all but the largest growers should remain in the market, including access to resources, production and marketing knowledge, postharvest transport and marketing services, and expertise in the use of pesticides and other agricultural chemicals which are of rising concern for buyers. These medium growers, moreover, necessarily need to pool their production to meet the economies of scale involved with post-harvesting and marketing, as well as to meet buyers' demands for continuous and reliable supplies. How have medium growers resolved these collective good problems?

Emerging studies reveal several ways through which small and medium growers have managed to remain in the market, but none of these explanations hold for Brazilian growers. In some cases, growers remain in the market through sourcing arrangements with smaller supermarkets or with dedicated wholesalers who contract out for supermarkets (Faiguenbaum, Berdegué, and Reardon 2002). In other cases, medium growers benefit from regulatory supports that ultimately protect them, such as the French government's support of the French wholesale markets (Gibbon 2003), or the EU's Banana Regime that provides preferential access to suppliers from African, Caribbean, and Pacific nations. And still others benefit from fair trade arrangements (Page and Slater 2003). In Brazil, larger supermarket chains already account for about 50% of fresh fruit and vegetable retail, compared to 9% in Chile and 30% in Argentina and Mexico. In addition, growers have not benefited from protected markets or privileged trade status,

and have had limited participation in fair trade arrangements. Moreover, few (if any) study analyzes the category of medium growers, focusing instead on the dichotomy between large commercial growers and small peasant type farmers.[22]

Table 4. Participation of medium growers across cases

Case - crop	Criteria[a]	Share of medium growers
Santa Catarina - apples[b]	< 40 hectares	30%
Petrolina-Juazeiro - mangos	< 100 hectares	40%[c]
Petrolina-Juazeiro - grapes	< 100 hectares	60%[d]
Rio Grande do Norte - melons[e]	< 300 hectares	27%

Note: These data reflect the percentage of production of each crop that is produced by medium (and some small) growers. For example, medium growers produce roughly 30% of all the apples produced in Santa Catarina.

[a] The cut-offs for grower size are based on Boeing (1998) for SC, Alves da Silva (1996) for PJ, and Gomes (1999) for RN.

[b] Data for 1996 from Santa Catarina State Census, as cited in Boeing (1998), which established the cut-off line between large and medium growers at 1000 tons. The transformation of tons to area planted was based on an average productivity of 27 tons/ha, the average productivity for 1997-1999 for the entire state according to data from FIESC (2001). At 27 tons/ha, 1000 tons is equivalent to 37 hectares.

[c] Data for 2002 from interview with Director of EMBRAPA Semi-Arido.

[d] Data for 2002 from interview with grape consultant in Petrolina.

[e] Data for 1997 as presented in Gomes (1999).

Evidence from my cases suggest that whether or not medium growers are excluded from the market depends not only on the more powerful actors along a chain (including importers, buyers, and supermarkets), but also on the scale and scope of public sector support that facilitated medium growers' participation in these chains in an earlier phase. More recently, as federal and state government support for agriculture declined, medium growers have also benefited from rising (but limited) private provision of agricultural extension and, especially, from technological diffusion through subcontractual ties with grower-exporters and through the continued engagement with ethnic-based production and marketing networks.

[22] Especially true within the literature on non-traditional agricultural exports, which draws heavily from the Central American experience, including Brockett (1997), Carter et al (1996), and Thrupp (1994).

This dissertation focuses especially on how ethnic ties have enabled groups of Japanese-Brazilian medium growers to successfully overcome collective good problems through the formation of cooperatives in SC and PJ, and a marketing group in RN. These growers are former members of COTIA, an agricultural cooperative made up of Japanese immigrants that at one point was the largest agricultural cooperative in Latin America. These are undoubtedly the most cohesive grower groups across my cases, based on an unparalleled collaborative ethic that motivate members to strive for collective quality, share their knowledge, engage with each other, contribute to common good efforts, and refrain from rent-seeking behavior. Although Japanese-Brazilian growers account for at most 15% of total production across the cases, their technological and marketing expertise have generated positive spillovers that extend beyond their communities and benefit the clusters as a whole.

Studies that focus on how ethnic-based social networks impact economic performance are few and generally focus on manufacturing.[23] A major exception is Wells' (1991, 1996) study of Anglo, Japanese, and Mexican growers in California's strawberry industry where she identifies specific attributes of ethnic-based groups that explain variations in behavior and outcome.

Whereas Wells' analysis is focused on three ethnic groups producing the same crop, this study focuses on a single ethnic group across three cases and crops. Two patterns emerge from comparing these groups: First, the Japanese-Brazilian cooperatives are the most well-endowed and well-respected cooperatives in the fresh fruit industry compared to other medium grower cooperatives and marketing groups. And second, an important distinction across between the Japanese-Brazilians and those ethnic groups analyzed by Wells is the extent to which the Japanese-Brazilians generated positive spillovers to other, non Japanese-Brazilian growers. In particular, Japanese-Brazilian growers were the first small growers to produce apples in SC, introduce table grapes in PJ, and carry out field trials in RN; they opened domestic and European markets for the pioneering large firms in PJ and RN; and provided a model of collective action.

[23] These studies stress the power of ethnicity in facilitating cooperative behavior among firms by facilitating buyer-seller linkages (Rauch 1996), the sharing of information (Schmitz 1995), and the pooling of resources to resolve common good problems (Kennedy 1999).

Methodology

My research question naturally lent itself to the use of the comparative case method since I defined, from the onset, the phenomenon being studied (the institutional arrangements used to resolve collective good problems) and aimed to explain the diversity (of institutional responses) within a particular set of cases (Brazilian fruit growers).[24]

Case selection

My choice of cases was driven by my interest in analyzing the different arrangements growers have used to resolve collective good problems and, in particular, the role of public sector support in this process. I therefore chose three comparable cases in the same industry that differed substantially in terms of the public sector support growers received over time.

These three cases share the following common characteristics that make their comparison fruitful, as summarized in Table 5. First, growers in all cases produce fresh fruit for the domestic market and for export to the EU and/or the US. Melon growers export about half of their output, followed by growers of mangos (35%), grapes (11%), and apples (7%).[25] Over half of all Brazilian mango, grape, and apple exports are channeled to the EU, while half of melon exports go to the UK. The US is especially important for mangos (about 25% of Brazilian exports), with only negligible shares in the other crops. Second, commercial (versus backyard) production of these crops began in the mid-1970s, so growers had more than 20 years in which to learn different strategies for upgrading, including to establish their relationship with each other and local support agencies. Third, they all have large, medium, and small growers, allowing a comparative evaluation of how efforts developed by grower organizations and public sector agencies reach different size growers. Fourth, all cases include production by groups of Japanese-Brazilian growers. And fifth, the problems facing the three cases are similar as growers try to upgrade in light of increasing demands from buyers on the one hand, and tighter profit margins on the other.

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[24] See Ragin (1994) for a description of the comparative method.

[25] Year to which data refers and source: apples: 2000 in FIESC (2001); mangos: 1998 in Agland (1998); grapes: 1997 in Agland (1998); and melons: 1998 in Gomes (1999).

At the same time, these cases differ in at least three important aspects. First, growers received very different forms of public sector support over time that ultimately shaped the kinds of institutions that have helped growers resolve collective problems today. In SC, government support was mostly in the hands of the state agricultural agency, ACARESC, which was very active with research and extension, and in facilitating access to credit beginning in the mid 1960s. Fruit production in PJ also emerged as a result of strong political backing at the state level (through the influential Nilo Coelho), but institutionally, it was coordinated by a federal parastatal, CODEVASF, focused on the development of the entire San Francisco River Valley especially during the 1970s and 1980s. CODEVASF provided land, irrigation infrastructure, selection of firms, guidance on what was to be produced, and direct support in the establishment of a grower organization. Unlike SC and PJ, public support in RN was limited primarily to subsidized credit to two very large firms, disassociated from any kind of coordinating agency.

Second, these cases also differ in the nature of the crops produced, with perennial crops in SC (apples) and PJ (mangos and grapes), and an annual crop in RN (melons). This crop based distinction allows for two comparisons. The first between the impacts of annual versus perennial in shaping how growers organize. The second between perennial crops across two cases (SC and PJ), thus having crop characteristics (and their "social nature") constant while comparing the effects of state-level (ACARESC) versus federal-level (CODEVASF) coordinating agencies on how growers resolve collective action kinds of problems.

And third, another major difference is that two cases are in the Brazilian Northeast (PJ and RN) and one in the South (SC), reflecting very different economic conditions as well for different physical characteristics which influence production practices. Compared to the Northeast, moreover, per capita income in the South is over 2.5 times higher, infant mortality rate is less than half that of the Northeast, and illiteracy is one-third that of the Northeast.[26] In addition to the economic disparities between both

[26] All data for 1999 from IBGE. Raw data are as follows: per capita income for the South, US$3730, and for the Northeast, US$1448 (converted from 1999 Brazilian reais); infant mortality rate (deaths per 1000 life births) for the South, 21, and for the Northeast, 53; illiteracy rate (percentage of population over 15 years of age that cannot read or write) for the South, 8, and for the Northeast, 27.

regions, these regions differ physically, the Northeast region of PJ and RN being mostly semi-arid and the South temperate. This means that crops in the Northeast can only be produced under irrigation because of the scarce and erratic rainfall patterns in that region; apples in the South are not irrigated and rainfall is adequate. This implies that access to irrigation infrastructure is a critical factor determining who enters these markets in PJ and RN, but is not an issue in SC. These differences are summarized in Table 5.

Table 5. Similarities and differences across cases

Similarities	Differences
- Produce fresh fruits	- Early government support: state agricultural agency in SC, federal parastatal in PJ, no such coordinating agency in RN
- Export to EU and/or US	
- Began production in late 1970s-early 1980s	- Nature of crops: perennials in SC and PJ, annual in RN
- Consist of large, medium, and small growers	
- Include former members of COTIA, agricultural cooperative formed by Japanese immigrants	- Location: PJ and RN in Northast, SC in South
- Face similar set of buyer-driven demands	

Case studies

In order to look for patterns that may run across these cases regarding the institutions growers create or draw upon in their efforts to upgrade, I developed detailed case studies, life histories of growers, and of their relation to government agencies and global buyers.

The majority of my data came from over 210 semi-structured, open-ended interviews with growers, researchers and administrators from the Brazilian Agricultural Research Agency (EMBRAPA) and the Santa Catarina State Agricultural Agency (EPAGRI), state agricultural officials and technicians, the San Francisco River Valley Development Agency (CODEVASF) administrators, Bank of the Northeast (a regional development bank) rural credit officers, input suppliers, agricultural consultants, and

university professors in these cases over nine months between 1997-2002.[27] I also interviewed US Department of Agriculture (USDA) technicians in Washington, DC and inspectors in Petrolina, and importers of Brazilian fresh fruit in the UK and Rotterdam.

Selection of people to interview

In aiming to have a representative sample of growers, selection was based primarily on size (from the largest firms to smaller growers) and years in the sector (pioneers and later entrants). Substantial time was dedicated to interviews with four particular kinds of growers: 1) the pioneering firms – those that first produced fruit crops across the cases – to understand the incentives and constraints shaping the industry in its formative years; 2) leading medium growers in terms of production and marketing structure to understand their trajectories in the sector; and 3) specifically within medium growers, those belonging to Japanese-Brazilian based cooperatives to understand how they have excelled in both production and marketing relative to other medium (and even some larger) growers; and 4) small growers to understand why some managed to expand into medium growers and others not.

I also selected respondents from the main public sector agricultural agencies across the cases, these being EPAGRI in SC, CPATSA in PJ, and ESAM (an agronomy school) in RN. Within these agencies, the entry interview was generally with the lead crop-based researcher or director, who then pointed to other staff members.

For each case I had key respondents with whom I had multiple meetings. These were among the most knowledgeable and articulate respondents I came across, with 15-30 years of experience in their given sector, very knowledgeable about the technological trajectory and improvements in their sectors, the politics behind certain decision-making by the growers' associations (and lead firms), and willing to meet with me on several occasions. These included the technical directors of two of the largest apple firms in Fraiburgo (one of whom had previously been a research in the state agency, EPAGRI) and an EPAGRI extension worker in Sao Joaquim in the case of SC; a technical director of VALEXPORT and a former director of CPATSA in PJ; and a technical director of the

[27] Of these, I spent 5 1/2 months in Rio Grande do Norte over June-July 1997, January and August 1998, March 2000, and October 2001; 2 months in Santa Catarina during June-July 2001; and 1 1/2 months in Petrolina-Juazeiro between November 2000 and September-October 2001. Interview to importers were done over 4 days in the UK in February 2001 and 4 days in Rotterdam during February 2002.

pioneering firm, two leading medium growers (one of whom also owns a large agricultural input store in Mossoro), and a university professor in RN. These conversations were central in revealing the stories that I would eventually pursue through additional interviews and research. Just as important, they allowed me to crosscheck my information as I proceeded with the research.

Structure of interviews

The majority of interviews were with growers and public sector agricultural research and extension agents (see Appendix C). Interviews were semi-structured and lasted on average two hours. Interviews with growers usually took place on the farms, with some interviews also held in the offices of associations and cooperatives. Interviews with growers often extended entire mornings or afternoons during which I accompanied their activities in the field or pack house, and focused mainly on the origins of the firm, what motivated it to adopt fruit production, how it first established marketing channels, and to what extent and on what matters growers engaged with other growers or public sector agricultural research and extension agencies.

Interviews with agricultural researchers in EPAGRI (SC), CPATSA (PJ), and ESAM (RN) were held at the research centers (and school, in the case of ESAM) and generally focused on two broad issues: the development of production technologies for each crop and the historical relationship between researchers and growers. I aimed to identify key technological improvements and focused on understanding what brought them about, including the development of integrated production practices in SC, a major shift towards fruit research in CPATSA in PJ, and the evolution of irrigation technologies for melon production in RN.

Sample bias

As reflected in the distribution of interviews across cases and professions (Appendix C), I had three times as many interviews in RN (134) as I did in either SC (33) or PJ (43). This reflects that fact that I began my query into Brazilian fresh fruits through RN during my first year as a graduate student at MIT (Gomes 1999), having the opportunity to return there on four occasions over a five-year period. Additionally, there were simply no other studies on RN when I began my research and very few have emerged even since. Absent empirical information on RN, the analysis of that case more

than the others relies almost entirely on my primary field data. I picked up the other cases three years and benefited tremendously from the work of others, especially Octavio Damiani's (1999) work on PJ for that case and EPAGRI's books, papers, and documents on the apple sector in SC (Boneti et al 1999, Hentske 1994, EPAGRI.

Technical and market data

Interviews with growers generally involved a visit to the field and a tour of the packhouses through which explanations about production, quality control and selection, packaging, pest management, and worker supervision were given. Most of the interviews with medium growers were in their offices, generally strategically located to allow continuous supervision of the packhouse. The longer 2-3 hour interviews were especially good opportunities to observe how growers interact with other growers through walk-in visits or phone conversations.

Research on markets involved interviews with European importers of Brazilian fresh fruit, including five in the UK, four in Rotterdam, and a phone interview with an importer in Hamburg. In addition to meeting these importers in Europe and observing how fruits were received and prepared for distribution, I also benefited from meeting with two of these importers during their visits to melon growers in RN, allowing me to observe their direct interaction.

Quantitative data

Production data were mainly obtained from the Brazilian Institute for Geography and Statistics' (IBGE) municipal-level agricultural production database (great, user-friendly database, but limited to 1990-2002), the United Nations Food and Agricultural Organization (FAO) agricultural statistics database (also user-friendly, with data dating back to the 1970s and earlier, but national-level data, which is problematic since crops from my cases represent from 8% [PJ grapes] to 51% [SC apples] of total national production), EPAGRI (SC) and growers' associations (ABPM in SC and VALEXPORT in PJ). Export data from FAO and the Brazilian Secretary of Commerce's online trade database (www.desenvolvimento.aliceweb.gov.br).

Scope and structure of dissertation

This dissertation does not attempt to address all the questions relating to how growers have upgraded to remain in the market. Issues concerning infrastructure (energy distribution, port facilities) and services (transportation logistics, management), although indispensable to growers as they contend with the new market environment, are beyond the scope of my study. I focus almost exclusively on how growers have overcome collective good problems associated with production and marketing.

With this focus in mind, this dissertation is organized as follows: Chapter 2 provides a general description of each case and explains why growers are facing unprecedented competitive pressures. It argues that early government support shaped the organization of growers and consequently, the kinds of institutional arrangements growers could create or draw upon in resolving collective good problems. Chapter 3 extends this early public policy argument by analyzing the development and outcome of public-private collaboration in agricultural research, especially in SC and PJ. Next, Chapter 4 discusses how crop and market characteristics affect why and how growers organize. It argues that crop and market characteristics help explain the "success" of melon growers in RN despite the absence of the kinds of public-private collaboration in agricultural research seen in SC and PJ. Crop characteristics also help explain the varying arrangements between mango and grape growers in PJ. Chapter 5 then focuses on the role of ethnic ties in resolving collective action problems by analysing the case of Japanese-Brazilian growers across the cases. Finally, Chapter 6 summarizes the argument and discusses implications for policy formulation.

CHAPTER 2. GROWERS, THE STATE, AND THE MARKET

Recent explanations of how firms respond to market-driven pressures for cost and quality tend to emphasize growers' relationships with their buyers. The importance of buyers in shaping opportunities and generating constraints for developing country suppliers has been a major contribution of the literature on global value chains.[28] While recognizing the increasing influence of global buyers and supermarkets, this dissertation argues that growers' participation in the market for fresh fruits does not always hinge on the decisions of these global buyers and retailers. Instead, evidence from this research suggests that whether growers can respond to market demands for quality, consistency, and improved varieties often reflects their underlying relationships with each other and with government agencies. More specifically, this chapter argues that early government support directly shaped the organization of growers in each case, their number, their size, and the relationship between them and, consequently, the kinds of institutions growers could create, or tap into, to support their upgrading efforts.

The organization of growers matters in terms of upgrading since upgrading, defined as changes in production and post-harvesting technologies and the institutions to support these innovations, often requires collective action among growers because of scale economies of research, and the shared risks of poor quality control. And, as is well documented, firms in a more horizontal structure of production, with many like-sized firms, are more likely to "share information, form alliances, build trust, and resolve conflicts through negotiations," than are firms in more hierarchical and fragmented networks, where decision-making lay instead in the hands of more powerful firms heading the value chains (Locke 1995:25).[29]

While scholars recognize the importance of egalitarian structures in explaining the likelihood of public-private partnerships, I further argue that the state itself shapes this underlying structure. This argument resonates with Evans' (1996) discussion of the "constructability" of synergy, whereby the state can promote the formation of local ties

[28] See, in particular, Humphrey and Schmitz (2000) and Nadvi and Schmitz (1999).
[29] Locke argues that polycentric systems – characterized by dense networks of associations and interests groups with stronger horizontal ties among each other than vertical ties to the central government – have been especially effective in resolving collective problems compared to more hierarchical or "polarized" systems.

that may facilitate public-private interactions aimed at developmental ends. The difference is my focus on the nature of the structure itself – whether more or less concentrated – in addition to the forms of organizational ties the bind local firms to each other.

This chapter is divided into two sections. The first section analyzes the above proposition above the three cases, aiming to draw out the precise ways early government support influenced growers' subsequent upgrading strategies. Underlying this analysis is a general description of each case aimed at providing the reader with a background for the remainder of the dissertation. The second section then describes whey the pressures to upgrade are so relevant now and less so in the past. In particular, it briefly describes the impacts of macroeconomic changes and the restructuring of food retail in the 1990s on growers and their incentives to upgrade.

Early public sector support and the organization of production

The nature, scale, and scope of early public sector support varied widely across the cases, each leading to a unique organization of production. The different forms of government support and the resulting structure of production are summarized in Tables 6 and 7. The remainder of this section tells each of these stories and their implications for how growers would respond to the wave of upgrading pressures in the 1990s and thereafter.

In SC, the state government aggressively promoted apple production across the state beginning in the late 1960s by facilitating access to credit, agricultural research and extension among growers of all sizes. As a result, the structure of production was almost evenly divided among 10 large firms (52% of output) and about 700 small and medium growers.

In PJ, a federal parastatal established six public irrigation projects in the 1970s and 1980s with areas designated to large firms and small growers, and facilitated access to credit and technical assistance. As will be discussed below, growers in PJ did not initially produce mangos and grapes, but rather tomatoes, onions, beans, and, to a lesser extent, melons. Growers only began producing mangos and grapes towards the mid 1980s and, when they did, larger firms adopted mango production and small and medium

growers grape. The result in reflected in Table 7, where about five mango firms produced 95% of mangos and 40 small and medium growers produced 85% of grapes.

Finally, in contrast, in RN there was no state or federal support similar to that in SC and PJ. Instead, public sector support was mostly in the form of highly subsidized from regional and national development banks (Bank of the Northeast, BNDES) to two very large firms. This lead to a very concentrated structure where two firms accounted for almost all of the state's melon production through the early 1990s and which, moreover, eventually went bankrupt in 2000/2001.

Table 6. Early government support and resulting structure of production across the cases

Case	Form of government support in 1970s-1980s	Structure of production
Santa Catarina apples	The state agricultural agency, ACARESC, collaborated with pioneering firm and promoted apple production among SMEs by providing access to credit, agricultural extension and training, and highly rated apple research system accessible to both large growers and SMEs.	Ten like-sized large growers and hundreds of SMEs began producing during the same period.
Petrolina-Juazeiro mangos and grapes	The federal parastatal, CODEVASF, created its irrigation projects based on a dual structure of production. Large firms received facilitated access to credit; SMEs benefited from irrigation-ready lot, agricultural extension, guidance on what to produce, and support with marketing channels.	The majority of firms and growers in PJ initially produced tomatos, onions, beans, and other annual crops. Mango and grape production began in the 1980s. By the mid 1980s, five large firms produced about 95% of mangos and 40 medium growers produced about 85% of grapes.
Rio Grande do Norte melons	No single government agency coordinated the development of the melon industry. Instead, development banks provided substantial highly subsidized credit to two large pioneering firms. SMEs benefited from piecemeal projects and programs.	Pioneering firms produced nearly 100% of melons up through the early 1990s, when dozens of SMEs began entering the market as large firms began subcontracting.

Table 7. Estimated number of growers and share of production by size, selected years

Case	1980s				late 1990s			
	Large growers		SMEs		Large growers		SMEs	
	No.	Share	No.	Share	No.	Share	No.	Share
Santa Catarina[a]	10	52%	700	48%	14	60%	700	40%
Petrolina-Juazeiro								
mangoes[b]	5	95%	100	5%	30	70%	300	30%
grapes[b]	3	20%	40	85%	25	41%	200	59%
Rio Grande do Norte	3	100%	0	0	6	73%	120	27%

Source: Unless otherwise notes, data on shares of production from Annex A and estimated number of growers based on own fieldwork. Note that numbers of growers are estimates; precise data on size distribution of growers are not available.

[a] SMEs in SC refer to growers with less than 60 planted hectares, as defined by the Santa Catarina census cited in Boeing (1998). Data for 1985 and 1996 from Boeing (1998), data for 1991 from Hentske (1994).

[b] Data for shares of production for 1990s from Alves da Silva (1996); all others estimated from own field work. The estimates for grapes in the 1980s, for instance, reflects the COTIA members who first introduced and began producing grapes in the mid 1980s.

Apples in Santa Catarina

Santa Catarina was the birthplace for Brazil's apple industry, where today over 700 growers produce 14,000 hectares of apples, accounting for half of national production and 96% of exports, as shown in Table 1.[30] Production in Santa Catarina is spread across two main growing regions centered on the cities of Fraiburgo and São Joaquim (Map 1), as described in Table 8.[31] Both areas have soils and climate favorable for apple production, but differ in their terrain and, consequently, pattern of occupation. Fraiburgo and its surrounding areas have vast expanses of gently rolling hills, allowing for large scale production. The surface in Sao Joaquim, in contrast, is mountainous and rocky, favoring smaller scale production instead.

These cities share the title of "Brazilian Apple Capital" and, since the 1970s, have had in the apple sector their main source of income and employment. Apple production in Fraiburgo contributes roughly 23% of the municipality's revenue and directly employs 38% of its labor force, while accounting for over 60% of the revenues in São Joaquim

[30] According to data from IBGE, average annual production of apples in Santa Catarina between 1999-2002 was 51% of national production.

[31] According to data from IBGE, the municipalities of Fraiburgo and Sao Joaquim account for 42% and 24% of the state's apple production (in hectares planted), respectively. Production in over twenty other municipalities make up the rest.

and surrounding municipalities (Peres and Lacowicz 2001, Globo Rural 1999). The importance of apple production for both cities is also evident throughout its public spaces. Street signs, public phone booths, and trash bins in Fraiburgo are all apple-shaped, while São Joaquim has an enormous concrete apple in its main town square and apple designed benches and planters along its commercial boardwalk.

The state's rise as a major apple producer was a direct result of a deliberate strategy of the SC state government to support the production of apples and other temperate fruits in the state. Several factor contributed to this early support: the SC state government's long-standing commitment to small scale enterprises; its timely search for an agricultural activity to reverse the rural exodus beginning in the early 1960s; and the successful experience of one pioneering firm in Fraiburgo in producing apples.

The state's interest in promoting fruit production emerged as rural-urban migration increased in the state in the 1960s as a result of falling returns from traditional smallholder crops like corn and beans. In response to this situation, the state governor demanded an alternative strategy for small growers in order to reverse this rural-urban migration and strengthen small rural establishments which made up 90% of the state's landholdings.[32] Although the concern over rural-urban migration is typical in the political discourse throughout Brazil, and especially in the Northeast, the commitment of the SC state govenrment was radically different from that of the states in PJ and RN in several ways.

[32] Personal conversation with Glauco Olinger, former president of ACARESC, and Olinger (1996).

Table 8. Basic characteristics of apple production in Fraiburgo and Sao Joaquim, Santa Catarina

	Fraiburgo	Sao Joaquim
Tons produced[a]	231,822	120,420
Area planted (ha)[b]	8,586	4,460
% of total production SC	67%	34%
No. of growers[c]	85	506
<100 tons	69 (1%)[c]	395 (10%)
100-1000 tons	5 (3%)	111 (21%)
>1000 tons	11 (65%)	0
Average area (ha)	77.3	5.9
Range area (ha)	1-3576	1-150

[a] Estimated based on 27 tons/ha, the average productivity for 1997-1999 for the entire state, according to data from FIESC (2001). IBGE data not used for volume because IBGE measures volume of apples produced in number of fruits, not tons.

[b] Area planted is annual average for 1998-2002 from IBGE. Fraiburgo includes Fraiburgo, Agua Doce, Lebon Regis, and Monte Carlo. Sao Joaquim includes Sao Joaquim, Bom Jardim da Serra, Bom Retiro, and Urubici.

[c] Estimate from data available through EPAGRI/Fraiburgo and Boneti et al (1999). Number of growers presented first, followed by share in state production in parentheses.

First, the state's decision to include apples as part of its development strategy was based on the proven success of a pioneering firm in Fraiburgo. This pioneering firm, SAFRA, first experimented, then collaborated with the state in opening its gates to state researchers, eventually donating its plant collection. This kind of relationship between the pioneering firm and the state is strikingly different from those that emerged in PJ and RN.

Inspired by SAFRA's success with apples, in 1968 the SC state government established an uncommonly well-structured program targeted at promoting the production of apples and other temperate fruits. The *Programa de Fruticultura de Clima Temperado* (PROFIT), administered through the state's Association of Credit and Rural Assistance (ACARESC), first mapped out regions within the state apt for fruit production and established several regional technical extension offices. By the mid 1970s, apples accounted for over 70% of the are planted under PROFIT (ACARESC 1977). Through its support, PROFIT enabled small growers to adopt apple production through a combination of support policies for credit, marketing, research, training, and extension.

This early state support was striking in its aggressive outreach and research efforts that established a link between small and medium growers and the state agricultural

agency that persisted well into the 1990s. Beginning in the mid 1960s, ACARESC established extension offices in each of the regions determined favorable for apple production, providing at least one agronomist specialized in temperate fruit production for every 20 growers. This ratio is high compared for example, with that in CODEVASF's largest project (Senador Nilo Coelho) which had an average of one agronomist for every 144 growers during its first four years of operation between 1984-1987.[33] ACARESC also offered training courses and seminars for growers held in ACARESC Training Centers throughout the state, and helped small growers organize into cooperatives that could enable growers to process and market their apples collectively. Even today, growers recognize the effectiveness of this early support in getting them started.

In addition to agricultural extension, the state's agricultural research system also assured that all growers, independent of their scale of production, had access to appropriate public sector research. ACARESC distributed the responsibility and resources for apple research across two state research experimental stations, one near Fraiburgo, and the other in SJ. This structure allowed state researchers to tailor their work to the particular characteristics of each region with differ in terms of climate, terrain, and soils, and to the different varieties, with emphasis on Gala in Fraiburgo, and Fuji in SJ. And since large firms are located in Fraiburgo and small and medium growers are concentrated around SJ, this allocation of research across these two locations had direct benefits easily accessible by each class of grower.

Apple growers also benefited from support through the federal government, which promoted domestic production of apples to reduce Brazil's dependency on imported apples. According to Glauco Olinger, former president of ACARESC, the federal government supported apple production at that particular moment as part of the federal government's broader import substitution industrialization strategy. Brazil in the 1970s was among the world's leading world importer of apples, moslty from Argentina. In 1980, therefore, the Ministry of Agriculture implemented the first of two programs to support apple production, the *Programa Nacional de Produção e Abastecimento de Maçã*

[33] Miranda's (1989) evaluation of the Senador Nilo Coelho project stresses this inadequate coverage by agronomists (p. 50).

(PRONAMA). PRONAMA I (1980-1984) aimed to: a) increase the participation of domestically-produced apples in the national market; b) assure the distribution of domestic apples, increasing its presence in volume and season; and c) progressively reduce apple imports.[34]

Apple growers thus benefited from a targeted federal program, unlike the growers of other crops in PJ and RN, who benefitted from federal support in other ways, including CODEVASF's role in PJ and the subsided credit in RN. PRONAMA did not provide direct credit, but rather structured the lending priorities for the municipalities in which apples were produced, serving as a catalyst for investments in apple orchards. Despite increased domestic production, Brazilian consumers in the early 1980s still preferred the Argentine apples to which they were accustomed. With continued interest in substituting Argentine apple imports, the Ministry of Agriculture implemented PRONAMA II (1987-1990) which included, in addition to production-related measures, guidelines for the establishment of classification and standardization norms. As a result of these policies, apple production almost tripled between the late 1970s and late 1990s, as shown in Table 9.

Table 9. Number of growers and apple production in Santa Catarina, 1970-2000

Year	No. of growers	Total area (ha)
1970	117[a]	n.a.
1977	1207[a]	5,287
1980	1,448	8,031
1990	1,296	13,483
2000	1,600	17,177

Source: 1970, 1977 from ACARESC (1977); 1980 from CEPA/SC as cited in Bleicher (1984); 1990 from Hentske 91991); 2000 from EPAGRI (2001).

[a] These data are proxy since they reflect the number of growers receiving assistance from ACARESC to produce temperate fruits, in general, not just apples. These are reliable proxy, however, since most apple growers counted on ACARESC during these years and apples accounted for over 70% of the area planted under PROFIT during the 1970s.

The growth of the apple sector was based on the dual structure of production the SC State Government supported from early on. As mentioned, large firms were separated

[34] Ministerio da Agricultura 1987 as cited in Dotti Cesa (1998).

by region from smaller growers. Apple production in Fraiburgo dates back to the 1960s when a family of German immigrants, the Freys, took advantage of a federal fiscal incentive program for reforestation (FISET) and planted hundreds of acres of apple trees.[35] Prior to producing apples, the Freys had harvested timber in the surrounding areas of Fraiburgo since the 1940s. They looked to apples as an alternative for the diminishing timber. The Freys, along with two French partners, established the pioneering firm, SAFRA, which subsequently split between the Freys and the French partners into two of the largest firms still in the sector.

The Freys were followed by several other entrepreneurs who established most of Brazil's larger apple firms, as listed in Annex D. The largest of these, Fischer, belongs to an entrepreneurial group which is among Brazil's top producers and exporters of orange juice concentrate. It alone produced an average of 20% of the state's annual apple production between 1990-1999, reaching 30% of the state's apple production in 1999. The two firms that emerged out of SAFRA, together with Fischer, account for about half of state level production. The other firms in Fraiburgo make up about 30% of state production.

Whereas European immigrants pioneered apple production in Fraiburgo, Japanese immigrants led the process in São Joaquim. These Japanese were members of the large Japanese agricultural cooperative COTIA, established by 70 Japanese immigrants in Sao Paulo in 1927.[36] As COTIA expanded - by 1957 it had 5,000 members – it established a system of Grower Groups (more popularly know as "colonies") which it supported throughout Brazil.[37] Interested in expanding into apple production, COTIA sent several scouts to Santa Catarina in the early 1960s to investigate the best region for apple production and in 1964 established a colony of six families in São Joaquim. Unlike their European counterpart in Fraiburgo who at the time were already highly capitalized through their timber industry, COTIA growers arrived in São Joaquim with very little capital and old machinery. In their favor, they had COTIA as guarantor for bank loans, access to well established COTIA marketing channels and brand name recognition, and

[35] See Freitas (1978).
[36] Japanese farmers first migrated to Sao Paulo in 1908 as a result of an accord between the state of Sao Paulo and the Japanese Government and initially worked across the state's coffee plantations (Marcovitch 1996).
[37] See Marcovitch (1996).

an ethnic-based work strategy that enabled this group of growers to succeed even once COTIA shut down in 1994.

Other small growers, with the support of ACARESC, followed the example set by COTIA in SJ. The better off among these smaller growers are agronomists or agricultural technicians and belong to one of three main grower cooperatives or have established long term working relationships with one of the firms that subcontract production from São Joaquim. These growers tend to have apple production as their only activity, produce among the best quality apples in the state, and have strong informal ties with other growers and public sector researchers and extension workers. Alongside these are hundreds of growers who produce a couple hectares of apples and have other fruit crops and small animals.

The SC state, supported by the federal government, thus transformed the landscape throughout the regions surrounding Fraiburgo and São Joaquim through its targeted support in promoting apple production. More than a catalyst, the state propelled the production of apples and other temperate fruits among smaller growers, while also continuously interacting with larger growers, paving the way for the dual structure of production which remains up to today, with larger growers concentrated around Fraiburgo and small and medium growers in SJ. Despite falling support over the years (as discussed in Chapter 5), this early period established ties that have persisted well into the present.

Mangos and grapes in Petrolina-Juazeiro

PJ is Brazil's largest fresh fruit cluster, situated in the heart of the semi-arid Northeast region, characterized by recurring drought-related social and economic maladies.[38] The bordering cities of Petrolina (in the state of Pernambuco) and Juazeiro (in the state of Bahia) are divided by the San Francisco River, the largest and only perennial river in the Northeast, and are the center of an area covering about 20,500 square miles (Map 1).[39] Prior to the introduction of irrigation in the 1970s, this area was best known as a commercial entrepot and for its traditional industries of leather, plant-

[38] See Carvalho (1988), Hirschman (1963), and Kutcher and Scandizzo (1981) for the impacts of droughts in the Northeast.

[39] This region includes the municipalities of Petrolina, Santa Maria da Boa Vista, and Lagoa Grande in the state of Pernambuco, and Juazeiro, Curaçá, Casa Nova, and Sento Sé in Bahia.

based chemicals, and minerals, while its agriculture consisted mostly of onions and other rainfed crops. The advent of irrigation first allowed growers to complement rainfed crops with a mix of irrigated annual vegetable crops, then subsequently with permanent fruit crops, especially mangos and grapes (Alves da Silva 1996). Today, the production of mangos and grapes alone employ over 29,000 workers in producing 90% of Brazil's mango exports, and 30% of its table grape exports (see Table 1).[40]

The booming fresh fruit cluster in PJ is the result of support by the San Francisco River Valley Development Agency (CODEVASF), a parastatal dedicated to the promotion of navigation, irrigation, agricultural and industrial development in the San Francisco River Valley.[41] In PJ, CODEVASF expropriated land and implemented six projects in PJ containing lots ranging from 6 to 200 hectares, covering a total of 38,000 hectares (CODEVASF) to be distributed to small and large growers. CODEVASF built the irrigation infrastructure to channel water from the Sobradinho Dam to each individual lot, hand-picked who would produce, facilitated credit to get production started and, for small growers, also facilitated their initial access to the market.[42] In addition, CODEVASF supported the creation of a grower association, VALEXPORT, which remains the strongest voice for growers in PJ, as discussed below.

As did ACARESC in SC, CODEVASF thus established a structure of production based on many like-sized large firms and hundreds of smaller growers. The nature of these early growers in PJ and the support they received, however, differed substantially from that of growers in SC in ways that had lasting impacts on how growers in both cases upgraded later on. Without exception, all of the larger growers in PJ were from outside PJ, in contrast to the pioneering apple firms in SC that had been established in the local economy since the 1940s. Once CODEVASF established its projects, it sought out entrepreneurs who would invest in large scale production (100-400 hectare farms) in the

[40] Data from Damiani (1999). Employment figure for 1996, export figure for 1997. Other employment estimates range from 33,121-42,666 direct jobs and 46, 169 indirect jobs associated with irrigated agriculture (small growers 1999).

[41] See Chapter 2 in Damiani (1999), "An Overview of Early Government Supports," for a discussion of the role of CODEVASF in the development of the San Francisco River Valley.

[42] This was especially so for tomato growers. In return for subsidies, CODEVASF obliged the tomato pulp processing firms to source locally from growers in the irrigation projects.

region and provided them with subsidized land,[43] access to irrigation water channeled from the San Francisco River, and subsidized water fees. These growers belonged to economic groups mostly from Sao Paulo, and from the capitals of Pernambuco and Bahia, that had investments in sectors as diverse as construction, engineering, metalworking, and banking. Among them were politically influential businessmen, including the brother of a state deputy who became a leading force in organizing exporters and representing them before government agencies.

This group of firms is credited with having introduced new crops and technologies necessary to produce them, along with the domestic and export marketing channels, supporting the transformation of agriculture in PJ (Damiani 1999). By the late 1980s, each of about 15 firms produced anywhere from 100-450 hectares of mango. Mango exports were concentrated in about 10 of the largest firms, with five of these having the necessary post-harvesting infrastructure to export to the US, Brazil's main market.

As outsiders moving into newly opened irrigation projects in the semiarid Northeast in the late 1970s and early 1980s, these firms benefited from substantial public sector incentives with credit, infrastructure, and so forth. The pioneering firm in SC, in contrast, were from Fraiburgo and had already begun producing apples even before the state government began its support of the apple industry. The state did not need to attract large firms in SC; rather, it was the pioneering firm in SC that first guided the state in its support of the industry by sharing with the state its research findings the proving the viability of apples in the state.

Similar implications also hold for small growers across these cases. In PJ, CODEVASF "colonized" its irrigation projects by providing roughly 1,500 small growers with irrigation-ready lots (with on-farm pumps, canals, and drainage system installed and ready for use), training in crop and irrigation technologies, and agricultural extension. CODEVASF initially encouraged small growers to produce tomatoes, and to facilitate this process, it enlisted several tomato pulp processing firms to the region, all obliged to purchase their tomatoes locally. Although the majority of these small growers

[43] Government incentives for large farms in Petrolina-Juazeiro included subsidizing 50% of their irrigation infrastructure and assuring investment capital for the remainder 50% through the Bank of the Northeast and the Bank of Brazil (Damiani 1999).

were locals, they were generally new to irrigated agriculture, its technologies, and markets. The tomato pulp processing industry eventually shut down in the early 1990s and, with them, went most of the small growers in the projects who never manged to diversify beyond tomatoes. In SC, the state promoted apple production among small growers that had already been in agriculture, many even producing other temperate fruits.

The one group of small growers that produced fruits in PJ from early on was that of COTIA growers. Thirty-five growers had on average 21 irrigated hectares – twice as much as most small growers yet only a fraction of the large firms' landholdings. What differentiated COTIA from other growers was their collective nature, where together they produced and marketed, counting on their well established Sao Paulo-based network of agronomists and market specialists.

In sum, CODEVASF (a federal agency) molded a dual structure of production in PJ similar to that which EPAGRI (a state agency) supported in SC. Yet early state-grower relationship across these cases differed in important ways. In SC, the state government agency, ACARESC, coordinated the development of the apple industry, while the federal parastatal CODEVASF did so in PJ. ACARESC worked closely with the pioneering firm in early apple research in SC; CODEVASF, in turn, had to provide incentives for large firms to move to the region and begin production. ACARESC emphasized agricultural extension and research from early on, providing the basis for institutions that would sustain the sector's growth over time. CODEVASF also coordinated agricultural extension and research, but its main focus was heavy-duty irrigation infrastructure and tax incentives for colonization of its projects. And finally, ACARESC facilitated apple production by small growers alongside larger growers, while CODEVASF promoted a different mix of crops among larger growers and small and medium growers. These differences had implications for the formation and outcomes of public-private partnerships (Chapter 3) and the possibility of medium and small growers to participate in the fresh fruit industry (Chapter 5).

Melons in Rio Grande do Norte

Also in the semi-arid is Brazil's main melon producing cluster, located in the state of RN. The production of melons in Rio Grande do Norte is concentrated in the

northwest municipalities of Mossoró and Barauna, with some production also in Assú, Carnaubais, and Ipanguaçu (Map 3). The introduction of melon production transformed the income generating activities of many rural communities in the region by complementing the traditional production of livestock, cotton, corn, and beans. Today, melon production employs about 14,000 workers,[44] accounting for about 40% of Brazil's melon production and 70% of its melon exports in 2003,[45] as shown in Table 1.

In contrast to the concerted government support via EPAGRI in SC and in Petrolina-Juazeiro through CODEVASF, government support in RN was instead limited to the more conventional provision of highly subsidized credit during the 1980s, a reflection of the regional development strategy undertaken by SUDENE, the BNB and Bank of Brazil.[46] Although firms in the other cases also benefited from subsidized credit when they began producing, the form in which this credit was allocated in RN led to a very different structure of production. Instead of a deliberate policy promoting a dual structure with growers large and small, SUDENE, the Bank of Northeast, and the Bank of Brazil channeled credit to two very large firms. As a result, while CODEVASF reduced the possibility of land concentration by establishing limits to land size, inducing the creation of several 100-200 hectare firms, with only a few larger firms (with up to 400 hectares), these federal agencies created a highly concentrated structure in RN.

The pioneering and largest firm in RN grew as a result of these targeted subsidies and also by FISET, the same federal government program to support reforestation of

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[44] The association of fruit growers in RN, PROFRUTAS (1996), estimates that one hectare of melon generates three direct jobs per year and two indirect jobs per year. Therefore, based on an annual average of 4,544 planted ha in RN between 1998-2002, approximately 13,632 people are directly employed in melon production and 9,088 are indirectly employed. These estimates are consistent with Pedrosa's (1991) estimate that in 1991 the melon industry generated between 15,000 and 20,000 direct jobs. Indirect jobs associated with packaging, marketing, transportation, and input providers would have further increased Pedrosa's estimate. I do not know, however, what share of these workers (in my own estimate as in Pedrosa's) is permanent or seasonal.

[45] According to data from IBGE, the average annual share of melons produced in RN in total melon production in Brazil between 1997-1999 was 39.8%. Export share from own fieldwork, as presented in Gomes (1999).

[46] In the case of the western municipalities surrounding Assú, growers also benefited from the construction of the Armando Ribeiro Dam. The majority of melon production is concentrated around the eastern most municipalities in the state, around Mossoró, where irrigation water is drawn from underground aquifers and not from the dam. It's important to note, however, that DNOCS did not build the dam as part of a strategy for irrigated agriculture. Instead, it built this dam as part of its broader strategy to distribute water through the semi-arid Northeast. Without it, however, irrigation in Assú would have remained limited to the Assú River banks, prone to periodic flooding.

native species that favored the pioneer apple growers in SC. MAISA used FISET to purchase its lands, covering over 30,000 hectares across the Rio Grande do Norte and Ceará border, on which it planted cashew trees, among the accepted crops under the FISET program. It only switched to melon after the 1983 drought, when it lost much of its cashew production.[47] At its peak in 1997, it produced 2,500 irrigated hectares of melons, representing 56% of the total area planted with melons in RN (4,741 ha) and an estimated 18% of total area planted with melons in Brazil (13,715 ha), over six times as much as the irrigated area in the largest firm in PJ (see Annex D). This in addition to hundreds of hectares of other fruits, including acerola, mango, dwarf cashew, grapes, passion fruit, and twenty other crops, a cashew nut processing plant (which employed up to 500 workers), and a fruit pulp processing facility.

In addition to generous sums of subsidized investment credit from development agencies and banks, MAISA also diverted funds for collective goods to private goods. In the late 1980s, it convinced the federal government to build a public housing project within its properties: the 600-house complex, originally destined for the city of Mossoró (about 25 miles from MAISA), sits near the front gates of MAISA, facing RN's main interstate. MAISA touts the village as one of the many ways it looks after the welfare of its workers. Critics cite it as one of the many ways MAISA bribed the state. Likewise, individuals familiar with the early years of the cluster claim that MAISA only discovered it was sitting atop a large aquifer when the Brazilian Petroleum Enterprise (Petrobras) drilled several deep (700-1000 meters) wells throughout its properties in search of oil. Instead of oil, Petrobras tapped the aquifer which enabled MAISA to irrigate. Until then, it had depended on the region's sparse and erratic rainfall, allowing it to produce cashews, but not melons.

Inspired by the early success of MAISA, an entrepreneur from Sao Paulo bought 10,000 hectares in Assú when the federal government was just about to complete the construction of the Engenheiro Armando Ribeiro dam. He began producing melons and became the second largest grower in the state, FRUNORTE, eventually producing up to 900 irrigated hectares of melons, in addition to mangoes and hearts-of-palm.

[47] The firm decided to focus on melons because several varieties of the melon family (*concurbitacae*), such as pumpkins and squash, grew naturally in the Mossoró region, reflecting the region's national endowment for melon production.

These pioneers tested new varieties of melons and learned the best production practices for the local conditions, established domestic and export channels, and built a recognized name for locally produced melons. These early investments undoubtedly explain the subsequent growth of this cluster since these pioneers proved the viability of melon production and trained hundreds of workers that subsequently created a labor force skilled in the production of melons. Their success in terms of producing and exporting melons attracted other firms and growers to invest in melon production in the region.

MAISA and FRUNORTE, however, in no way directly facilitated the entrance of other growers into the sector, like did SAFRA in SC. It was only beginning in the mid 1990s, as they both faced mounting financial burdens, that these firms increasingly turned to subcontracting production from small and medium growers. These included growers from the Mossoró region, neighboring states, and from São Paulo. Those from the region previously produced other crops, were involved in other agricultural related businesses (input stores, marketing), or worked as agronomists for the lead firms. Outsiders moved to the region specifically to produce melons drawn by the success of the leading firms. Most of the medium growers are trained agronomists, many with university or technical school degrees, who make all the production decisions and monitor and supervise the entire production process themselves.

Medium growers also included at least six Japanese-Brazilians (*nissei*) that moved from São Paulo to produce melons in Mossoró. The first *nissei* moved to Mossoró in the late 1970s to experiment with melon production in MAISA. Although his ties with MAISA were short-lived and he returned to Sao Paulo, his son remained in Mossoró and worked at the Fazenda São João from 1981-1990, leaving then to start his own farm. This *nissei* subsequently helped at least two other *nissei* farmers settle in the region by first allowing them to work on his farm and, with the collapse of COTIA in 1994, other nissei moved to RN to pursue melon production.

Moreover, where the pioneering firm in SC encouraged the state to support apple production among smaller growers, and in PJ they formed VALEXPORT, the pioneering firms in RN in no way facilitated inter-firm relations that could benefit the entire cluster. To be fair, these firms were key in first attracting ships to the port of Natal and, at one point, organized a short-lived shipping pool. In addition, they collaborated in creating

and maintaining the fruit fly monitoring program, COEX, and the growers association, PRFRUTAS, as demanded by the USDA. But, as discussed in Chapters 3 and 4, these organizations were neither as representative or as effective as grower organizations in SC and PJ.

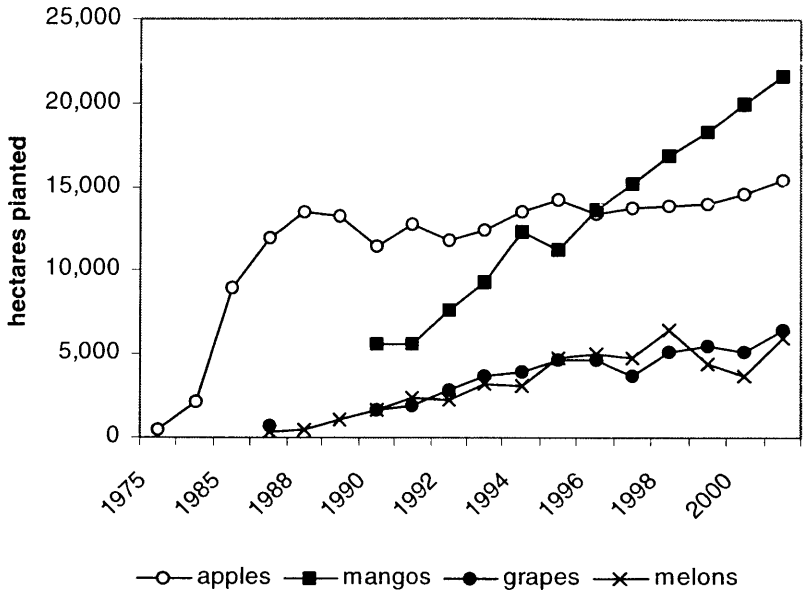
To summarize, in contrast to the concerted federal government support in PJ which included support with infrastructure, credit, mediation among growers, and research and extension, public sector support in RN was mostly limited to highly subsidized credit channeled to a few large growers. These firms undoubtedly paved the way for what eventually became a cluster of melon firms. However, the concentration of production between two very large firms was not conducive to collaboration among growers, leading instead to a fragmented and weak sectoral association, and comparatively limited public-private partnerships.

Rising volumes, falling prices, and the supermarket revolution

Production across the cases gradually increased since the early and mid 1980s (Figure 1). By the early 1990s, growers had well-established production technologies, domestic and export marketing channels, and a network of input suppliers. Yet Brazil's economy underwent several major events in the 1990s that radically transformed the scenario in which growers operated, including increased liberalization, the 1994 Real Plan, the 1999 crises, and the increased consolidation of food retail. The causes and consequences of these events are analyzed elsewhere.[48] Here I simply summarize the main impacts of these events on fruit growers in terms of production, exports, and prices, and ultimately their incentives to collaborate with each other and with public sector agricultural research agencies in their efforts to upgrade.

[48] Rigolon and Giambiagi (1999) present a succinct description of these macroeconomic events and Langley (2000) and Langley and Bolling (1999) discuss their implications for Brazilian agriculture. Farina (2002) and Reardon and Berdegué (2003) describe the consolidation of food retail in Brazil.

Figure 1. Area planted with apples, mangos, grapes, and melons across the cases, 1987-2001



Source: IBGE, except for the following: apples 1975-1989, estimated from data on tons produced from FIESC (2001) and average tons/ha for 1988-1990 (17 tons/ha) from Boneti (1999); grapes 1987 from Alves da Silva et al (1996); melons 1987-1989 from Carraro and Cunha (1994).[49] Data is for state level. This means that mangoes and grapes in PJ represent the aggregate values for the states of Pernambuco and Bahia.

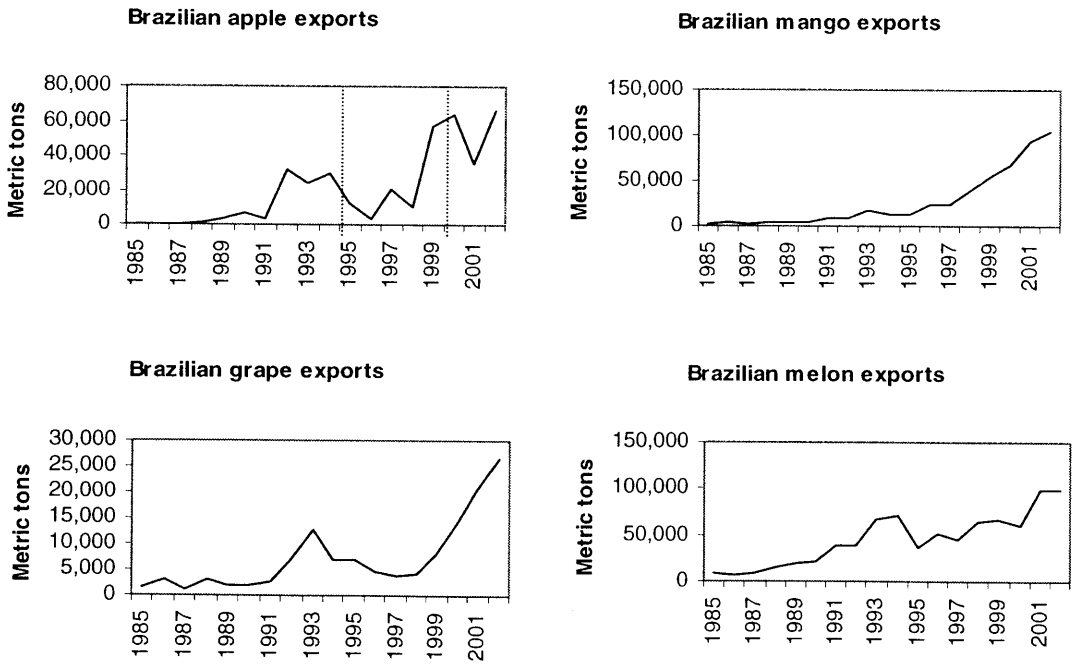
Following a decade of hyperinflation, modest growth rates, and falling rate of investment, the federal government implemented the 1994 stabilization plan (*Plano Real*), based on the introduction of a new currency, the *Real*, along with an exchange rate anchor to stabilize the *Real* with respect to the US dollar that led to an appreciation of the Brazilian exchange rate by over 30% between 1993-1996.[50] Brazilian goods thus became costlier abroad and imports cheaper. As a result, fruit exports were constrained, while imports soared, as shown in Figures 2 and 3. Rising fruit imports meant greater competitive pressures on growers. Consumers accessed to a wider variety of and higher quality fruits at competitive prices, raising consumer awareness of and demand for better quality in the domestic market as well (Albuquerque 2001).

[49] Data is for state level. This means that mangos and grapes in PJ represent the aggregate values for the states of Pernambuco and Bahia.

[50] See Homen de Melo (1997).

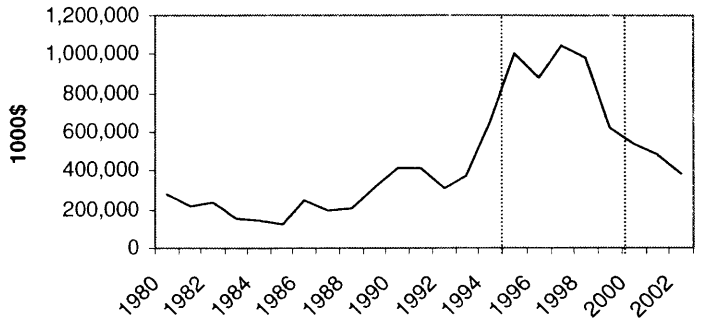
The unfavorable market situation facing growers was somewhat reversed in early 1999, when the federal government devalued the *Real* in an attempt to revert capital outflow associated with the international financial crisis that began in Thailand in 1997 and subsequently spread to other countries. The devaluation in early 1999 improved the competitiveness of fruit exporters by giving growers higher prices in terms of the *Real* abroad, inducing growers to increase production and exports, and raising the prices of imported fruits, thus reducing the volume of fruit imports (Figure 3). However, increased production over the years was accompanied by a generalized fall in domestic and export prices. This downward trend in prices has persisted until now, as shown for mangoes, melons, and grapes in Figures 4 and 5. By the late 1990s, growers thus had increasingly tighter profit margins, and unprecedented pressured to improve their efficiency.

Figure 2. Brazilian exports of apples, mangoes, grapes, and melons, 1980-2001



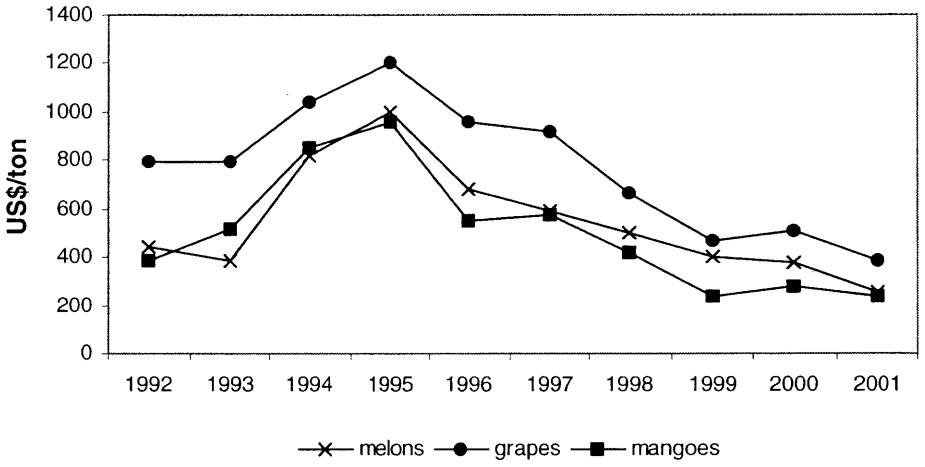
Source: FAOStats

Figure 3. Brazilian imports of fresh fruits and vegetables, 1980-2001



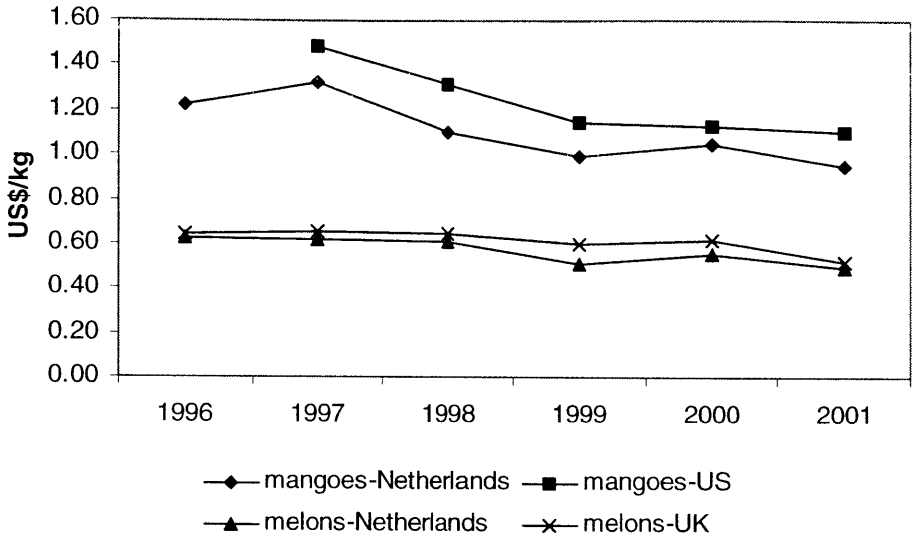
Source: FAOStats.

Figure 4. Average domestic annual prices for melons, mangos, and grapes, 1992-2001



Source: These data reflect average annual prices for fruits sold at CEAGESP, Brazil's largest wholesale fresh fruit market, as listed at www.irrigar.org.br [accessed 7/18/03]

Figure 5. Export prices for Brazilian mangos and melons in selected countries, 1996-2001



Source: COMTRADE

In addition to the rising pressures for greater efficiency, the 1990s also brought mounting norms and standards by which growers need to abide, a direct result of the global restructuring of food retail. Food retail is much different today than that which prevailed when growers first began producing as global retailers have gradually substituted national retailers and local vendors. This process has been especially rapid in Latin America, where the consolidation of food retail in the past decade mirrors that which occurred in the United States over a period of five decades (Reardon, Timmer, and Berdegue 2003). In Brazil, this process picked up following the stabilization plan of 1994 when foreign direct investment by multinational supermarket chains, including Carrefour, Ahold, and Walmart (Farina 2002). As a result, the share of supermarkets in national food retail increased from about 30% in 1990 to 75% in 2000 (Reardon, Timmer, and Berdegue 2003). For fresh produce in particular, supermarkets in Brazil now account for about 50% of national sales (Reardon, Timmer, and Berdegue 2003).

The restructuring of food retail has been accompanied by an increase in buyer-driven standards as large retailers seek to differentiate their products on the basis of quality and consumer safety, thus generating additional sources of rent (Reardon and

Farina 2001). This product differentiation has led buyers to gradually shift from demanding product quality standards alone, to also imposing a series of process standards (Reardon et al 2002).

The rising competition in the fresh fruit industry and the need to impose these norms and standards has meant a changing relationship between growers and buyers. Whereas previously this relationship was generally segmented with an intermediary, retailers are increasingly shifting away from middlemen and wholesalers to alternative, more direct forms of procurement. These alternative strategies include formal and informal contracts directly with growers and the establishment of their own distribution centers, practices which allow the supermarkets greater leverage in enforcing their quality and safety norms and standards (Farina 2002). All of this means that growers must now be much more than just price-competitive – they must now meet the mounting demands for better fruits, "better" being whatever the supermarkets define as better: varieties, production methods, postharvesting technologies, packaging and labeling specifications, and acceptable environmental impacts and working conditions.

In addition to conforming to norms and standards imposed by foreign buyers, importing country regulations and standards which have also been on the rise in the 1990s. Aside from the standard regulations on minimum requirements (appearance, texture, cleanliness, etc), classification (Class I, II, etc), presentation (uniformity, packaging), labeling (identification, specifications, etc), and maximum allowable levels of pesticide residues, both the EU and the US have imposed more norms to which growers have had to respond by adjusting their production and post-harvesting technologies. Particularly important for my cases was the EU's introduction in 1993 of a program to harmonize maximum pesticide residue levels (MRLs) on food sold in the EU and their announcement that it would only import fruits that were produced under integrated production practices.[51] Brazilian growers of fresh fruit have thus been living a

[51] Integrated production is defined as the "economical production of high quality fruit, giving priority to ecologically safer methods, minimizing side effects and use of agrochemicals, to enhance the safeguards to the environment and human health" (www.iobc.ch). In practice, integrated production entails continuous monitoring of plant health as the basis on which agrochemicals are then used. This implies a more targeted and reduced use of agrochemicals compared to the conventional methods where growers would apply x or y chemical on day z of the production cycle.

scenario of higher production, lower prices, increased competition, and rising demands from buyers and industrialized country governments.

The next three chapters analyze the institutions growers have created or counted to resolve collective good kinds of problems associated with the new market environment. More specifically, Chapter 3 examines the varying role of public-private partnerships in helping growers upgrade, especially in SC and PJ. Chapter 4 then explains how the nature of the crop also influences these arrangements. Finally, Chapter 5 focuses on how medium growers have overcome these problems, especially the influence of Japanese-Brazilian ties in this process.

CHAPTER 3. UPGRADING THROUGH PUBLIC-PRIVATE PARTNERSHIPS

Increased competitive pressures have generally raised Brazilian growers' interest in and committed to collaborating with public sector agricultural research agencies in resolving research-based problems. Meanwhile, in seeking to improve the efficiency and effectiveness of public sector agricultural research, the Brazilian federal government has instituted competitive grant programs and other funding mechanisms that promote partnerships between government researchers and growers, where both collaborate in defining, executing and funding research. Despite the well-accepted notion of the state's importance in promoting innovation in agriculture and increasingly through partnerships with growers, the actual process leading to this greater public-private interaction is rarely analyzed nor are the conditions under which this public-private collaboration is more likely to occur or be constructive and inclusive. [52]

This chapter analyzes the formation of public-private partnerships across the cases, explaining how, in light of very similar circumstances of tightening market pressures and changing public sector funding, they vary so much in terms of what they accomplish and whom they benefit. In comparison to the more conventional way governments have done research, public-private partnerships are more consultative and growers actually contribute to funding public research either via contributions to their sectoral association, which are then passed on to public sector agricultural centers and researchers (as happens in ABPM in SC) or in-kind contributions such as land, inputs, and labor to carry out field operations in experimental plots.

In principle, the government's new funding mechanisms based on public-private partnerships should increase the effectiveness and efficiency of public research. These gains are achieved by involving growers in the defining the government's research agenda, making it more applicable and useful for growers, while at the same time providing additional funding for public sector agencies. [53] There are, however, at least two problems with this logic.

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[52] I raise the issue of a constructive and inclusive public-private partnership in light of Tendler's (1999, 2001b, 2001e) work questioning the assumptions behind the growing interest in these kinds of relationships between the private sector and the state.

[53] See Alston, Pardey, and Roseboom (1998) Echeverría (1998), and Portugal and Contini (1997).

First, this effectiveness is based on the assumption that the private side of these partnerships, in this case the grower associations, are actually representative of a majority of growers involved in a given activity. While these associations may in effect represent the majority of volume produced, they do not always reflect the voices (and therefore needs) of the majority of growers.[54] In fact, powerful grower associations may even crowd out public sector support for segments of smaller, less powerful growers, who could potentially benefit relatively even more from public sector support because of their difficulty in coping with global buyer driven demands (Tendler 1999, 2001e). These new funding mechanisms may even worsen this crowding out problem since they essentially increase the attraction of public sector agencies to larger, more modern firms which are more likely to secure funding for public research than the medium-sized newcomers.[55]

And second, the efficiency expected from these partnerships assumes that public sector research will have the ability to continuously move its knowledge frontier, helping growers resolve problems that tend to become more complex and costly. However, since these partnerships pressure the state to pursue short-term problem-oriented research almost exclusively, longer-term basic research tends to be marginalized, much of what may be needed for innovations down the road (Jarvis 1994, Echeverria et al 1998, Alston and Pardy 1999).

In practice, these alternative mechanisms for funding research have had mixed outcomes, ranging from the strengthening of public sector research capabilities and to successful implementation of new laboratories and improved fruit research, to accusations of corrupt misallocations of funds implicating public officials and grower associations alike.[56] In the least, this mixed experience reflects that the effectiveness of these grant programs in fostering public private partnerships depends on 1) the mission and structure of the public sector agricultural research agency in each case that makes it more or less responsive to these changes in incentives to forge closer relations with the private sector, and 2) the representation, transparency, and accountability of growers'

[54] See Biggs and Smith (1998), Locke (1995), and Tendler (1999).
[55] Tendler (2001e) notes a similar attraction between professionals in training and technical assistance centers, including agricultural research and extension workers, to their more "modern" clients.
[56] See CNPq (1995) for a general listing of BIOEx projects and ESAM/NEP (2000) for a listing of such projects in RN. Despite these achievements, several sources reported how officials from the Ministry of Agriculture and several growers' association, including VALEXPORT and PROFRUTAS, misallocated research funds.

associations, which holds the public sector agency and its members accountable for the appropriate use of these funds.[57] The effectiveness of these associations, in turn, reflects the extent to which the lead firms in each cases deliberately generate positive externalities that benefit other growers in the sector, including lobbying of public sector support for infrastructure, credit, research, and other ways that reduce the risks and costs associated with adopting fruit production.[58]

The stories that emerge from my cases vary both in the process of building of public-private partnerships and their outcomes. I label the formation of public-private partnerships as collaboration "by design" in Santa Catarina (SC), "by coercion" in Petrolina-Juazeiro (PJ), and "almost by accident and ad hoc" in Rio Grande do Norte (RN). That is, public-private collaboration in SC today is the result of the state's deliberate approach to apple research over a period of three decades which relied heavily on continuous interactions between researchers and growers. Apple growers, in turn, have been effectively organized through the Brazilian Apple Growers Association (ABPM).

In PJ, I label this interaction "by coercion" to reflect how greater public-private partnerships emerged as a result of strong lobbying by the growers association, VALEXPORT. In this case, the main source of agricultural research for growers is CPATSA, one of EMBRAPA's 37 centers and units, located in Petrolina. In the late 1990s, VALEXPORT successfully pressured EMBRAPA to substitute CPATSA's former director with one more supportive of fruit production. Although the process is richer than that captured in one single event, I focus on this event since it was a major

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[57] These findings resonate with Hayami and Ruttan's (1985) classical model of technological change in agriculture. They argue that the "dialectic interaction" between farmers and researchers is central in explaining the agenda of public sector research. Moreover, they argue that this interaction is likely to be most effective when farmers are organized into politically effective associations and the agricultural research system is decentralized.

[58] Tendler (2001c) questions the commonly-held assumption that lead firms necessarily support upgrading and suggests, alternatively, that this lead firm impact on upgrading can be quite mixed, with positive effects in one stage and negative in another, or even both positive and negative at the same time. It is in light of her insights that I analyze the impact of the lead firm, trying to understand what makes some lead firms more "developmental" than others. I emphasize externalities that lead firms "deliberately generate" to differentiate them from the kinds of passive externalities that emerge from large-scale production and exports, including a trained pool of workers, attraction of agricultural input stores and services, and the formation of a reputation for locally-produced fruits.

push behind increased public-private partnerships in PJ and also reflects the power of VALEXPORT in influencing policymaking that ultimately impacts the entire cluster.

Finally, RN contrasts SC and PJ in its relative absence of public-private collaboration in agricultural research, limited to a few sporadic and ad hoc projects, combined with a poorly-representative and largely ineffective growers' association. The outcomes of these partnerships vary accordingly across the cases, ranging from a more constructive and distributive pattern in SC, where partnerships have resulted in concrete, tangible improvements in production and post-harvesting technologies that have spread across growers, to a less constructive and more exclusive one in RN, where outcomes have been few and mostly in the hands of a few very large growers.

This chapter is organized as follows. Parting from the premise established in Chapter 1 that growers have faced increased competitive pressures to upgrade their products and production processes, the first section discusses the instances under which growers need to resort to public rather than private research in their efforts to upgrade. The second section then describes the concomitant changes in the state apparatus for research in Brazil, particularly its tendency towards alternative funding mechanisms which draw on greater public-private collaboration. We are thus left with a situation in which public and private agents have greater incentives to collaborate and the institutional means through which to collaborate. Having the incentives and the institutional means for behaving in a particular way does not, however, on their own insure agents will do so. The third section presents the case studies which demonstrate how other factors, especially the organization and political voice of growers, and the nature and structure of the local public sector research agencies, also shape how growers and public sector agencies interact. Finally, the last section discusses the implications of the empirical evidence for the debate on public-private partnerships in agricultural research.

When responding to the market requires public sector support

Growers can upgrade in many ways without any input or guidance from public sector research agencies. Growers can turn to buyers themselves or to importing country governments for information and guidance on the use of particular inputs, production

practices, or post-harvesting technologies. This would be the case when a UK melon importer suggests a new variety for his suppliers to experiment with, or when a USDA field inspector in Brazil recommends changes in the organization of the sorting and packaging system in a packinghouse used for US-bound mangos. In other cases, growers may obtain the necessary skills and knowledge from in-house technical expertise, consultants, local input suppliers, or conversations with each other. Input suppliers across all the cases host numerous seminars and field days to disseminate varieties and agricultural inputs, while the use of consultants by growers, many of them producers themselves, is also prevalent.

There are, however, a host of activities that have public good attributes that demand government support, including adaptive research, biological control of pests and pathogens, and particular improvements in farming practices and management. As such, results from research, once disseminated, become freely available (i.e., nonexcludable), and one grower's use of this knowledge does not reduce its supply to others (i.e., non-rival). Public sector involvement in these activities is also justified on the grounds of risk and uncertainty associated with research, as well as in its economies of scale, both which would keep the private sector from taking on these kinds of activities itself.[59]

Growers across my cases, and especially in SC and PJ, have sought public sector support for a wide range of public good type of activities aimed at upgrading fruits and their production processes, including the following:

- Design and implementation of integrated production, a production method which minimizes the use of agrochemicals by combining traditional (e.g., chemical fertilizers) and alternative production techniques (e.g., use of natural predators) to resolve problems of fungi, insects, and diseases. In contrast to the purely traditional production method, under integrated production, growers only treat their crops when necessary, at the right time, and using the appropriate doses, all based on continuous and detailed field monitoring and evaluation.
- Improvements in production practices, such as floral induction which enabled growers to control the harvest season in SC (apples) and PJ (mangoes). Floral induction in SC enabled apple growers to overcome the problem of variable

[59] See Pray and Umali-Deininger (1998) and Hayami and Ruttan (1985).

blooming by forcing a more homogeneous bloom and, consequently, harvest. In the case of PJ, floral induction enabled mango growers to take advantage of the region's favorable and relatively stable climatic conditions by producing mangos year-round.

- Development of new varieties, including seedless grapes in PJ, which allowed growers to participate in this growing market segment.
- Pest and pathogen control, such as that for fruit flies in PJ and RN, and a fungal disease by the name of black spot or apple scab (*sarna*) in SC. Fruit fly control in PJ and RN depends on a field monitoring program involving growers and public sector researchers. As for the black spot problem in SC, the state established Phytosanitary Alert Stations to inform growers of the probability of the occurrence of black spot, allowing growers to reduce losses through early support.
- Implementation of quality control system for classification and packaging standards in SC.

My analysis focuses on how growers and public sector agricultural researchers collaborated in designing, funding, implementing, and disseminating these kinds of research-based activities. While these challenges increased growers' incentives to seek public sector support, the public sector research itself has undergone a series of changes since the 1970s which have shaped its response to these demands, as discussed below.

The changing state apparatus for agricultural research

The Brazilian public sector agricultural research system is very different today than that which prevailed in the 1970s and 1980s, when these fruit clusters were just beginning to consolidate. This section describes this changing state apparatus and its implications for grower-state relations.

The development of the national agricultural research system as it is today dates back to the 1970s with the establishment of Brazilian Agricultural Research Agency (EMBRAPA).[60] EMBRAPA is the leading public agricultural research agency in Latin

[60] EMBRAPA, in turn, is the product of a long chain of institutional arrangements for agricultural research. Among its precursors, the National Service of Agronomic Research (SNPA) established several research and experimental centers throughout Brazil in the 1930s and 1940s. Another reorganization in the late 1960s led to the formation of the Department of Agricultural Research and Experiment (DPEA), which

America in terms of expenditures, alone accounting for over half of the region's total expenditures by national agricultural institutions.[61] It is roughly the size of the USDA in number of scientists (2,300), 40% of which holds PhDs mostly from US and European universities, and is based on a network of 37 research centers and units spread across the country (Reifschneider and Lele 1998). Among its research centers are the EMBRAPA Tropical Semi-Arid (formerly known as CPATSA) in PJ; the EMBRAPA Grapes and Wine in Bento Gonçalves (CNPUV), Rio Grande do Sul, which does some apple research; and the EMBRAPA Tropical Agroindustry in Fortaleza, Ceará which does some melon research.

EMBRAPA was a product of its time: a centrally planned and managed agency in an era of heavy state support in all areas of the economy. Decisions on what to research, where, and for whom were taken centrally (Silva and Flores 1993). This top-down approach worked well in making EMBRAPA a well-endowed and well-respected research agency, central to much of Brazil's agricultural growth. It established a national research network, trained a cadre of researchers, built research infrastructure, coordinated research nationally, established linkages with extension agencies, and formed institutional ties with foreign research agencies. To date, EMBRAPA has developed a reputable portfolio of technologies, including those for animal feed and production, agroindustry, grains, fruits and vegetables, biological control, natural resource management, and information sciences.[62] In addition, EMBRAPA has been a leading voice among Brazilian researchers focusing on a wide range of areas, including advanced agricultural technologies, family agriculture, food safety, and agribusiness.

According to an evaluation by Beitema, Avila, and Pardey (2001), EMBRAPA's total expenditure more than doubled between the late 1970s and late 1980s, but has fallen continuously since 1996, as presented in Figure 6. This fall in expenditure is reflected in a substantial decline in spending by most EMBRAPA centers. In fact, EMBRAPA's National Center for Soil Research (CNPS) was the only center to have increased its total spending in recent years – expenditures by all the other centers decreased substantially,

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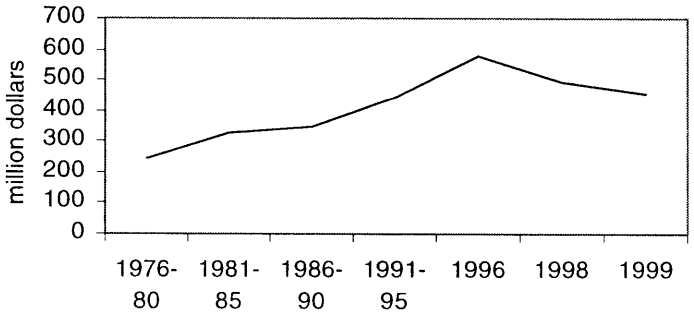
included the establishment of six regional institutes. By the early 1970s, DPEA, now renamed National Agricultural Research and Experiment Department (DNPEA), had altogether nine regional units and 75 experimental stations, all of which were transferred to EMBRAPA upon its creation (Beintema et al 2001).

[61] Estimated from ISNAR data for 1991/1992, as presented in Echeverria (1998).

[62] See www.embrapa.br/english/techno/index.htm for complete portfolio listing.

with several centers down by more than 35% between 1996-1998. EMBRAPA also reduced its financial and technical support to state agencies. In response to these tighter budget constraints, EMBRAPA implemented a series of institutional reforms seeking greater participation of its own professionals in its planning and management, increased interaction with research beneficiaries and partners, and greater efficiency in delivering its goods and services (Silva and Flores 1993).

Figure 6. EMBRAPA's spending on agricultural research, 1976-1999



Source: EMBRAPA and several authors, as cited in Beintema et al (2001:57). Expenditures in constant 1993 international dollars.

At the same time, the federal government devised new mechanisms to secure continued funding for public research, including private funding of public research and public funding of private research through competitive grant funds. The National Research Council (CNPq), in coordination with the Ministry of Agriculture, implemented several competitive grant programs in the 1990s for researchers from state and federal research agencies and universities working on fruit research. These programs included the Biotechnological Program to Support the International Competitiveness of Brazilian Agriculture (BIOEx, 1995) and the Agronegocio (1997), aimed at training and the acquisition of laboratory research equipment, and based on "partnerships" and "joint action" between federal and state governments and especially of sectoral associations. These programs sought to make the private sector "use its political force in defense of the R&D sector, especially in its participation of state and federal budgets which would no longer be exclusive of public sector scientists and researchers" (CNPq 1995).

EMBRAPA also established its own competitive grants program, PRODETAB, in 1996, open to any Brazilian institution, including grower organizations, as long as it was in conjunction with a public agricultural research agency. The primary objective of PRODETAB is to improve the integration of national agricultural research through collaborative research with the private sector (Beintema et al 2001:35). Although initially accounting for less than one percent of total national research expenditures, the program seeks to eventually allocate 30% of the national agricultural research system's budget (Reifschneider and Lele 1998).

In short, growers now contend with a reduced and different form of support compared to the monumental investments of the 1970s, when the federal government had a full-fledged agenda of building its research competencies by training its researchers, expanding its scope, and strengthening its laboratories and research infrastructure, especially as reflected in the establishment of EMBRAPA. Today, the federal government faces tighter budget and political constraints, which have among other things propelled it to forge closer ties with the private sector as a source of funding. The remainder of this chapter explores the implications of these partnerships for growers and for public sector agricultural research in general.

Case studies

In this section, I present the case studies through which I try to understand what is it about public sector agencies that make them more or less responsive to growers and what makes growers more or less demanding of public sector agencies, and the contribution of public-private partnerships to growers' upgrading efforts. For each case, I describe the state-grower relation over time, aiming to show how the organizational and political voice of growers and the nature and structure of public sector agricultural research agencies shaped the public-private relationship dominant today. I begin with the most effective public-private collaboration in terms of scope and distribution which was in SC, then use it to judge what has emerged in PJ and RN.

Collaboration by design in Santa Catarina

Public-private collaboration in agricultural research is strongest in SC, as reflected in the scope of activities in which growers and state researchers interact and support each other and in the extent to which these partnerships benefit large and small growers. The effectiveness of this partnership can be explained by 1) the form of support provided by the state agricultural agency, with its emphasis on research and extension and outreach to both large and small growers over time; and 2) a well-organized and representative growers association, ABPM, backed by large firms that have historically engaged with the state in ways that generated spillovers to the entire cluster.

In comparison to the other cases, government support in SC stands out for its uncommonly strong sense of mission in providing growers with agricultural research and extension.[63] According to Olinger (1996), the absence of any other public sector agency anywhere near growers, the novelty of the extension methods used (slide shows and movies, in addition to the more traditional demonstrations), and the above average wages of extension workers contributed to ACARESC's "sprit d'corps." Not only did the state help growers adopt the production of apples and guide them in apple production technologies, but it did so in such a way that growers continuously interacted with state researchers and extension workers. In particular, there are at least three attributes of policy support in SC that differentiates if form the other cases in fostering these kinds of partnerships:

First, the state agency ACARESC from early on established an institutional venue through which to engage with growers. It reached out to large growers especially via the state's Research Center in Videira, which had research plots in the large firms in Fraiburgo, as early as 1972. The state later transferred its apple expertise from Videira to Caçador, also in the vicinity of Fraiburgo. Smaller growers in São Joaquim benefited from the research coming out of the São Joaquim Experimental Station.

Second, the state became a leading expert in apple research, earning growers' respect and lasting support. Especially during the 1970s and early 1980s, the SC state government formed a highly trained group of researchers specializing on apple

[63] Tendler (1997) explains the good performance among public workers across several programs in Ceará as a result of the state's creation of a "strong sense of 'calling' and mission around particular programs and their workers" (p.14).

production.[64] It also sought technical expertise and financial resources from industrialized country agencies with extensive experience in apple production, including the Japanese Agency for International Development (JICA), the German GTZ, Cornell University, the Israeli Volcani Center, and the Experimental Station in East Malling, UK.[65] Collaborative efforts with JICA were particularly impressive: the first consortium spanned 25 years (1971-1996) during which at least one Japanese apple expert worked out of the Experimental Station in São Joaquim at any given time, several EPAGRI[66] researchers were trained in Japan, and EPAGRI made substantial improvements to its research infrastructure and equipment. That such a small state mobilized such international support reflects the state's financial and technical commitment to promoting excellence in apple research.

These efforts and contacts enabled state researchers to identify and resolve some of the main problems hampering apple production, including low productivity associated with problems in pollination, the uneven break in dormancy across orchards resulting from insufficient cold hours in the winter, the occurrence of black spots, and high incidence of virus infestation that plagued the main greenhouses that initially supplied growers with apple tree seedlings. This in addition to its own research leading to improvements in soil fertilization, grafting, spacing, pruning, harvesting, and storage.

And third, just as impressive as its commitment to apple research was the state's well-structured and funded agricultural extension service. As mentioned in Chapter 1, the state established extension offices throughout the apple producing areas, supplying one extension worker for every 20 growers.[67] ACARESC's extension workers visited growers often, guiding them in their production practices and providing growers a direct and reliable liaison to state research. The marvel and gratitude with which growers today speak of the state's earlier extension service starkly contrast the complaints one usually

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[64] The SC state government created is Agricultural Research Agency, EMPASC, in 1975. Before then, the state supported research done through the federal government's several experimental stations spread throughout the state.

[65] Kurtz (1999) provides a brief description of these consortia.

[66] The SC state government merged ACARESC and EMPASC into EPAGRI in 1991. See Chapter 4 for further details.

[67] As mentioned in Chapter 2, this ratio is high especially in comparison to that of the irrigation projects in PJ, where in the early years (for which data is available) the ratio averaged one extension worker for every 74 growers (Miranda 1989:51 cites that between 1984-1987, for growers in the Nilo Coelho project, the ratio of agronomists to growers was 1:144 and for agricultural technicians, 1:74).

hears of extension workers "not having anything to extend" or of overextended extension workers struggling to serve an impossible number of growers.[68] The very approach of the SC state government in promoting apple production thus ushered the possibility of public-private partnerships from early on, welcoming growers to engage with state extension workers and, in the process, and earning growers' lasting respect.

That growers were so responsive to these opportunities reflects the nature of the pioneering firms in SC, as well as of the growers' association, ABPM. In contrast to the pioneering firms in the other cases, the pioneering large firm in Fraiburgo, SAFRA (Sociedade Agricola Fraiburgo), deliberately sought government support that promoted the production of apples throughout the state. At the federal level, the Freys successfully lobbied to include apples in the FISET, a fiscal incentive program that supported the production of fruit trees native in each region.[69] At the state level, the Freys encouraged the state government to focus PROFIT on apples. According to Mr. Glauco Olinger, then SC State Secretary of Agriculture (1969-1976), Rene Frey personally convinced him of the promises of apple production by estimating on paper that one hectare of apples would enable growers to obtain as much returns as from ten hectares of corn.

In addition to mobilizing federal and state government support for apple production, SAFRA also gave the state a jump-start on apple research by sharing its own extensive experimentations with state researchers. SAFRA began its apple research in 1962, four years before the state even established its program to support apple production (PROFIT), and almost 13 years before the state formed its own apple research program through the state agency for agricultural research, EMPASC. As part of its research efforts, SAFRA imported thousands of apple and other temperate fruit seedlings from France, along with a French agronomist, who dedicated 12 years (1962-1974) to searching for the most suitable fruits, varieties, and production methods for the region. In addition, SAFRA obtained federal support to invite a leading French apple export,

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[68] See Rolling (1982) for a critique of agricultural extension programs.

[69] FISET was administered by the Brazilian Institute for the Development of Forests (IBDF), the precursor to today's Brazilian Environmental Institute (IBAMA). FISET was originally aimed at assuring the needed volume of timber for industrial production by expanding areas with species of higher productivity, as well as restoring the natural vegetation in areas where deforestation had caused irreparable environmental damage. Soon after its implementation, however, IBDF included fruit trees as part of FISET, giving priority to those fruits which Brazil could potentially produce to substitute imports or to fruits produced in the underdeveloped North and Northeast regions (Freitas 1978).

Georges Delbard, to visit Brazil to guide the federal government's support of the apple sector (Frey 1990).

The development of public-private partnerships in SC is also explained by the effectiveness of apple growers in establishing a growers association representative of the sector and capable of voicing their needs to the state. Apple growers in SC first created an association, named Catarinense, along with growers of other temperate fruits in SC and the neighboring state of Rio Grande do Sul in 1978 to defend their interests in the federal government's fiscal incentive program (FISET). With the end of the FISET program, and growing importance of the apple industry, apple growers established the Brazilian Association of Apple Growers (ABPM).

Meanwhile, apple growers in Fraiburgo established the Fraiburgo Fruit Growers Association (AFF) in 1982, dedicated exclusively to introducing new technologies to the apple sector, including phytosanitary alert stations, hail control system, and research projects with EPAGRI. According the present director of ABPM, the effectiveness of AFF in generating tangible benefits to its members raised the interest of apple growers beyond Fraiburgo to also adopt a similar strategy and, as a result, the ABPM incorporated the AFF in 1992 by using it as a basis for its own research program.

ABPM is striking for its political voice despite the absence or weakness of certain factors or conditions that explain political strength of growers elsewhere: its leaders have no direct political affiliation as in the other cases, the participation of apple revenues to the state is less than that of the other cases and, at a national level, the value of apple exports is less than that of other crops, exceeding only grapes (Table 1).

These organizations have had collective successes as well as failures, though even some of the failures reflect an uncommon level of willingness and commitment to collective efforts. Among such failures was the establishment of a system to reduce the impacts of hail which can result in the loss of up to 20% of apple production. In 1990, AFF established a grower-funded hail control system consisting of radars, radio transmission, rockets, and launch pads, altogether "protecting" an area of 130,000 hectares. The impact of this system was debatable and, as several firms suffered hail-related losses in 1994 and other were cash-strapped and unable to pay their dues, AFF abandoned its program. The severity of hailstorms in 1995 once again revived growers'

interest in and commitment to a hail control system, this time using a less expensive system, which instead of rockets uses a network of ground-based generators that emit gases in the atmosphere capable of inhibiting the formation of hail over 350,000 hectares. The state's seven largest firms (accounting for over 62% of the state's production) initially covered the costs of this system, yet by 2000 only three remained.[70] The others dropped out, some out of disbelief in the effectiveness of the system, others as free-riders.

Growers unsuccessfully attempted collaborating in other activities, including a common shipping pool. As the European demand for Brazilian apples increased beginning in the mid 1980s, the lead firm in Fraiburgo, Fischer, coordinated the formation of a shipping pool among the ten largest firms in 1989. Three years late, however, these other firms decided to break from Fischer and form their own pool to try an alternative marketing channel. This second pool lasted for two years, at which point each firm began shipping independently. According to a director from Fischer, the first pool split up because Fischer did not trust the alternative marketing channel proposed by the other firms. The second pool, in turn, disbanded because firms were, as a group, unprepared to meet the buyer-driven demands for regularity in volume and quality.

In contrast, growers have been especially effective in collaborating with each other when joint action requires public sector support. As a director from one of the lead firms put it, "If EPAGRI or EMBRAPA mediate, then we (growers) collaborate because we cannot do it alone." The earliest example of this was the establishment of a phytosanitary alert station. AFF, along with EPAGRI, built a phytosanitary alert station in Fraiburgo in 1986 to provide growers with information on the probability of occurrence of a particular fungal disease, black spot. Growers can drastically reduce black spot if they treat their orchards within 24 hours of infection. Beyond that time frame, treating black spot requires more expensive, systemic, inputs. Upon verifying the likelihood of black spot on a given day, the technicians at the alert station call AFF members and provide warnings via local radio stations.

More recently, growers stepped up joint action as they faced rising volumes, falling prices, stricter buyer-driven norms and standards, diminished federal funding of state agricultural research resulting from the 1988 Constitution, and the need for better

[70] See Appendix B for an estimate of the share of the largest firms in total state production.

representation at Mercosul negotiations.[71] In response to these events, growers re-organized the ABPM, creating a Board of Directors to increase the association's participatory management and decision-making, and to formulate and fund its own research program. As part of its strategy, the ABPM designed measures that would allow for even closer ties between growers and EPAGRI researchers. It did this locally by incorporating EPAGRI in its own research agenda and at the federal level, by securing additional funding for fruit research. The latter was especially important in generating spillovers to growers elsewhere who ultimately also benefited from these federal funds.

As conventional transfers of federal funding for the state's agricultural research system fell, ABPM developed its own research program funded through member contributions (about US$8/ha/yr), formed its Technical Council and invited a leading EPAGRI researcher to coordinate its activities. The ABPM research program accepts research proposals once a year which are reviewed by its Technical Council, consisting of technical directors from the member firms and the lead EPAGRI's leading apple researcher. Throughout the year, members of the Technical Council repeatedly contact the researchers, keeping up to date on any findings and difficulties along the way. At the end of season, researchers circulate their project finding among members of the Technical Council and hold a seminar open to all ABPM members. Through this process, ABPM has funded 30%-50% of EPAGRI's local research station's (in Caçador) annual research costs, in addition to in-kind contributions from growers including access to orchards and technical labor to follow up on scientific measurements and monitoring.

Just as important, ABPM effectively sought alternative sources of federal funding to supplement EPAGRI's budgets. ABPM lobbied the CNPq to establish a competitive grants program to finance training and laboratory equipment for research on Brazilian fruit exports. As a result, CNPq created the first of a series of funding programs to support fresh fruit exports. This program required researchers to submit proposals endorsed by grower associations, which EPAGRI did repeatedly with the support of ABPM. Among other things, EPAGRI used these grants to setup a laboratory for soil

[71] Apple growers were left out of a Mercosul negotiation on fruit classification norms because of an oversight by the ABPM president who had failed to inform growers of the pending meeting.

analysis, carry out field tests on pulverizers, and purchase equipment for nutrient measurement.

Growers' increased interest in and management of research has contributed to the strength of EPAGRI's program on apple research in ways other than funding, including by raising the morale of state researchers who welcome the recognition of their work and are encouraged by the usefulness of their findings.[72] Additionally, growers have also backed the demands by EPAGRI researchers to the state for necessary research equipment and infrastructure. As an EPAGRI researcher commented, "When ABPM solicits (*reinvindica*), we get results," referring to ABPM's role in supporting EPAGRI's proposals to CNPq.

Among the most outstanding outcomes of the greater public-private collaboration in research in SC is the Integrated Production project, which was the first in Brazil and has subsequently served as a role model for the development of IP technologies for other crops. The EMBRAPA Grape and Wine Center (CNPUV), in the state of Rio Grande do Sul, initiated this project in 1997 even before the EU demanded that growers adopt integrated production by requesting growers for experimental areas in their farms. Growers, through ABPM, readily selected several plots throughout Fraiburgo for the experiments, which are carried out by researchers from EPAGRI in SC, EMBRAPA/CNPUV, the Federal University of Rio Grande do Sul, and the Instituto Biológico in Sao Paulo, each focusing on particular subprojects. EPAGRI coordinates the subproject on Plant Management and Nutrition, under which ABPM administers production. As for concrete results, the IP project resulted in the establishment of IP guidelines for apples; 8,600 certified hectares by 2002, with an additional 5,000 hectares going into quarantine; the training of field supervisors across the farms; and the certification of field inspectors.

The above demonstrates several attributes of this state support that reflect an underlying "social arrangement" of research unique to this case.[73] First, the SC state

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[72] Drawing from several cases in Northeast Brazil, Tendler (1997) demonstrates how positive recognition of public front line workers (agricultural extension workers, health agents, and nurse practitioners) can be associated with their better performance.

[73] I draw the notion of social arrangement of research from Fitzgerald's (1990) discussion on the centrality of social arrangements between farmers, researchers, and research administrators in explaining the development of scientific ideas in her study of hybrid corn in Illinois.

government from the very beginning relied on the support of the large firms as it promoted apple research among small growers. Second, the continuous grower-state interaction was possible because of the state's commitment to apple research and its dedication of Experimental Stations in both Fraiburgo and Sao Joaquim towards apple research, each focusing on the particular apple varieties produced in each subregion. This approach provided each set of growers with customized production technology, while avoiding the problem of appropriation of research by the larger, more powerful growers. At the same time, this case is also remarkable for the effectiveness of its grower organization in representing its members and in collaborating with the state in promoting research and other efforts that benefit the cluster.

Finally, in contrast to the other cases, the large firms generated positive externalities to the cluster as a whole. They have proprietary knowledge, of course, but at the same time engage in efforts that have wide-spreading benefits, including those through ABPM that resulted in improved pest management, integrated production practices, and apple marketing campaigns. What makes these firms more developmental than the large firms in the other cases? One possible explanation is the realization by the pioneering firm since the 1960s that it, alone, could not produce enough apples to compete with Argentine imports. Instead, a domestic apple sector would necessarily entail many growers competitively producing quality apples. This was not so in PJ or RN. By the time the large firms began producing fruits in these other cases, there were already growers of the same crop elsewhere. Mango production in Sao Paulo dates back to at least the 1960s and Sao Paulo remains the largest producer state, with about 25% of area planted, mostly for the domestic market (Ministerio da Agricultura 2000). And melon production had already peaked and subsided in PJ. The pioneering firms in PJ and RN therefore did not need other growers in the cluster as did the pioneers in SC.

Another difference between the large firms in SC and those in PJ and RN that helps explain the comparatively "developmental" nature of those SC is their origin. In SC, the main family behind the pioneering firm SAFRA, the Freys, had been traditionally important to local economic development through other productive activities, dating back to sausage production in the 1920s and a woodmill in the 1940s. The Frey family had also been important politically, by leading community efforts to obtain government

support for the construction of roads, bridges, and energy infrastructure for their growing village. In fact, as a result of their leadership, the Freys managed to convert their small village of mostly German and Italian immigrants into the municipality of Fraiburgo ("the city of the Freys") in 1961.

In RN, MAISA began producing cashews to take advantage of the FISET incentives through which it acquired about 30,000 hectares. Despite the scale of cashew production, its owners remained dedicated primarily to other economic activities elsewhere, including construction and transportation companies in the state of Ceará. In PJ, the large firms were entirely new to the region.

Collaboration by coercion in Petrolina-Juazeiro

Similar to SC, growers in PJ have also benefited from research partnerships with a public sector agricultural research agency, in this case, an EMBRAPA regional center located in Petrolina, CPATSA[74] (*Centro de Pesquisa Agropecuária do Trópico Semi-Árido*). Although CPATSA has always maintained some kind of exchange with fruit growers through field days, open seminars, and phone consultations, these interactions have in recent years materialized in a series of research partnerships that draw from CPATSA expertise and in-kind contributions from growers in the form of plant material, land, inputs, and labor to carry out the recommended practices by public researchers. These have included projects on integrated production, seedless grapes, and general improvements in fruit production and post-harvesting technologies.

Unlike SC, however, the public-private partnerships in PJ have generally been limited to specific projects and to contacts between individual growers and researchers as opposed to the broader scope and scale of such partnerships in SC. Additionally, these partnerships have been less distributive in PJ than in SC in terms of their accessibility by small and medium growers. These differences can be explained by 1) the form of public sector support in PJ, that focused on different crops for different growers, and 2) a less representative grower association in PJ relative to that in SC.

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[74] EMBRAPA recently renamed the Centro de Pesquisa do Trópico Semi-Árido (CPATSA) as EMBRAPA Semi-Árido. I use the acronym CPATSA for the sake of brevity and to avoid confusion with the central EMBRAPA.

Government support early on seemed very similar in SC and PJ where a government agency helped growers adopt fruit production through a combination of policies facilitating growers' access to credit, land, inputs, and agricultural research and extension. Yet there are several features of the form in which this support was provided in PJ that led to different implications for the formation of public-private partnerships. First, the different nature of the coordinating agency – ACARESC in SC and CODEVASF in PJ - shaped the formation of the resulting partnerships. In SC, ACARESC was a state rural development agency, with a clear and focused mission of promoting apple production among large and small growers throughout the state to strengthen its rural economy. Reaching out and engaging with growers was part and parcel of its strategy. In contrast, CODEVASF is a federal parastatal agency, with the mandate of developing the entire San Francisco River Valley. As an engineering-based agency, it specialized on building dams and irrigation infrastructure, along with electricity and transportation networks to support its public irrigation projects. Its mandate was thus much broader than ACARESC's and focused more on physical infrastructure and less so on the kinds of soft institutional infrastructure that characterized ACARESC.

Second, CODEVASF's early support of irrigated agriculture in PJ included a strong component of research, mostly done by CPATSA, but this research did not focus on fruit production as did ACARESC in SC. Instead, its agenda focused on improving the production of tomatoes, melons, onions, garlic, and pepper, crops that had been identified by a CODEVASF- commissioned study by FAO as the most promising crops for the region, along with rainfed agriculture, small husbandry, and other traditional activities for the semi-arid region.

Even as large growers began producing mango and grapes in the late 1980s, drawing heavily from the expertise of private agronomists from other regions in Brazil and from abroad, CPATSA remained true to its original mandate, all fields of expertise in which its cadre of researchers had been well trained, including many with doctoral degrees from US universities. Despite informal interactions early on between fruit growers and CPATSA, a growing disconnect between CPATSA's original mandate and

fruit growers' research needs left growers discontented, as reflected in the disdain with which growers spoke of CPATSA until very recently.

This is not to say that CPATSA did not experiment or research with fruits. It did in fact, especially with mangoes and melons. This early work served subsequent developments, but was not part of a concerted strategy or agenda on fruit research as was apple research in ACARESC. As early as 1979, CPATSA had planted over twenty mango varieties in their experimental station in the Mandacaru project in Petrolina to analyze the behavior of mango production under local agroclimatic conditions. Even though it would be at least another decade before commercial mango production began in the region, CPATSA had already envisaged its potential and thus can be credited with proving to growers that mango production was viable in the region. There was not, however, any continuity to this research, as CPATSA remained true to its original mandate and incorporated the irrigated crops most widely produced in PJ until the late 1980s.

Likewise, research on melons dates back to the 1980s. Melon had been widely produced in PJ between 1982-1987, mostly produced by medium and small growers. It was an extremely rudimentary activity however, in which there were no guidelines for production or transportation, and no varieties developed for the region, since existing varieties had been developed for other, more temperate parts of the world. In the late 1980s, CPATSA introduced the El Dorado 300 variety, better adapted to local conditions and resistant to a common leaf disease and virus. Though problematic for exports because of its high perishability, the El Dorado nevertheless became a pre-breeding variety, used for the development of commercial varieties done subsequently by private seed companies.

A third and final way in which the form of government support differed between SC and PJ that had lasting implications for the formation of public-private partnerships concerns the provision of agricultural extension. In comparison to SC's strong agricultural extension service, CODEVASF's provision of agricultural extension was marked by periods of good and bad performance, reflecting the resources and capabilities of its many providers: CODEVASF until 1980; the state level agricultural extension

agencies EMATER (1980-1986); multiple providers contracted by the associations and cooperatives (1986-1992); and other providers subcontracted by CODEVASF since 1992.

Growers throughout PJ voiced their frustration with the fluctuating quality of agricultural extension services. As one grower in the Nilo Coelho project put it, "EMATER had no idea how to produce fruits – they came to learn from us." Another grower, this one originally from Rio Grande do Sul, contrasted the variable quality of extension in PJ to that of Southern Brazil, "in the South, the EMATER extension worker is as important as the pastor."

For the above reasons, fruit growers and CPATSA researchers rarely interacted for decades, generating a rift and sense of disdain with which growers spoke of CPATSA's "useless research." This scenario finally changed in the late 1990s as large growers lobbied EMBRAPA to play a bigger role in fruit research. In the case of melons, CPATSA resumed its research in the late 1990s largely in response to one of the lead firms in RN that pressured for this research through EMBRAPA headquarters in Brasilia. In the case of mango research, growers in PJ went even further and lobbied in Brasilia for the replacement of CPATSA's former director – an outstanding agronomist and research manager committed to CPATSA's original mandate – with one who is familiar with and committed to supporting the expansion of fruit production in the region. The new director had previously been assistant director since 1994, at which point he began working on a fruit research agenda. This new director is an insider among the larger fruit growers, as reflected in their close professional and social ties.

CPATSA's new director opened the way for a renewed relationship between its researchers and fruit growers. Among this first activities as director, he visited each of the large mango firms to personally discuss the kinds of technical problems they were having that CPATSA could help resolve. These and other conversations led to a series of collaborative projects between VALEXPORT and CPATSA, including improvements in fruit fly control, postharvest technologies, and integration production.[75]

That growers lobbied in Brasilia enough to replace CPATSA's former director reflects their loud political voice, especially through VALEXPORT, whose composition and structure has also influenced the formation of partnerships in PJ. According to apple

[75] For a complete listing, see "Trabalhos desenvolvidos, parcerias e convênios" at www.valexport.com.br.

growrs in SC, VALEXPORT is more politically powerful in Brasilia than ABPM. At the same time, VALEXPORT is relatively less representative of its members. This means that VALEXPORT has obtained much government support, but which generally has been more exclusive and less easily accessible by small and medium growers.

Evidence of VALEXPORT's political clout which often goes distorted in temrs of beneficiaries was its effectiveness in lobbying the federal government for the construction of cold storage and the extension of the runway at the Petrolina airport to allow the fruit exports via cargo planes. The runway was built, and so was the storage, yet both remain idle since no one ever figured out what the cargo planes would bring into PJ.

VALEXPORT's political power can be traced back to its creation, volume of production, and insertion in the semi-arid region, historically associated with drought-related social and economic maladies. Faced with the prospects of exporting and the realities of a highly heterogeneous supply of fruits in terms of quality, growers, with CODEVASF's guidance and financial support, formed VALEXPORT in 1988 to represent them before government agencies (Damiani 1999). Its main objective was to establish ties with public and private institutions, both domestic and foreign, that could contribute to the improvement of fruit production, post harvesting, storage, transportation, marketing, exports, and promotion in the region (VALEXPORT 2003). CODEVASF thus helped growers organize to pressure the federal government itself. This direct liaison to the federal government is unique to this case.

The power of VALEXPORT also comes from its numbers. VALEXPORT consists of about 55 members, including two grower cooperatives (with about 150 members), and altogether accounts for 80% of total fruit production in PJ, and 90% of its exports. This meant that, in the 1999-2001 period, production by VALEXPORT members represented upwards of US$ 57 million in export revenues annually, about one quarter of the value of Brazil's total fresh fruit exports.[76] These figures are much higher than those for associations in SC and PJ.

In addition, according to apple growers in SC, VALEXPORT has a much louder voice in Brasilia than ABPM because of VALEXPORT's appeal to the "*causa*

[76] Estimated from data from CODEVASF, VALEXPORT, and SECEX, as cited in VALEXPORT (2002).

Nordestina," the Northeastern discourse for public sector support on the basis of drought-related economic and social maladies. This implies that growers in PJ have an easier battle to fight than growers in SC, who have no option than to jointly effectively present themselves to the state.

VALEXPORT has been central to many of the developments in PJ contributing to the growth of fruit production, including the expansion of research on irrigated fruit, improvement of the infrastructure at the ports and the Petrolina airport fruit transport and storage, coordination of USDA monitoring, and creation of an electronic marketing system (VALEXPORT 2002). For all its accomplishments, however, I was struck by how *un*representative VALEXPORT is of growers in PJ. Aside from the largest five firms, growers criticize its complete lack of transparency and accountability, including the refusal to hold elections.[77] In fact, the two largest mango growers in PJ have directed and co-directed VALEXPORT since its creation. The problem is that VALEXPORT has not kept up with the changing composition of growers.

With the incoming newer firms and the growing participation of medium growers producing mangoes and grapes beginning in the late 1990s, the sector has begun questioning and challenging VALEXPORT. Most growers continue to participate in VALEXPORT (in so far as they pay their dues) because they have no other alternative. No other grower association in the area has similar visibility, political power, and effectiveness in obtaining government concessions and, at least in terms of R&D. In recent years, however, growers have sought alternative means of organizing outside the auspices of VALEXPORT.

One of these is the Brazilian Grape Marketing Board (BGMB). Grape growers within VALEXPORT created the BGMB in 1992 to organize the marketing of grapes from the region. The BGMB unites all of VALEXPORT's grape exporters, including CAJ. Through the BGMB, growers enforce quality standards and production quotas and collective transport and market their grapes.[78] They are now trying to break away from VALEXPORT because of its bias towards mango growers and continued lack of transparency.

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[77] See Appendix D for an estimate of the share of the largest firms in total state production.
[78] See Damiani (1999:120).

Another group that growers have formed independent of VALEXPORT is the grower cooperative APROVALE, consisting of 30 medium mango growers who exported altogether 2,000 tons of mangoes to the EU in 2003 (or 2% of PJ's exports[79]). These growers established APROVALE in 1999 mainly to collectively meet the demands of buyers for higher volumes. Members share a packhouse in Petrolina and a brand name in the domestic market. They initially exported through one of the large grower-exporters in PJ and, beginning in 2002, started negotiations directly with an importer in Rotterdam. In addition, and central to my argument, APROVALE successfully sought to establish a partnership with CPATSA to help its members adopt integrated production practices. This partnership was challenging because until then, CPATSA had only established similar partnerships with VALEXPORT which required growers to pay their monthly dues to VALEXPORT in order to benefit from the work done by CPATSA.

In sum, VALEXPORT's political power has promoted the rise of public private partnerships observed in PJ. At the same time, these partnerships have generally been more exclusive that those in SC because of VALEXPORT's structure which has become less and less representative of the cluster as the newer firms and medium growers begin producing and as it sustains its biased support of mango growers despite the rising importance of grape production in the region.

Mango growers are now full of praise for CPATSA, yet often more so on this individual level than at the cluster level. One of the largest firms, located a few miles from CPATSA, for instance, claimed that it is practically an experimental field for CPATSA. "They do everything here, both by their demand and our own." This same firm went on to describe how responsive CPATSA is every time it calls on them with particular questions which their own technical staff cannot resolve.

Another example of how CPATSA now engages with growers in solving firm-specific problems comes from an interview with the technical director of one of the newer mango firms. During our conversation on the farm, a CPATSA researcher arrived to discuss the technical problems behind a poor shipment of mangoes that had arrived in the US. The CPATSA researcher, having analyzed a series of photos taken from the mangoes that been unloaded from the ship, was impressively familiar with the quality and

[79] Based on 93,359 tons exported by PJ in 2002, according to VALEXPORT (2002).

problems of the mangos produced by each firm. That same afternoon VALEXPORT was having a meeting to discuss the problem and, although CPATSA had not yet been invited, this researcher was going to attend as representative of this particular firm.

Ad hoc collaboration in Rio Grande do Norte

In contrast to multi-crop pattern in PJ, growers in RN have produced mostly melons since the pioneering firm, MAISA, first began commercial production of melons in the mid 1980s. At first glance then, one may expect to find a pattern of public-private partnership more similar to that in SC, where the focus on a single crop (apples) enabled growers to interact with public sector researchers and extension workers over several decades. Yet for the most part, public sector agricultural research and extension have remained marginal in the development of the melon industry in RN. Collaborative efforts between growers and research agencies have been few, sporadic, and mostly in the hands of two very large growers.

Several are the factors underlying this comparatively weak pattern of partnerships, including 1) the absence of a public sector development or research agency comparable to that in SC and PJ, coupled with a perverse policy that undermined public good aims by promoting private sector research instead, and 2) a skewed structure of production where two very large firms did not favor collaborative efforts which could have had more distributive outcomes.

Two public sector institutions could have potentially supported melon growers: the federal school of agronomy in Mossoró (*Escola Superior de Agricultura de Mossoró*, ESAM), located at the heart of melon country in RN, and EMBRAPA Tropical Agroindustry, an EMBRAPA research center located in the neighboring state of Ceará, a two-hour drive from Mossoró. When I first visited Mossoró, and learned of ESAM there, I figured it could help explain the growth of the melon industry there as opposed to somewhere else, such as the Ceará side of the Chapada do Apodi, which has practically the same growing conditions for melons as does RN and is within a two-hour radius from ESAM and EMBRAPA Tropical Agroindustry.[80] I expected to find the kinds of

[80] Melon production has now expanded to the Ceará side of the border as a result of aggressive support policies by the Ceará State Government beginning in the late 1990s that included expanded irrigation infrastructure, and technical and marketing support. Before the late 1990s, production in this region was

spillovers one could associate with an agricultural school, including laboratories and research infrastructure, and trained labor in the form of agronomists to work in the farms and of professors who could provide continuous guidance to their graduates and also provide technical assistance themselves directly to growers. Although ESAM graduates are indeed pervasive throughout the melon farms, and informal networking amongst them no doubt contributes to the dissemination of technologies throughout the cluster, growers generally complain of ESAM's poorly trained graduates (which they end up hiring anyhow), and the uselessness of whatever melon research it does.

As for the EMBRAPA Tropical Agroindustry in Ceará, its original mandate was for cassava and cashews, not fruits, similar to CPATSA's early focus on dryland agriculture in PJ. It was only the mid 1990s, that EMBRAPA renamed and reoriented this center toward research on tropical fruits. Nevertheless, as in ESAM, contacts between melon growers and EMBRAPA researchers have been minimal over the years. This distance endured even though the owners of the two largest melon farms were on the technical council of this center, meant to provide EMBRAPA with input from private end-users.

One possible explanation for this lack of coordination between these agencies and growers is that growers never believed in EMBRAPA's and ESAM's capabilities for research on melons and thus never expended any effort in that direction. In support of this argument is the view – held by at least one ESAM professor as well as some growers – that EMBRAPA invests so little in melon research that it cannot compete with multinational seed companies that have the resources to experiment with several varieties at once. Whatever results EMBRAPA comes up with are therefore of minimal value to growers, who already have access to the continuous experimenting done by the multinationals.

As for ESAM, the relative absence of collaborative work between its researchers and growers lies in a perverse incentive system which discourages ESAM faculty from seeking private consultancy. ESAM's system of payment establishes that faculty can receive either full salary for exclusive dedication to ESAM, or receive 45% of their salary

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limited to a few medium growers and to MAISA, whose property overlapped the Rio Grande do Norte-Ceará border.

and provide outside consultancies. Most faculty opt for the stability of the exclusive dedication option. The EPAGRI in SC and EMBRAPA in PJ, in contrast, are solely research agencies and not schools. In SC, ACARESC built its reputation on a commitment to excellence in research, earning growers' respect and support. In PJ, despite the initial disconnect between the needs of fruit growers and CPATSA's original mandate, CPATSA nevertheless had the core capabilities in terms of researchers and physical infrastructure for fruit research. It was because of these core capabilities that VALEXPORT eventually lobbied for greater fruit research by CPATSA by changing its director.

Another possible explanation is that the two large firms in RN had no interest in the widespread dissemination of production practices that could facilitate the entrance of other melon growers into the market. This was unlike the situation of the pioneering firms in SC, who needed production by other growers to make the apple industry a viable one. And in PJ, CODEVASF itself facilitated the entrance of many large firms, the largest of which was only a fraction of the size of the largest firm in RN. At the same time, the easy access to highly subsidized credit enabled the two pioneering firms in RN to bring melon experts from around Brazil and from abroad to work directly in their farms.

In addition, growers in RN never organized into an effective and representative association as did growers in the other cases. Even in PJ, where VALEXPORT has become increasingly less representative of the sector as new pack houses and growers enter the market, it nevertheless was representative for at least a decade, during which period it attained improved infrastructure, marketing, and research efforts that contributed to the development of the mango and (to a less extent) grape sectors.

In RN, the pioneering firms formed a growers association, PROFRUTAS, in 1990 as they sought to break into the US market and had to form an association as required by the USDA, parallel to the same process facing mango growers in PJ. Although collaborating on a common problem often builds the basis for further collaboration (Barzelay 1991), PROFRUTAS did not subsequently develop other activities as did ABPM in SC and VALEXPORT in PJ.[81] Instead, PROFRUTAS never developed the

[81] See Gomes (1999) for details.

administrative personnel and structure, or the many promised efforts to improve fruit production in the region. It remained but a weak and unreliable attempt to organize growers, with little or no credibility among growers, buyers, and public sector officials and agencies.

Growers are so divided in RN that, upon the creation of the federal grants program for fruit research, FRUNORTE created another association, VALEFRUTAS, to capture this federal funding independent of PROFRUTAS. VALEFRUTAS was essentially FRUNORTE and fifty or so of its workers who were also producing melons and beginning to supply them to FRUNORTE. VALEFRUTAS successfully backed ESAM's proposal to BIOEx for funding the construction of computerized refrigerated chambers to facilitate research on post-harvest handling and shelving of melons, laboratory equipment, and research fellowships. Yet most of this project was based in FRUNORTE, located in Assu, where few growers besides FRUNORTE and its workers produce melons. In fact, once FRUNORTE closed down in 2001, melon production in Assu fell from about 50% of state output in the early 1990s to less than 3% by the early 2000s.[82] VALEFRUTAS thus represents not only a break among growers in RN, but also how misrepresentative associations can be.

Despite the distance between melon growers in RN and public sector research agencies, over the years I sensed an improved view of ESAM by growers, beginning with the return of a young and energetic professor who had left to pursue his doctorate training at the Federal University in Lavras, one of Brazil's leading agronomy schools and returned to ESAM determined to implement a research program on melon production (his specialization was on post-harvesting technologies). Upon his return, this professor became a liaison between ESAM and growers. Informally, he visits growers upon their request and offers whatever technical advice they may need at no cost. Formally, he collaborates with growers in submitting research proposals to the federal research grants program and supervises field studies on experimental plots across several farms. ESAM benefits from these experiences by having access to land, inputs, and labor to assist

[82] Based on IBGE municipal-level data for Assú and the neighboring municipalities of Carnaubais and Ipanguacu, which altogether made up the Assú subregion of melon production within RN. Shares based on annual averages for 1991-1993 and 2000-2001.

ESAM researchers in the field, while growers benefit from technical assistance researchers provide during the course of each experiment.

Although ESAM is now more responsive to the needs of growers in terms of research, this responsiveness seems dependent on this single individual. I am not convinced that ESAM has changed institutionally in any fundamental way to facilitate the interaction and collaboration between ESAM faculty and growers. As a result, collaboration has been limited to the few projects for which growers have obtained federal funding.

Growers' relationship with EMBRAPA Tropical Agroindustry has also improved recently, as reflected in EMBRAPA's responsiveness to helping growers cope with a particular infestation (*amarelão*) and in establishing guidelines for integrated production. For both of these challenges, EMBRAPA held a series of seminars for growers and, for integrated production, has also begun field experiments in several farms. What has lead to these closer ties? At least one grower suggested this tighter relationship between EMBRAPA Tropical Agroindustry and melon growers emerged because of the rise in melon production in Ceará, where the state government began an aggressive program to support fruit production beginning in the late 1990s, which, among other things, attracted the multinational DelMonte to produce melons and pineapples.

What is it about melon production in Ceará versus that in RN that has led to this greater responsiveness of EMBRAPA Tropical Agroindustry? In the least, melon production in Ceará is backed by a politically effective and technically qualified State Secretary of Irrigated Agriculture, with a concrete mandate and sense of mission rarely found in similar state agencies in the Northeast. Just as important, the recent investments by the Ceará State Government in promoting fruit production has meant a very concrete agenda for this EMBRAPA center in evaluating the most promising areas for fruit production and the most appropriate production technologies for hundreds of growers. This delimitation of tasks and beneficiaries, tied to a timeline, has been shown to facilitate good performance among public sector agencies (Tendler 1993).

To summarize, the public private partnerships in RN have been far from those that emerged in SC and PJ. This weak tie has been partly the outcome of policies that shaped a highly concentrated structure of production and promoted private over public research.

The next chapter explains how the melon industry in RN managed to grow over the years despite these relatively weaker collaborative institutions.

CHAPTER 4. THE SOCIAL NATURE OF CROPS AND THEIR MARKETS[83]

The different arrangements growers have used to resolve collective good problems area also a function of the characteristics of their crops, especially production cycle (annual versus perennial) and production costs, and their markets (more or less demanding). By their very nature, some crops and markets are more demanding than others, affecting how growers organize and which activities they undertake collectively.[84] These market and crop characteristics help explain two patterns that emerge from my cases: 1) why melon growers have succeeded despite collective inaction and "no state" relative to SC and PJ, and 2) the strikingly different arrangements among mango and grape growers in PJ despite their access to similar kinds of policy based incentives and other public sector support.

If I explain the success of growers in SC and PJ in terms of the strengthening of local institutions and the responsiveness of the public sector, how can I explain the apparent success of melon growers in RN albeit the comparatively weak grower association and the relative absence of public sector agencies? By apparent success, I am referring to the fact that growers have expanded production over time, increased exports to the UK (a considerably more demanding market than those of continental European countries and the US), and are gradually adopting improved melon varieties and other fruit crops. Moreover, the structure of production has gradually become less concentrated, with medium growers gradually increasing their share in the market to 27% by 1997[85]. These medium growers have thus entered the market precisely when global demands are expected to exclude them.[86] The answer to this puzzle lay in at least three variables which differentiate melon production in RN from the other cases: its "easier" market at least during an earlier phase, shorter production cycle, and relatively lower per

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[83] I arrived at the notion of "crops and their social character" through Tendler's (1984) work on Bolivian cooperatives in which she analyzes the interaction of elite control and structural crop-based factors in shaping cooperative behavior.

[84] Attwood and Bavishkar (1987), Collins (1995), Perry et al (1997), and Tendler (1984) present variations of this crop-based argument in defining the organization of growers.

[85] See Gomes (1999).

[86] See Farina (2002), Gibbon (2001), and Reardon et al (2002) for discussions on how current trends in food retail are associated with higher barriers to entry for small growers. Although most of this literature concerns small farmers, I claim this argument also holds for medium growers because of the substantial differences between medium growers and larger growers in terms of investment capacity, access to technology, volumes of production, postharvesting infrastructure, and marketing channels.

hectare production costs. Differences in markets and production costs also help explain the variations in arrangements among two perennial crops – mangos and grapes – both produced in PJ.

This chapter is organized as follows. The first section begins by analyzing the differences in the markets for melons compared to those of the other crops as a source of pressures to upgrade. It argues that an easier market for melons in an earlier phase ultimately "cursed" melon growers by not forcing them to upgrade earlier on. The second section then analyzes how production cycle and production costs help explain the variations in how growers respond to collective good problems, first comparing melons (the only annual crop) versus the other, perennial crops, then comparing the case of mangos and grapes (both perennials) in PJ.

The nature of the market: cursed by an exclusive export window

The experience of RN melon growers reflects a fallacy of the commonly held assumption that the export market is necessarily demanding of quality products. What the RN story reveals instead is an export market that was quite undemanding during an earlier phase of melon exports spanning two decades (1975-mid 1990s), then increasingly demanding during a more recent phase, beginning in the mid 1990s. This earlier phase helps explain how growers in RN, who export the most compared to growers in the other cases, have also been the ones who historically had the fewer investments in upgrading, including as reflected in collective efforts via the association or with public sector agricultural agencies, such as the federal agronomy school in Mossoro (ESAM) and the EMBRAPA research center located in the neighboring state of Ceará.

Likewise, when I began this research, I expected to find foreign buyers profoundly concerned about and vigilant of growers' performance because of the rising scrutiny of retailers and consumers. What I found instead was a wide spectrum of buyers. On one end were the large UK importers, who, according to several European importers, are the "thermometer" for what will be happening in Rotterdam five years from now in terms of demands for quality.[87] UK buyers are committed to fully complying with

[87] The UK is more demanding than the other markets because of its comparatively higher concentration of supermarkets, along with the emergence of "category managers," importing firms who coordinate imports

norms and standards regulating everything from fruit quality; to the establishment of cold storage on-farm; packing facilities that comply to minimum construction standards on materials (such as concrete floors and walls) and facilities (restroom, sorting area, storage); use of specific varieties; auditing and monitoring procedures to assure traceability; environmental impacts; and the welfare of farm workers.[88]

On the other extreme were the smaller UK buyers and those in Rotterdam in general, who were surprisingly "flexible" in their demands. Even if concerned about environmental and labor implications of their fruit imports, rarely do these buyers imposed such demands on their suppliers, being more concerned instead about providing their customers with continuous supplies of competitively priced fruits. In the end, the extent to which buyers demanded their suppliers to comply with norms and standards reflected the importance of these suppliers to the buyer-importer. Where growers were the sole suppliers at any given period, buyers tended to be more lenient. Where growers were one of many suppliers, buyers were at their most demanding.

In contrast to the other cases, melon exporters enjoyed an exclusive four-month window to the European market for about 15 years, from when they first began exporting in the mid 1980s until the late 1990s. The possibility of Brazilian growers to produce and export during Northern Hemisphere winters was central in explaining how growers managed to break into exports in the first place. Brazilian melons entered the European market in October as the Spanish melons began phasing out and withdrew as lower-cost and sweeter melons from Honduras and Costa Rica began entering in February. From October to February, melons from RN were the only ones on the European table.

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and distribution from multiple suppliers for specific supermarket chains. These category managers are increasingly liable for the quality of the products they source and distribute and consequently demand that their suppliers (growers) abide by a series of norms and standards to help ensure consistency of quality. These demands include the establishment of cold storage on-farm; packing facilities that comply to minimum construction standards on materials (such as concrete floors and walls) and facilities (restroom, sorting area, storage); use of specific varieties; and auditing/monitoring procedures to assure traceability.

[88] To ensure growers' compliance with their standards, UK supermarkets and their importers conduct yearly and seasonal field visits to their suppliers. During their visits, they inspect the entire production process, observing field practices, auditing field reports, and inspecting the cleanliness and safety of the working environment in the packinghouse. They are concerned about workers washing their hands upon leaving the restrooms and about the possibility of any type of foreign particle accompanying the melons. For instance, supermarkets require that all the fluorescent lamps in the packinghouses be covered by a mesh-type net just in case a lamp accidentally breaks and falls over the fruits.

Although the exclusive European window enabled Brazilian growers to become established in the market, it also reduced growers' incentives to upgrade. Growers had no competition and, despite a single variety (Yellow melon) and one that was more bitter than sweet, importers bought whatever melons reached their shores since the availability of melons during the North Hemisphere winter was, at least initially, an exclusive and exotic product, with uncommonly high margins. Even as late as 2000, melon importers in the UK (Brazil's main melon importer) complained that growers in RN were only slowly responding to several of their requirements, including:

- The establishment of cool chains from farm to supermarket. Although by that point the shipping company Lauritzen had already built a storage facility in the port of Natal (RN's main outlet for melons), many growers still failed to have on-farm pre-cooling systems.
- Improvement of packinghouses, including concrete floors and walls, and the availability of on-site restrooms and wash basins for workers.
- Improved varieties. RN growers opted to focus on yellow melons because of their long shelf life. The problem is that melons present a trade-off between shelf life and sugar content: the sweeter the melon, the shorter its shelf life.[89] Importers urged growers to do trials with medium-life varieties and cool them on-farm, yet growers continued focusing on yellow melons, which do not require on-farm cooling, and have longer shelf life.

This rather lax export market was very different than that facing mango and apple growers as they first began producing and exporting. Mango growers targeted the US market since early on and, in order to even enter the US, growers had to abide by pre-clearance policies of the USDA. These included the production in areas certified to be free of fruit flies and the use of thermal bath treatment targeted at eliminating fruit fly larvae. The USDA also required that each exporting firm have a USDA inspector on-site to verify the thermal bath procedure and to assure that growers were following the quarantine procedures established by the USDA. Given the importance of the US market for mango growers – exports to the US have accounted for about one quarter of all of

[89] Melons are non-climataric fruit. Contrast to the banana, for example, in which, even after harvesting, starch converts into sugars. Melons have no such sugar reserves.

mango exports – the USDA imposed norms had a much greater impact on mango growers in PJ than on RN melon growers.

Apple growers, in turn, began producing at a time when Brazil was among the world's leading importers of apples.[90] Growers therefore had to produce to compete on the domestic market with imports, especially of Argentine apples, which were by then already well established in the Brazilian market. So here was a group of growers who from early was forced to be competitive in price and quality, not because of the export market (as tends to be emphasized in the globalization literature), but because of demands within the domestic market.

The unresponsiveness of melon growers had its price. Despite the advantages to UK buyers of maintaining long-term relationships with growers,[91] importers scoped the globe for other potential suppliers. As a result, melon growers saw their "exclusive" four-month window reduced as growers from Costa Rica, Peru, Sudan, and South Africa began exporting during this same period beginning in the late 1990s, and the share of Brazilian melons in total UK melon imports gradually fell from 23% in 1993 to 13% in 1998, as shown in Figure 7. That Brazilian share of UK melon imports once again rose after 1997 and especially after 2000 reflects increasing production from outside RN, especially in Ceará the neighboring state which has invested heavily in irrigated "poles" and, among others, attracted Del Monte investments in melon production. So, although the share of Brazilian melons in total UK melon imports has once again picked up, melon growers in RN have reduced their overall participation in these exports, as shown in Figure 8.

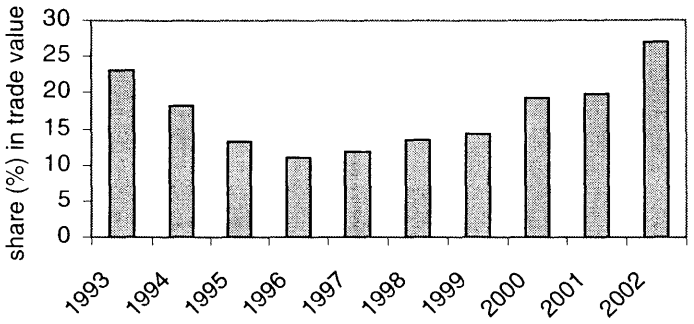
Melon growers in RN are now well aware that they can only remain in the market if they upgrade. And many growers have done just that by harvesting more mature, sweeter melons, instead of the premature, rather bitter melons, which growers harvested in the earlier phase. And since sweeter melons are more susceptible to fungus and spoilage, growers have also made the necessary improvements in general handling practices and on-farm infrastructure, including in pre-cooling systems and controlled

[90] According to FAO, as cited in Kurtz (1999), Brazil was the world's fourth largest apple importer in 1975, accounting for 6.8% of total imports

[91] Egan and Mody (1992) stress the importance of mutual obligation, learning, and trust that favor longer-term buyer-seller relationships.

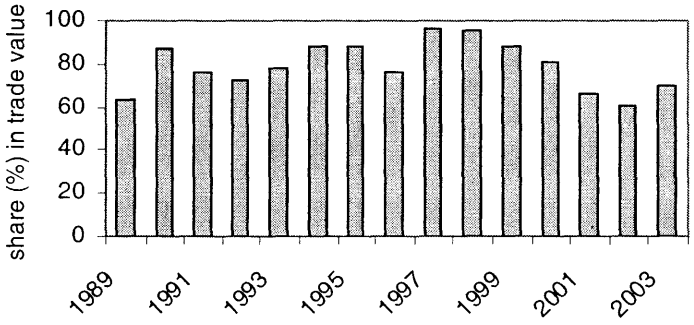
temperature storage. However, the failure to upgrade earlier on hurt the reputation of melons from RN. The UK has turned to buyers in other countries and, within Brazil, increasingly to melons from Ceará.

Figure 7. Share of Brazilian melons in UK melon imports, 1993-2002



Source: UN Stats/COMTRADE.

Figure 8. Share of RN melon exports to UK as share of total Brazilian melon exports to UK



Source: Ministerio da Industria e Comercio via www.aliceweb.gov.br

The nature of the crop: easier crops and the organization of production

While markets are a source of incentives or disincentives for collective action among growers, crop characteristics help explain why and how growers respond to these incentives. This study reveals that crop cycles and production costs are especially relevant in affecting growers' organizations.

Annual versus perennials: Why melons are an "easier" crop

The RN story also stresses the impact of product characteristics on firm organization – of why upgrading in certain sectors or products requires more collective action or public sector support than in others.[92] This is even true for public good kinds of support, such as with varietal research. In principle, growers cannot usually undertake these investments on their own because they do not have the necessary research material and laboratories, and because of the usually long waiting periods to obtain results. Even when growers are capable of doing their own research, they often refrain from doing so because of the ease with each this information is subsequently spread throughout the cluster – this would occur as growers draw from a common labor pool, with workers transiting from one farm to the next, and as agronomists, input suppliers, consultants, and agricultural extension workers exchange information. In practice, however, the nature of the crop, including its production cycle, production cost, and labor intensity, determines the costs associated with upgrading and growers' incentives to go at alone or collectively with each other and the state.

The production of melons in RN differs from that of mangoes, grapes, and apples in the other cases in an important way: melons are harvested in 60 days; mangoes, grapes, and apples in three years for the first crop. This means that within two short months, melon growers in RN see the results of a new variety or the outcomes of modifications to the production process, such as spacing, weeding, irrigation, fertilizer and pesticide use. Growers of the other, perennial crops, in contrast, must wait at least three years to observe any comparable results, making the learning process longer and more expensive both in terms of the actual research costs as well as the opportunity cost of having to wait years before arriving at some conclusion about improved production technologies.

Melons are also "easier" because they require considerably less capital to produce than apples, mangoes, and grapes. As shown in Table 10, the per hectare cost of simply establishing these crops, covering the first 3-4 years during which they do not bear fruit (and not the cost of once they are actually producing), range from about $3,000 for mangoes to $15,000 for grapes. The production of melons, from laying out the drip

[92] For other discussions on the impacts of crop characteristics on how growers and which they activities they undertake collectively, see Attwood and Bavishkar (1987), Perry et al (1997), and Tendler (1984).

irrigation system to harvesting, is $4,710 per hectare.[93] This means that the risks involved in trying something new with the production of melons is considerably lower than that involved with experimenting with the other crops.

The lower cost of melon production is partly attributed to its lower labor-intensity compared to the other crops, especially grapes and apples. Labor cost per hectare accounts for 20% of the total production cost for melons, whereas it accounts for up to 26% in the case of apples, and 43% in the case of grapes. Producing grapes and apples requires the meticulous task of thinning, the removal of flower bud clusters to promote better quality fruits, maintain plant vigor, and eliminate over-production. Workers use nail scissors or special thinning scissors to remove individual grape berries or reduce apple clusters at an early stage of production.

Table 10. Estimated costs for apples, mangos, grapes, and melons (US$/ha/yr)

	SC apples	PJ mangos	PJ grapes	RN melons
Cost of implementing crop (US$/ha)[a]	8,700	3,050	15,330	-
Production cost (US$/ha/yr)[b]	4,300	3,010	9,110	4,710
Labor cost[c]	1,118	181	3,917	942
Share of labor cost[d]	26%	6%	43%	20%
Post-harvesting and transportation cost[e]	2,849	7,310	14,068	4,615

[a] For perennial crops, this reflects the costs associated with planting and maintaining fruit trees and vineyards during their first three to four years during which they do not bear fruit. This cost is irrelevant for melons since they are an annual crop.

[b] For fruit-bearing years. From Carvalho (1996).

[c] Estimated by multiplying the share of labor cost obtained from data in Albuquerque (2001) by total production cost.

[d] Estimated from data in Albuquerque (2001).

[e] Estimated by multiplying share of post-harvesting and transportation costs in total cost by total cost. Based on data in Albuquerque (2001).

[f] From Albuquerque (2001).

As a result of these differences, growers are more likely to act collectively and in collaboration with the state when they produce perennial crops (such as mangoes, grapes, and apples), whose upgrading often calls for complex and long-term R&D, too costly for individual growers to undertake. Growers of annual, short-term crops (such as melons), in contrast, can usually carry out much of the R&D independently or with guidance from

[93] Note that irrigation is not a one-time investment cost for melon growers in RN since the drip irrigation system is laid out each cycle, in contrast to a fixed irrigation system.

local input suppliers, consultants, and their buyers, thus having fewer incentives to collaborate with other growers or government agencies. An especially illustrative example here is how melon growers have engaged repeatedly with their global buyers and input suppliers in carrying out field trials for melon varieties (described in Chapter 5).

The disincentives for inter-firm collaboration embedded in the comparatively "easier" production of melons thus helps explain the absence of the kinds of collaborative institutions that have helped growers upgrade in the other cases. One could argue that the melon industry is really the success story among my cases because growers have managed to upgrade without the costly collective arrangements and public support present in the other cases. The evidence, however, reveals a comparatively more vulnerable sector. In fact, growers' failure to collaborate in RN has led to several collective failures, including the widespread infestation with white flies beginning around 1999 which could have at least been diminished through a joint monitoring system, and the depletion of the water table in 2001 resulting from the uncontrolled exploration by too many growers in the Mossoro region. The once leading, pioneering firms, have all gone out of business. And, as shown earlier in the chapter (Figure 8), growers from RN have gradually lost much of their market share in the UK to growers from the state of Ceará.

Different arrangements across two perennial crops: Mangos and grapes

Crop characteristics also help explain the different arrangements across two perennial crops: mangos and grapes in PJ. As the two main fresh fruits produced in PJ (in terms of value), mangos and grapes share a common history of access to similar public sector support. Growers first began producing mangos and grapes in the region as a result of CODEVASF's transformation of the region's infrastructure, establishment of irrigation projects, facilitated access to credit, and guidance and initial funding of the sectoral association, VALEXPORT. Yet the very different production and marketing requirements between mango and grapes generated distinct structures of production and collective good problems.

Visiting mango and grape farms readily reveals their different production and marketing requirements. Mango plantations are generally extensive, with countless rows of mango trees separated by just enough room for trucks and tractors to drive by with

farmworkers armed with large pruning shears and agrochemical sprayers. Somewhere in the property stands the packhouse, which for the larger grower-exporters, includes the USDA-certified thermal bath and quarantine infrastructure in addition to sorting and packaging systems. Vineyards, in contrast, are much smaller and structured so as to permit farmworkers to reach each and every bunch. The trellises are just above head height, permitting workers to painstakingly remove excess growth with manicure scissors.[94] Once grapes are harvested, growers take them to a packhouse and, within hours, to a refrigerated warehouse.

The differences in mango and grape production are also reflected in their different cost structures. According to the data presented in Table 10, grapes cost about three times as much to produce per hectare than mangos. Much of this difference is explained by the greater labor-intensity of grapes: per hectare, labor costs for grapes are more than twenty times as much as labor costs for mangos.

These distinct crop-based demands naturally led to different structures of production. Although precise data on the distribution of production by crop and by grower size are not available, interviews with mango and grape researchers and consultants in PJ are consistent with Alves da Silva's (1996) earlier estimates that large grower-exporters produce about 60% of the mangos in PJ, while medium growers produce about 60% of grapes.

This size distribution has direct influence on the kinds of problems growers have to resolve collectively and how they go about in doing it. In the case of mangos, large growers first organized when faced with the prospective of exporting to the US and its strict import regulations. Large mango growers, with initial financial and managerial support of CODEVASF, formed VALEXPORT in 1988 (Damiani 1999). Among other objectives, growers designed VALEXPORT to represent them and grape growers before federal agencies, carry out market studies, and organize and manage the USDA-required fruit fly monitoring program. VALEXPORT has 55 members (including two cooperatives), accounting for 70% of all the fresh fruit production in the San Francisco River Valley and 80% of its mango and grape exports (VALEXPORT 2002).

[94] Collins (1995) provides an excellent description of grape production and postharvesting practices in PJ.

As discussed in Chapter 3, VALEXPORT has been the most powerful grower association in PJ, responsible for coordinating research and marketing programs along with federal and state government agencies. At the same time, all but the largest mango growers resent VALEXPORT's lack of transparency and participation, where the same co-directors have essentially governed VALEXPORT since its creation. Medium mango growers complain about VALEXPORT's bias towards "big firm interests" and at least one medium grower association has begun to collaborate directly with CPATSA in research projects independently of VALEXPORT. Grape growers are also discontent with VALEXPORT because of its bias towards mango production despite their ongoing financial contributions to VALEXPORT.

Having the additional challenge of pooling production, grape growers are mostly organized around the Brazilian Grape Marketing Board (BGMB). Grape growers within VALEXPORT created the BGMB in 1992 as a division of VALEXPORT to "overcome the high cost of shipping individually by bulking produce, and to avoid competition among producers" (Collins 1995:1109). To this end, members collectively purchase inputs, enforce quality standards, coordinate timing of harvests, contract shipping, and sell under one brand-name. The BGMB has 22 members, including one cooperative (that of the Japanese-Brazilian growers, CAJ), and is responsible for about 80% of the grapes produced in PJ.

This chapter shows how specific characteristics of crops and their markets influence whether and how growers organize to resolve collective good problems. The mango-grape comparison in PJ reflects that crop characteristics first and foremost affect the structure of production of each crop: the substantial labor-intensity of grapes makes it a more suitable crop for medium and not large-scale production. The next chapter focuses precisely on how medium growers in PJ and the other cases have overcome collective good problems.

CHAPTER 5. RESILIENT MEDIUM GROWERS

The literature tends to emphasize the many reasons why all but the largest growers should remain in the market, including access to resources, production and marketing knowledge, postharvest transport and marketing services, and expertise in the use of pesticides and other agricultural chemicals which are of rising concern for buyers. These medium growers, moreover, necessarily need to pool their production to meet the economies of scale involved with post-harvesting and marketing, as well as to meet buyers' demands for continuous and reliable supplies.[95] In light of this exclusive tendency and associated concentration of production, I was struck by how production by commercial medium growers, in particular, has remained substantial even in recent years, accounting for 30% to 60% of the fruits produced in each cluster (Table 11). Given that medium growers channel most of this production via larger growers or directly to buyers, these data raise questions about how medium growers have been resilient and responsiveness to the pressures for upgrading.

This chapter explains how medium growers first entered the market and how they have managed to upgrade and transform their production and post harvesting practices accordingly. It makes two sets of arguments. First, the nature of public sector support which varied between the cases influenced the adoption of fruit production by medium growers in earlier decades by shaping a) the structure of production in each case, influencing the possibilities for medium growers to adopt fruit crops, and b) the kinds of public sector support available for medium growers, especially access to credit, and agricultural research and extension. And second, medium growers have more recently managed to remain in these high-value markets through a) increased (but limited) interaction with local input suppliers and consultants that have served as sources of technical assistance and innovation; b) subcontracting relations with large grower-exporters; and c) ethnic-based cooperatives.

Before proceeding, it is important to clearly define who are these medium growers – what differentiates them as a group and across the cases – and to provide evidence of their participation in producing these crops. The medium growers in this

[95] See Farina (2002), Gibbon (2001), Reardon et al (2002), and Thrupp (1994).

study are so defined relative to the range in farm size in each case, as reflected in Appendix B. As such, a grower producing 50 hectares may be considered large in the case of grapes, but small in the cases of melons, since the financial, management, production, and post-harvesting requirements per hectare are much greater for grapes than for melons. For SC and PJ, I use the cut-offs between grower sizes and data on firm structure from available studies.[96] Data for RN are from my own field research.[97]

Table 11. Participation of medium growers across the cases

Case - crop	Criteria[a]	1985	1988/1991	1996/1997	2002
Santa Catarina - apples[b]	< 60 ha	48%	35%	30%	n.a.
Petrolina-Juazeiro - all crops[c]	*< 200 ha*	*81%*	*66%*	*61%*	*56%*
mangos	< 50 ha	n.a.	n.a.	30%	40%[d]
grapes	< 20 ha	n.a.	n.a.	59%	60%[e]
Rio Grande do Norte - melons[f]	< 300 ha	0	9%	27%	n.a.

Note: These data reflect the percentage of production of each crop that is produced by medium (and some small) growers. For example, by the late 1990s, medium growers were producing roughly 30% of all the apples produced in Santa Catarina.

[a] The cut-offs for grower size are based on Boeing (1998) for SC, Alves da Silva (1996) and own estimates for PJ, and Gomes (1999) for RN.

[b] Data for 1985 and 1996 from Santa Catarina State Census, as cited in Boeing (1998); data for 1991 from Hentske (1994).

[c] The first row is the share of small and medium growers in the total irrigated area in PJ, not just for mangos and grapes. These data are included since no time series are available that pertain specifically to mangos and grapes. Data are for Senador Nilo Coelho Irrigation Project, the largest among CODEVASF's six projects in PJ. Unless otherwise noted, data for 1985 and 1988 from Miranda (1989), 1996 from Alves da Silva (1996), and 2002 from www.codevasf.gov.br/produtos/pro_senadornilocoelho.htm.

[d] Data from interview with Director of EMBRAPA Semi-Arido.

[e] Data from interview with grape consultant in Petrolina.

[f] SMEs refer to growers with less than 300 planted hectares. Data from own fieldwork, as presented in Gomes (1999).

Generally speaking, medium growers differ from larger growers not only in terms of area planted or produced, but also in terms of the levels and kinds of fixed capital equipment (such as storage and processing plants), administrative strategy (self-managed versus professionally-managed), and the use of labor (self-supervised versus hierarchically-supervised). Large growers, in turn, undertake agricultural production as a

[96] See Hentske (1994) and Boeing (1998) for grower size and distribution in SC, and Miranda (1989) and CODEVASF (2003) for PJ.
[97] See Gomes (1999).

secondary activity to construction, transportation, or banking and many are from traditionally wealthy and politically connected families. Medium growers, in contrast, are usually agronomists or agricultural technicians, fully dedicated to their farms, which tend to focus almost exclusively on fruit crops. Small growers range from well-qualified growers with the means to eventually expand into medium growers, to others who remain focused on lower-value crops, with only minimal investments in fruits.

As for the participation of medium growers across the cases, the available data may seem contradictory to my claim about medium grower resiliency since the share of medium growers has actually fallen since the 1980s in both SC and PJ, as shown in Table 11. These data deceive, however, since they do not capture the transformation of most medium growers across these cases. Generally speaking, medium growers originally produced fresh fruit with minimal technology and rudimentary post-harvesting infrastructure, resulting in low quality fruits until the early 1990s. Medium growers producing by the mid 1990s, in contrast, were producing crops of comparable quality to that of larger growers, often adopting the same production and post-harvesting technologies. Even when medium growers have not had modern pack houses, cool storages, and processing equipment (in the case of thermal bath for mangos), they have had enough infrastructure and know-how to deliver quality fruits to larger growers, good enough for larger growers to then turn around and sell these fruits under their own brand names.

I present my arguments in light of work that analyzes the social and economic impacts of non-traditional agricultural exports (NTAEs) on farmers. NTAEs are crops that were not traditionally produced in a particular country or region, or was traditionally produced for domestic consumption but now is exported (Thrupp 1995). Drawing mostly from the Central American experience, this literature argues that the introduction of NTAE often excludes smaller growers because of their limited resources, limited production and marketing knowledge, insecure access to postharvest transport and marketing services, and lack of expertise in the use of pesticides and other agricultural chemicals which are of rising concern for buyers.[98] These are among the "size biases" which favor larger scale production of NTAE, including fresh fruit, and which ultimately

[98] See Carter et al (1996), Collins (1995), Murray (1994), and Thrupp (1994).

override the advantage smaller growers may have because of certain diseconomies of scales in production.[99]

In addition to the above mentioned constraints, more recent work on the restructuring of food retail argues that medium growers are also at a disadvantage under the new market conditions because they are less likely than larger growers to make the needed technological and organizational improvements to ensure quality, consistency, and timing as defined by their buyers.[100] This means that, if medium growers are to produce fruits with comparable quality to those produced by larger growers, investments in technology and management must ensure traceability and the reduction of transaction costs associated with monitoring of a many smaller sized growers.

Emerging studies reveal several ways through which small and medium growers have managed to remain in the market, but none of these explanations hold for Brazilian growers. In some cases, growers remain in the market through sourcing arrangements with smaller supermarkets (Faiguenbaum, Berdegué, and Reardon 2002) or with dedicated wholesalers who contract out for supermarkets (Alvaro and Charmel 2002). In other cases, medium growers benefit from regulatory supports that ultimately protect them, such as the French government's support of the French wholesale markets (Gibbon 2003), or the EU's Banana Regime that protects suppliers from African, Pacific, and the Caribbean. And still others benefit from fair trade arrangements (Page and Slater 2003). In Brazil, larger supermarket chains already account for about 50% of fresh fruit and vegetable retail, compared to 9% in Chile and 30% in Argentina and Mexico. In addition, growers have not benefited from protected markets or privileged trade status, and have had limited participation in fair trade arrangements.

Evidence from my cases suggest that whether or not medium growers are excluded from the market depends not only on the nature of actors along a particular supply chain (including importers, buyers, and supermarkets), but also on the scale and scope of public sector support that facilitated medium growers' participation in these chains in an earlier phase. More recently, as federal and state government support for

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[99] Diseconomies of scale associated with fruit production arises from 1) smaller growers having cheaper labor, and 2) particularly for management-intensive crops, like grapes (Barry and Cline 1979, Binswanger and Elgin 1990, Collins 1995).

[100] See Dolan and Humphrey (2004), Faiguenbaum, Berdegué, and Reardon (2002), Farina (2002), Gibbon (2003), and Reardon and Berdegué (2002).

agriculture declined, medium growers have benefited from a rise in private provision of agricultural extension and, especially, from technological diffusion through subcontractual ties with grower-exporters and through the continued engagement with ethnic-based production and marketing networks.

To be fair, much of the work noting how high-value crops marginalize medium growers focus on very smallholders alone – those with at most 1-2 hectares. The growers that are squeezed out of the market then are many times smaller than those included in my category of medium growers. Likewise, some of these studies draw upon cases of fresh vegetables, which have more complex processing and logistics problems that those of fresh fruit.[101] That being said, I hold to my claim of small and medium grower resiliency because these growers are indeed many times smaller than the larger growers in each case, as described above.

A caveat before proceeding: Brazil's large domestic market may seem enough to explain why smaller growers have managed to participate in the market, assuming as we often do that domestic markets are less demanding than export markets, thus providing medium growers with a niche for lower-quality fruits. Although Brazilian growers may not be under as much pressure for quality standards as growers in other almost exclusively export-dependent countries in which fresh fruits have been analyzed (including Chile, Peru, Guatemala, Zimbabwe, and Kenya), they are nevertheless under pressure to upgrade because: 1) even if exports are only a small share of production (apple growers in SC export only 7% of their production), exports are important complements to the domestic market; 2) growers faced increased competition in the domestic market from imports especially in the mid 1990s, a factor less significant in small countries with small domestic markets; and 3) large domestic food retailers in Brazil are becoming as demanding as global buyers.[102] The large-domestic-market-low-quality argument, therefore, is insufficient to fully explain the participation of small and medium growers in the Brazilian fresh fruit industry.

This chapter is organized as follows. The fist section begins by describing how early public sector policies supported small scale production of fruit crops. Given the fall

[101] Such as Dolan and Humphrey's account of the Kenyan vegetable exporters to the UK.
[102] See Farina (2002), Reardon and Berdegué (2002).

in public sector support over the years and the rising pressures for upgrading, the second section then argues that, although the increase in private sources of agricultural extension accessible to medium growers has been important, it has been insufficient to "fill the gap" left by the fall in public extension. At the same time, medium growers have more recently benefited from the rising tendency of larger firms to subcontract production as a cost-reducing strategy, and from the endurance of an ethnic based network of medium growers.

Medium growers and the state

Government policies were central in enabling or facilitating the participation of small and medium growers across the cases in an earlier period. Much of this support was paternalistic and unsustainable, including the high per grower investment in SC's agricultural extension and training programs, and the debatable selection of program beneficiaries in PJ that eventually resulted in high turnover rates. But to simply dismiss these earlier policies altogether would be to miss out on aspects of this support that, in addition to stimulating agricultural development, also enabled medium growers to enter the market, modernize, improve their livelihoods, and contribute to the generation of local employment and income.

In what follows, I illustrate how public sector support influenced the adoption of fruit crops by small and medium growers in the early years of each cluster, especially through its impact on the structure of production and the relationship the state established between medium growers and public sector agricultural research and extension agencies. Among the differences that emerge between the cases, the mission and structure of the coordinating agency is especially strong in explaining the degree to which the public sector intervened in favor of medium growers and the varying levels of state-grower relations.

Instituting a small firm bias: The small-firm tradition in SC

Over 600 medium growers in SJ produce about 30% of the state's apples, supplying to large firms in Fraiburgo and in Vacaria (in the neighboring state of Rio Grande do Sul), or marketing directly through cooperatives. That medium growers in SC

have managed to participate in the apple market is explained by the pioneering efforst of members of the agricultural cooperative COTIA and, especially, by state government policies that supported small-scale production alongside larger growers from early on in the formation of the sector.

As the Frey brothers pioneered apple production in Fraiburgo, COTIA growers led the way for small-scale production in Sao Joaquim. COTIA growers initially had very limited knowledge about apple production technology and lived through years of trial and error, even with guidance from ACARESC and the Japanese International Development Agency (JICA) researchers.[103] By the early 1990s, these same medium growers were producing high quality apples and investing in modern pack houses and storage facilities. The transformation of the COTIA group of growers, although unmatched by any other group in the cluster, reflects the general trend of improved production by medium growers in Sao Joaquim.

At the same time, medium growers benefited from SC state government's long-standing commitment to small scale enterprises. Inspired by the successful apple production by the lead firm in Fraiburgo, in 1968 the SC state government established an uncommonly well-structured program targeted at promoting the production of apples and other temperate fruits. The *Programa de Fruticultura de Clima Temperado* (PROFIT), administered through the state's Association of Credit and Rural Assistance (ACARESC), first mapped out regions within the state apt for fruit production and established several regional technical extension offices. Through its support, PROFIT enabled small growers to adopt apple production through a combination of support policies for credit, marketing, research, training, and extension, as described in Chapter 1.

In addition to helping growers adopt apple production, early state support also established a link between growers and the state agricultural research agency that persisted well into the 1990s. This lasting impact was the result of the structure of the SC state's agricultural research system which benefited medium growers in two particular ways.

[103] Their initial choice of varieties, for example, was heavily based on the experience of other countries. As a result, growers toiled with several varieties which ultimately turned out to suffer from pollinization problems, low productivity, and low quality.

First, the structure of the state's agricultural research system facilitated access of small growers to public sector research. The state did this by distributing the responsibility and resources for apple research across two state research experimental stations, one near Fraiburgo (in Caçador), and the other in São Joaquim.[104] The state spread apple research across two of its experimental stations to enable state researchers to focus on the particular characteristics of each region which differ in terms of climate, terrain, and soils, and to the different varieties, with emphasis on Gala in Fraiburgo and Fuji in São Joaquim. As an unintended consequence, this structure avoided the appropriation of research by the larger, more powerful growers in Fraiburgo, since larger growers are located in Fraiburgo and medium growers mostly in São Joaquim. This set up avoided the kind of "fatal attraction" Tendler (2001e) notes can occur as a result of proximity between large firms and nearby public institutions that result in limiting spillovers to other potential beneficiaries. Instead, the smaller growers in São Joaquim had direct and easy access to their own station, located within walking distance of downtown São Joaquim.

Second, the state's long-standing research consortium with the Japanese International Cooperation Agency, JICA, was also crucial to consolidating the lasting relation between state researchers and medium growers, particularly those associated with COTIA. This consortium dates back to the early 1970s when, as part of PROFIT, the SC state saught technical assistance from apple experts from countries with tradition in apple production, including Japan. The EPAGRI/JICA consortium provided generous funding for the acquisition of laboratory equipment and training to Brazilian agronomists in Japan, while also supporting a residency program where Japanese researchers spent from one to five years stationed at the Experimental Station in São Joaquim. Among the contributions of JICA researchers to growers in São Joaquim was the introduction of the Fuji variety, brought to São Joaquim from Japan by JICA researcher, Dr. Ushirozawa, who subsequently remained in São Joaquim. JICA researchers became an integral part of

[104] Prior to apple research , the Experimental Center in Caçador focused mostly on corn, beans, and cereals. It was only in 1983 that the SC state government transferred apple research to Caçador from its center in Videira, which had done apple research since the 1940s (Santos 1994). As for the Experimental Station in Sao Joaquim, ACARESC established it as part of its PROFIT program.

the COTIA community in São Joaquim, forming long-lasting professional and personal ties with growers, and providing them a privileged liaison to state research.

Although this privileged relationship to JICA researchers was limited to COTIA growers, who traditionally exclude non-Japanese from their communities, other small growers in the state benefited indirectly from the technology transfer via JICA and from the state's impressive agricultural extension service. As described in Chapter 1, the SC state government's agricultural agency, ACARESC, had a well-trained and well-equipped cadre of extension workers dedicated to helping growers learn how to produce apples and other temperate fruits. ACARESC's extension workers visited growers weekly, "almost too much," according to some growers, reflecting a strong sense of mission.[105] ACARESC also sponsored field days in demonstration units, andoffered courses in their training centers, providing transportation to and from the centers, and lodging and meals for the duration of each session.

ACARESC helped growers beyond the production phase by helping them organize into marketing cooperatives. In the 1970s, ACARESC assisted medium growers in forming about seven cooperatives dedicated to temperate fruit production by providing growers with technical assistance and access to storage chambers. ACARESC also administered the Fund for Cooperatives, a state fund that allowed these newly created cooperatives to obtain investment capital at favorable rates and conditions (Olinguer 1996). Despite ACARESC's success in other efforts, all but one cooperative closed down because of administrative failures and technical problems, including the choice of locations with inappropriate agroclimatic conditions for apple production.

Only one of these, COOPERSERRA, remains active, uniting 90 medium growers, each producing between 3-5 hectares, or together about 3% of the state's production.[106] The cooperative has its own pack house with storage, selection, classification, and packaging infrastructure, and provides technical assistance to its members, who often attribute their successful production to this very assistance.[107] The survival of COOPERSERRA can be attributed at least in part to its location – SJ turned out to be among the best apple producing areas in the state. Members of COOPERSERRA thus

[105] See Tendler (1997).
[106] Based on cooperative data from Dotti (1999) and state production from IBGE.
[107] Globo Rural (1999) June 26-30.

not only benefited from the very favorable agroclimatic conditions, but also from the dense network of growers, ACARESC extension workers and state researchers that congregated in SJ.

These early efforts by the state government agency established a lasting network between growers and state researchers and extension workers, which outlasted the demise of ACARESC (more details later in the chapter). By the late 1980s, the state reduced its budget for agricultural research and extension and, in a move consistent with that observed throughout Brazil, in 1990 merged its research (EMPASC) and extension (ACARESC) agencies into one, the *Empresa de Pesquisa Agropecuária do Estado de Santa Catarina* (EPAGRI). At the same time, the 1988 Constitution decentralized several responsibilities from the federal government to state governments, including the administration of myriad rural and agricultural programs, such as those dealing with the land bank and reforestation. Extension workers, now fewer in number, had to substitute their time in the field with time in the office administering these projects. As one extension worker put it, "EPAGRI gradually lost its identity with fruit production. What remains is a 'shadow' of those of us who had 'lived' fruit production." In another account, a former director of ACARESC blames the merger for the "loss of identity" for both EMPASC researchers and ACARESC extension workers.

Apple growers no longer count on the resources, political commitment, and esprit d'corps which defined ACARESC and gave it the impetus to implement PROFIT as successfully as it did. Even so, the ties the SC state generated with medium growers early on taught growers to seek the state and promoted a mutual familiarity between growers and state workers that continues to benefit growers as they seek the state for support in improving their crops and production practices. In particular, the state's initial strategy has endured in its outreach to medium growers through medium growers' continued interaction with researchers at the Experimental Station in São Joaquim and with former ACARESC extension workers now based in municipal-level offices. This kind of lasting government commitment to medium growers was not found in the other cases.

Redistribution and diversification: The changing nature of medium growers in PJ

While medium growers in SC benefitted from a state government historically committed to supporting smallholder production, medium growers in PJ benefited from CODEVASF's explicit policies favoring their incorporation in the irrigation projects along the San Fransisco River Valley. Through its development strategy, CODEVASF directly shaped the structure of production in PJ to include smallholders, redistributing exppropriated land, of which it originally designated 60% to smallholders, mostly in 6 hectare lots. That CODEVASF managed to expropriate so much land in the PJ area is partly explained by the backing of the politically influential Coelho family, who supported the construction and expansion of the projects in PJ because of its potential to develop the region, not only through irrigation itself, but also through the related provision of roads, electrification, and construction of schools and housing for project beneficiaries (Damiani 1999:61). CODEVASF's emphasis on smallgrowers also reflects the current of the time in promoting irrigation in the Northeast as a means of transforming the livelihoods of the population of the semi-arid. The idea was to settle families in these projects and provide them with whatever was necessary for them to produce irrigated crops, including subsidized inputs and credit, access to irrigation, electricity, road infrastructure, and agricultural research and extension.

The state-small grower relationship in PJ differed from that in SC in at least three inter-related aspects that influenced the long-term viability of smallholder production. Whereas in SC, medium growers have continuously produced throughout the years, medium growers in PJ have exited and entered, with high turn-over rates among original settlers and a high influx of new, medium sized growers from other states. This substitution of small growers by medium growers has accompanied the expansion of perennial crops observed in the projects since the mid 1990s.

First, the distinct nature of the involved agency in each case led to tighter relations between growers and state agencies in SC and weaker ones in PJ. CODEVASF was an engineering-based agency, focused on constructing massive irrigation and productive infrastructure along the entire San Fransisco River Valley, including the establishment of public irrigation projects. ACARESC, in turn, was a rural development agency, focused on agricultural extension, training, and credit and which, at the particular

moment in time, promoted the production of temperate fruits, and especially of apples, among the state's smallholders.

CODEVASF also instituted a link between public sector agricultural research and extension and growers. This link was far from the tight focused and lasting relationship of ACARESC and growers in SC, but also served to provide growers a source of know-how and skills. CODEVASF from early on coordinated research among federal and state agencies, namely CPATSA and IPA, tailored to the needs of growers in the irrigation projects. Most of this research focused on identifying the optimal water schedules and other production technologies for those crops CODEVASF had identified as priority for the region: mostly a combination of annual crops, led by tomatoes, onions, and peppers. IPA played an especially important role in the tomato industry, identifying a variety particularly suitable for local production and supplying growers with a planting manual. CPATSA meanwhile focused on smallholder crops, including several rainfed crops, which were expected to complement growers' irrigated production.

CODEVASF also provided agricultural extension to growers throughout the 1970s and 1980s. Although there were extension workers in offices throughout each irrigation projects, this extension turned out to be problematic because it was highly focused on infrastructure and maintenance, being less qualified for technical support with irrigated crops. In fact, in a survey of tomato growers as late as 1995, many growers mistrusted these extension workers on technical grounds (Gomes 1996). Extension workers were also often at odds with growers because extension workers were also the collectors of user fees among growers. According to a director of the Senador Nilo Coelho Irrigation District, "CODEVASF only really offered technical assistance beginning in 1992; until then we were collectors (*cobradores*)."

Second, CODEVASF's selection criteria for smallholders to settle in the irrigation projects had serious consequences and remains debatable.[108] As a general rule, maximum priority was given to farmers who had been displaced through CODEVASF's land expropriations for irrigation projects and works. Second in line were the small growers residing locally, then in the local region, and so forth. Other factors accounted for were the candidates' experience with agricultural activities, the household labor force, and an

[108] See Alves da Silva et al (1996) and Gomes (1996).

interest in irrigated agriculture.[109] Though the latter criteria are more critical for success in irrigated agriculture (experience, technical aptitude), the former criteria were dominant in the selection process (loss of land from CODEVASF appropriation). Consequently, many of the growers initially settled in the projects tried producing tomatoes and other annual crops as guided by CODEVASF, but ultimately were unable to pay their water fees or diversify when the market called for it because were completely unprepared to work with irrigated agriculture.

What further exacerbated the situation for many of these growers was CODEVASF's decision to begin enforcing water fees in the early 1990s – until then, most growers had never paid for their water use.[110] More importantly, CODEVASF began requiring growers to purchase their lots beginning in 1995. Although growers had been aware of this provision since their initial occupation, most were unable to pay up and, already in a dire situation, "sold" their farms. (Growers settled in the projects are not landowners, but rather legal occupants of their farms, yet they can sell their land entitlements in the market).[111]

And third, while early on medium growers in both cases benefited from abundant support with credit, training, research, extension, and marketing (cooperatives in SC, link to agroindustries in PJ), in SC, medium growers produced the same crops as the larger growers, while in PJ, medium growers focused initially on different crops and only switched to fruits in the 1990s. As a result, medium growers in SC benefited from the learning process of large firms along the way, while those in PJ did not. CODEVASF's choice of crops for medium growers also had its mixed results. While many medium growers successfully adopted tomatoes then subsequently diversified into other crops, including perennial fruits, many medium growers learned to produce tomatos, but failed to diversify when the tomato pulp processing industry closed down in the late 1980s. Tomato production was initially a safe activity for growers: they received technical assistance, advanced inputs, and a minimum price through contracts with the processing firms, which were mediated by CODEVASF's Office of Technical Assistence (ATER).

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[109] See CODEVASF (1987).
[110] According to Cavalcanti (1999), when CODEVASF began enforcing water tariffs, 72% of growers in the projects were late in making their payments, including some growers who were late as many as 20 payments, totaling over R$ 15,000.
[111] See Gomes (1996).

The dependence on the processing firms as buyers was complete however. Without the local buyers, growers could not transport (highly perishable) tomatoes to the large consumer centers in Sao Paulo and other Southeastern and Southern states.

These early efforts had mixed results for medium growers. On the one hand, many medium growers successfully adopted irrigated crops over a ten year period, transitioning from annuals to perennials, and have as a result improved their livlihoods, and generated employment and income. The diversification from annuals to perennials can be illustrated by examining data for the largest irrigation project in PJ, the Senador Nilo Coelho Irrigation Perimeter (DISNC 1999, 2001).[112] This data reflect three notable trends:

- First, growers began substituting annual crops with perennials in the early 1990s and by the late 1990s, perennial crops occupied over 70% of the land in the project, tending towards 100% in 2001, as shown in Figure 9.
- Second, by the late 1990s, most medium growers (54%) had adopted the production of a perennial crop, especially bananas, mangoes, coconut, guava, and grapes.
- And third, by 1998, at which point perennials already covered nearly 80% of the land in the project, 44% of growers had occupied their lots for at least 11 years, and most of these had been original occupants.

Damiani (1999) describes this process and argues that growers' successful transition towards perenial fruit crops derived from CODEVASF's development strategy. According to Damiani, CODEVASF fostered a sequence in learning from annuals to perennials, allowing growers to gradually learn about irrigation technology and marketing, while gradually investing in perennials while living off the continuous income from annuals. CODEVASF also faciliated this transition by facilitating access to credit through World Bank funded *Programa de Fruticultura* (1989), administered by the Bank of the Northeast, which unintentionally faciliated the transfer of technology among growers.

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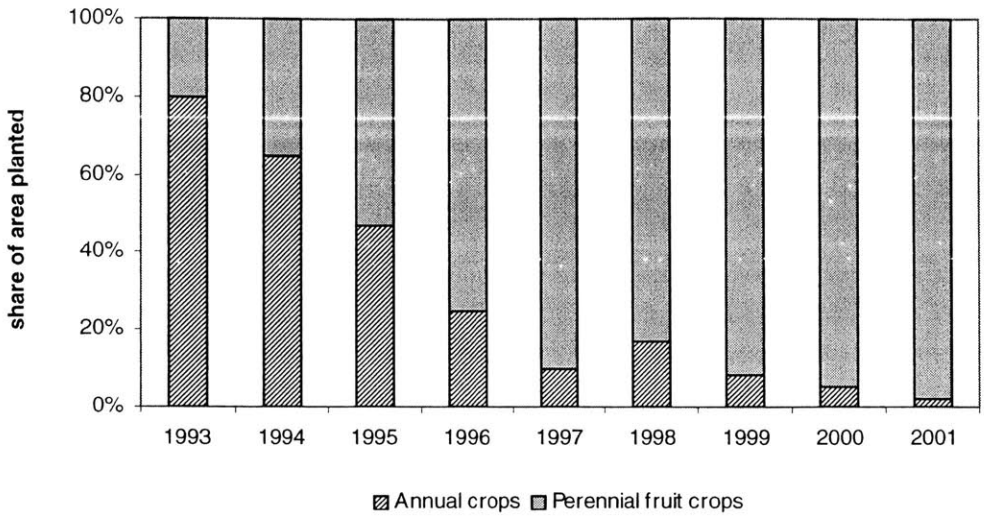
[112] The Senador Nilo Coelho projects accounts for about half of the total area in CODEVASF's six public irrigation projects in PJ (22,061 of 46,729 ha, or 47%) and about half of the total government expenditures by CODEVASF on common irrigation infrastructure and "benfeitorias" in lots (US$341 million of US$674 million, or 51%) (small growers 1999).

Figure 9. Share of annual and perennial crops produced in Senador Nilo Coelho Project



Source: DISNC 2002.

On the other hand, this diversification among medium growers has been accompanied by the substitution of the original smallholders by medium growers, many of them from Sao Paulo and of Japanese and Italian descent.[113] According to available data, between 40%-70% of the original settlers in some of CODEVASF's projects abandoned their lots because they were unable to succeed in irrigated agriculture or diversify into perennials.[114] The abandonment by the original settlers opened the way for occupation by the newer, medium sized growers, whose entry into production was facilitated by the availability of credit and the expansion of processing capacity among larger firms. medium growers in PJ, as elsewhere, had always faced the problem of difficult access to investment capital. This was especially constraining in the case of fruit production which generally take several years to become commercially profitable because of the first years in which these plants do not produce fruits. To circumvent this problem, CODEVASF and the Bank of the Northeast reached an accord in 1994 that

[113] As described by Cavalcanti (1999).

[114] small growers (1999) estimates turn-over rates of about 50% for the Bebedouro and Mandacaru Projects and of 43% for Curaçá, and Alves da Silva et al (1996) and Rocha (1996) estimate turn-over rates of 70% and 60%, respectively, for the Senador Nilo Coelho Project. The estimates for the Senador Nilo Coelho Project were confirmed through a personal interview with the current director of the Senador Nilo Coelho Irrigation District.

enabled growers to use their lots as collateral for investment capital. The newer growers also benefited from the rising tendency of larger firms to subcontract production and from the recent increase in the number of large processing firms.

These newer growers are generally agricultural technicians or agronomists, many from the South and Southeast regions, others former employees of the larger firms or EMBRAPA. This substitution can be explained by factors that affected the performance of the original settlers, along with policies and changing market conditions that facilitated the entrance of the better-qualified medium growers.

As in SC, medium growers in PJ no longer count on the abundant public sector support of earlier decades. Whereas in SC medium growers continue to benefit from a lasting relationship with EPAGRI, medium growers in PJ instead benefit from newer mechanisms used by EMBRAPA that ensure small growers access to agricultural research. One example is EMBRAPA's research of seedless grapes which is being done in collaboration with Brazilian Service for Micro and Small Enterprises (SEBRAE) to ensure that research findings reach smaller grape growers. EMBRAPA's work with seedless grapes began in 1995 with experimental installation of 20 varieties, of which one has been especially successful (Festival). As part of this effort, EMBRAPA developed a collaborative effort with SEBRAE to disseminate seedless grape technology to medium growers. This dissemination is critical for the adoption of seedless varieties since they demand more careful management of grafts in order to avoid maturation during rainy season, to which seedless varieties are especially susceptible.[115]

Another example is EMBRAPA's recent collaboration directly with medium growers bypassing the previously used intermediation by the sectoral association, VALEXPORT. It used to be that EMBRAPA only worked with VALEXPORT, who then turned around and charged growers for provision of public services. In the case of integrated production, for example, VALEXPORT had proposed to EMBRAPA that it be the sole administrator in PJ. Concerned that this intermediation by VALEXPORT would only raise costs for adherence to the program, groups of medium growers, namely APROVALE (a mango cooperative), CAJ, and the Irrigation District, successfully requested that EMBRAPA work directly with them independently of VALEXPORT.

[115] See EMBRAPA Semi-Arido (2002).

In hindsight, CODEVASF committed several of the mistakes pervasive in public irrigation projects in Brazil and elsewhere, including in its initial selection of beneficiaries, provision of technical assistance, and initial choice of crop (the emphasis on tomatoes). At the same time, CODEVASF established a structure of production inclusive of medium growers and enabled many of them to subsequently adopt perennial fruit crops and participate in the increasingly demanding fresh fruit market.

Halfway there: the piecemeal approach to medium growers in RN

In contrast to the other cases, medium growers did not participate in the early phase of the melon industry in RN, but rather entered the market a decade later, in the early 1990s, and rapidly increased their participation, reaching 27% of area planted by 1997 (Table 10).[116] The changing composition of growers was not the result of planned policy as that promoted by the state government of SC commited to small grower development or the politically-backed CODEVASF approach to incorporating medium growers. Despite the absence of a coordinating agency, medium growers nevertheless benefited from several public sector initiatives in RN, including 1) a public irrigation project in Assu, 2) federal agrarian reform settlements of the National Institute for Colonization and Agrarian Reform (INCRA) throughout the state, and 3) a Bank of the Northeast (BN)-sponsored program that subsidized land for new agronomists.

These early steps enabled many medium growers in RN to take advantage of the expanding market that resulted from the liberalization and stabilization policies of the mid 1990s – precisely when the pioneering firms began subcontracting, and of the discovery of new and more accessable sources of water. [117] Although each of these initiatives ultimately helped medium growers adopt melon production, I argue their

[116] Although more recent data on medium grower participation in RN is unavailable, I suspect it has increased as the pioneering firms went bankrupt between 2000-2002, the largest firm now (an "offspring" of the pioneering firm) subcontracts about half of its production, and former agronomists from these bankrupt firms have established their own farms and marketing groups, thus raising the total number of medium growers and their participation in total production.

[117] Up until the mid1990s, most of the irrigation in Mossoro was based on water drawn from deep water wells (700-1000m), which cost up to US$ 500,000 to build. In the mid 1990s, a local geologist discovered the possibility of shallower wells, costing as little as US$ 15,000. Even so, there were several public sector supports that, in the least, influenced how segments of medium growers adopted irrigated production. See Gomes (1999).

impacts were minimized because they did not have a committed state government as in SC or a central agency with political backing, as the Coelho Family in CODEVASF.

How a public dam went private

In contrast to the widespread benefits of the irrigation infrastructure among fruit growers in PJ, the public dam built by the federal government in RN in 1985 benefited mostly two very large melon growers for its first decade and a half.[118] The National Department of Works Against Droughts (DNOCS) originally planned the public dam in Assú along with a public irrigation project intended for small growers, the Baixo Assú Project. Although irrigation agencies have an advantage in implementing redistributive programs because of their power to expropriate land for projects (Tendler 1982) and DNOCS originally designed the dam with a redistributive component through a public irrigation project, the redistributive effects in Assú have been minimal.[119]

Part of the problem was that DNOCS was not focused on implementing irrigation projects per se. It build the Armando Ribeiro Dam in Assu in 1983 as part of DNOCS' strategy of retaining and distributing water throughout the semi-arid Northeast region. It completed the irrigation project component only a decade later, at which point may locals who had hoped to participate in the project had already sold their lands. At the same time, once established, growers that did settle in the project never received adequate technical assistance and many continued producing the same combination of crops they had done so without irrigation. Finally, large private entrepreneurs purchased the best lands in terms of soils and location along the area of influence of the dam.

Modernizing agrarian reform settlements

Aside from the Baixo Assu Project, the federal government also facilitated smallholder access to land, credi, and technical assistance in RN through about 20 federal agrarian reform settlements administered by the National Institute for Colonization and Agrarian Reform (INCRA). INCRA established these agrarian reform settlements during the 1980s as part of its strategey to redistribute land in the region. Each settlement consisted of a residential village with small lots destined for subsistence production by

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[118] The majority of melons produced in RN comes from the western municipalities of Mossoro and Barauna, which use underground aquifers as source their source of irrigation water. The public dam in Assú only mattered for growers in and around Assú, where no such aquifers exist.

[119] This section draws mainly from the work by Aldenor Gomes da Silva (1992, 1997), of the Federal University of Rio Grande do Norte, on how the introduction of large scale irrigation projects transformed the economy and labor relations in the Assú Valley.

each family and a large lot for collective production of a commercial crop. For decades, growers produced rainfed subsistence crops, complementing their incomes through a combination of small animal husbandry and wage income from employment in the large firms or in town.

These smallholders, however, were never a part of a broader strategy, such as that in SC or in PJ. Consequently, these smallholders kept their rustic, peasant type production of subsistence crops for deacdes, switching to irrigated melons only in the mid 1990s, favored by a confluence of factors: newly established lines of credit for smallholders (*Programa de Apoio ao Pequeño Produtor,* PAPP and the *Programa de Credito Special para Reforma Agrária,* PROCERA), rising tendency of large firms to subcontract, and the direct support of a Dutch-funded NGO (*Associação de Assistência a Comunidades do Campo,* AACC) that provided technical assistance to the settlements in their transition from subsistence crops to melon production. As a result of this process, by 1997, growers in 13 settlements were altogether producing 366 ha of melons, about 6% of total state production.[120] More recently, the US based NGO World Vision (with offices in Recife) invited 200 smallholders in the settlements to collectively sell directly to the European market under World Vision's Fair Trade Program.[121]

Agronomy graduates as extension workers

The third publis sector initiative in RN that stood out for faciliating small and medium grower adoption of melons was the Bank of the Northeast's program that subsidized land for new agronomists in turn for technical assistance to other local growers (*Programa de Apoio Creditício à Reorientação da Pequena e Média Unidade Produtiva Rural do Semi-Árido Nordestino,* PRODEASA).[122] Despite several problems that led to its termination in 19xx, the PRODESA left its legacy in RN through providing

[120] Based on data from INCRA/RN-Seção de Assentamentos, as cited in Andrade (1998).

[121] In its first years of support (1999-2000), World Vision manged to help growers reduce their overall export costs from 26% to 8% of the total value of sales, and obtain a 58% increase in the per unit price of melons. See World Vision (2001).

[122] Through PRODESA, qualified agronomists receive bank loans for the purchase of land (up to 500 ha) in the semi-arid region, investments, technical assistance, a vehicle, farm machinery, and other expenses associated with starting an agricultural enterprise. The payment period for these loans allowed for a two-year grace period and up to twelve years for repayment of investment capital. In turn, these agronomists committed to providing technical assistance to other growers by designing agricultural projects; providing guidance with bank procedures; providing a given number of field visits; and promoting the establishment of other growers within the PRODESA. These growers also committed to allowing supervised internships from agronomy students in their properties and to participating in fairs and expos (BN/IICA 1997).

a jumpstart to highly qualified and entrepreneurial agronomists and creating for them a forum for interaction which has outlasted the PRODESA itself. In fact, a group of five "Prodesianos" was among the first to successfully organize into a joint marketing group, selling quality melons domestically and abroad. At its peak, this group produced about 180 hectares, or 3% of state's production. Just as important, the success of these "Prodesianos" attracted other, non-Prodesiano medium growers to the sector.

In sum, the participation of medium growers across these cases in the fresh fruit sector can be traced back to public sector policies that facilitated their access to land, credit, and technical assistance. These policies were especially effective in SC because of the state's long-standing commitment to the development of small and medium growers, including by the building of agricultural extension and R&D institutions that established ties and capabilities that outlasted the government cutbacks in the 1990s. Production by small and medium growers in PJ is also a direct outcome of CODEVASF policies. Yet the form in which CODEVASF provided that support led to a very different outcome: although it enabled hundreds of medium-sized growers to adopt fruit mango and grape production in the 1990s, at was at the economic and social costs of high turnover rates among the original settlers. Finally, the kind of public sector support that facilitated small and medium growers production in RN was piecemeal, neither enabling a core group of medium growers to adopt fruit production, nor creating institutions to support them.

Beyond the state: private extension, and subcontractual and ethnic ties

Having established how most medium growers first adopted fruit production in each case, this section explains how they have managed to remain in the market and upgrade in recent years despite the demise of the kinds of public sector support they received in earlier years, especially in SC and PJ. I argue that medium growers' capabilities to participate in the market today and upgrade are associated with

1) An increase in (but limited) private sources of agricultural extension on which medium growers now depend.
2) A rising tendency for larger firms to subcontract production from medium growers, and

3) The endurance of ethnic based networks based on medium growers.

When agricultural extension goes private: input suppliers and consultants

In trying to identify sources of innovation among growers, my interviewees repeatedly reminded me of the importance of the social milieu – how growers continuously interact and exchange views on production technologies. [123] Growers meet formally, including at associational meetings and those coordinated by federal or state agencies, such as training course on fruit flies by EMBRAPA in RN or an HACCP training by the US Food and Drug Administration (FDA) in PJ. They also congregate at the countless seminars and presentations given by the multinational agricultural input suppliers and the field days sponsored by the input stores. Growers meet socially and informally throughout town, while waiting for service in banks, shopping for agricultural inputs, and having drinks at the bar. This section argues that medium growers have upgraded despite falling public sector agricultural extension because of their engagement in this broader context. Absent the evidence on the formation and impact of these ties on local upgrading, this section presents two drivers of innovation for which there is (limited) evidence: input suppliers and consultants.

Earlier in this chapter, I argue that the state shaped the extent to which medium growers adopted these crops. Apple growers in SC benefited from the guidance provided by the state's PROFIT program, including its support with credit, research, training, and extension, which the state coordinated through its network of research and training centers, and extension offices. Meanwhile, medium growers in PJ benefited from the tremendous federal investments in irrigation infrastructure by receiving lots ready for irrigation, facilitated access to credit and markets (through the tomato processing firms), and research and extension support through federal and state agencies, including CODEVASF, EMBRAPA, and IPA. Yet in both cases, the public sector drastically reduced its support in the past decade, including with respect to agricultural extension. In

[123] The importance of the local context in the process of innovation has been studied elsewhere. Gertler, Wolfe, and Garkut (2000) summarize the main views on the importance of local embeddedness in explaining innovation. Schmitz (1995) analyzes the role of these "non-economic ties" between local firms in a Brazilian shoe cluster in the "diffusion and innovation of ideas." Walters (1999), drawing from the wine industries in Chile and Argentina, focuses on the importance of "learning institutions" which promote interactions among agents of a value chain that are conducive to continuous upgrading. There are no such studies for my cases and the evidence I obtained is mostly anecdotal and very piecemeal.

contrast to abundant evidence on the failure of public sector agricultural extension to deliver "anything of value," the extension services in these cases were central in helping medium growers in SC to adopt apple production, and medium growers in PJ to adopt irrigated annual crops that preceded their work with irrigated perennial fruit crops. This reduction in technical support occurred precisely as growers began face greater pressures for improved products and production processes.

The fall of public sector agricultural extension across the cases can be attributed to federal level policies.[124] The federal government created the Brazilian Agricultural Extension Agency (*Empresa Brasileiro de Extensão Rural*, EMATER) in 1975 along with EMBRAPA. EMATER's mission was to coordinate state-level extension agencies and provide financial support to those that would be willing to adopt the principles and selection criteria of its directors similar to those of EMBRAPA and EMATER. This measure led to the creation of the state level EMATERs, most of which substituted the previously existing non-profit state level civic associations. Only three states kept their own state associations: Paraná, Rio Grande do Sul, and Santa Catarina, which in turn provided service to EMATER.

For its first several years, EMATER had generous federal funding for construction of training centers and extension offices, and for salaries. The initial funding was from the Ministry of Agriculture, and subsequently, through a World Bank loan that supported its expenditures (including salaries) during 1979-1985. By then EMATER was already facing mounting criticism for ineffectiveness, while it broadened its agenda to include land reform, including through participation of political demonstrations in Brasilia alongside the MST. According to Olinger (1996), these events led President Sarney to propose the extinction of EMATER to the National Congress. Although Congress initially turned down the proposal, it eventually accepted it in 1990 when presented by President Collor. As a result, federal spending on agricultural extension fell from 21% of total government spending in agriculture in the early 1980s to 5.5% by the late 1990s (Gasques 2001). Few were the state governments that picked up

[124] This section is mostly based on Olinger's (1996) account of the rise and fall of public agricultural extension in Brazil. Mr. Olinger was the founder and director of ACARESC; Secretary of Agriculture of the State of Santa Catarina (1969-1976); and President of the Brazilian Agency for Agricultural Extension (EMBRATER) (1979-1986).

the slack; most states marginalized its EMATERs to the point where many eventually closed down. Others merged whatever was left from their extension agencies with their state agricultural research agencies.

In SC, the fall of ACARESC was gradual, culminating with its merger with the state's research agency, Empasc, into the now existing Epagri in 1991. According to a former director of EMBRATER and SC State Secretary of Agriculture (Olinguer 1996), the fall of ACARESC actually dates back to the very creation of EMBRATER in 1975 which led to:

- Increase in number of ACARESC staff without the training and qualification of the original ACARESC staff
- Increased staff size reduced monitoring and quality of local offices
- New entrants included political appointees, often adversaries, diverting efforts to political cleaveges within ACARESC
- Increase in wage differentials between administrative and technical staff
- Lower investment in continued training

Despite these events, ACARESC maintained its presence in the field through the 1980s, yet gradually losing the impetus with which it had operated until then. The 1991 merger led to the dismissal of most of its workforce. Those that remained were assigned to municipal city offices, where an increase in bureaucratic duties reduced their availability for continued field visits to growers.

In PJ, growers counted on a series of different providers of agricultural extension. Growers initially counted on Emater extension workers based in each of the villages of the irrigation projects. CODEVASF also had its own cadre of extension workers, with at least one allocated to each of the several villages in each irrigation project. With several changes in its management and funding, CODEVASF sustained its agricultural extension service until the mid 1990s, when it then limited its work to project development.

The above reflects a substantial reduction in public extension driven by changing federal level policies, more a reflection of the making and breaking of political coalitions than a belief that growers no longer need public sector support with agricultural extension. Reduction in public provision of agricultural extension would be justified if the activity has in fact been effectively adopted and private providers have taken up

information-diffusion services (Birkenhaeuser et al 1991). Evidence from my cases suggest that private sources of agricultural extension have indeed risen over the past decade. Yet, as has been noted elsewhere, this private extension is unlikely to "fill the gap" left by the fall of public sector extension.

Input suppliers

The expansion of fruit production across the cases has been accompanied by an increase in the number of agricultural input stores and investments by national and multinational agricultural input suppliers. The number of stores dedicated to serving fruit production have more than tripled in PJ and RN since the late 1980s: PJ went from having five stores in the 1980s to twenty stores today, while the number of stores in RN increased from two to seven in the same period. As a result of increased competition among stores, the variety of services these stores offer to growers have multiplied. Aside from selling agricultural inputs and implements, stores now serve as important providers of technical assistance and, occasionally, of financial support.

Despite the expanding role for input suppliers with technical assistance, they by no means fully meet the needs of medium growers. If for no other reason, input stores emphasize profits over welfare, rightly so as private enterprises. This means they stress the promotion of the products for which they are distributors regardless of whether these products are in effect the best available for each growers. In addition, input stores limit their provision of technical assistance to growers that have enough volume to make their efforts worthwhile, meaning medium growers are rarely among their main clients.

In PJ, stores organize free workshops on main crops produced in each project, choose growers for field trials to whom they provide technical assistance throughout cycle, then host field days in each trial area through which store agronomists review recommended production practices. In addition, store agronomists visit growers on demand to suggest possible solutions to technical problems growers may face with production. As a result, a visit through the irrigation projects will reveal the presence of logo-marked vehicles driven by store extension workers where once the motorcycle or downtrodden vehicle of the public extension worker was found.

Assuming the largest 5-6 stores have 3 or 4 agronomists (or agricultural technicians, as is usually the case), there are between 15-24 agronomists to provide

technical extension. In light of the 1,400 medium growers in the Senador Nilo Coelho Project alone, this cadre of agronomists is unlikely to reach everyone. In Fraiburgo, SC, stores also limit their technical assistance to the "larger" smaller growers, those who in addition to apples also plant garlic or other shorter cycle crop for which the agronomist can also earn for his assistance.

In RN, the technical assistance provided by input suppliers has been particularly important in the absence of public sector support with R&D as the stores themselves have helped growers identify the most suitable melon varieties to produce. Input suppliers in this case serve as the main liasion between growers (including medium growers) and multinational seed distributers. Agronomists from the stores essentially choose several growers to carry out field trials with particular varieties and provide them assistance throughout the growing cycle. At harvest time, store agronomists evaluate the outcomes and pass the information onto the multinational seed distributers, who then market successful varieties and continue their variety improvement program for the region. Input suppliers in RN also serve as financial institutions by providing melon growers payment plan with grace periods longer than the melon cycle thus allowing growrs to pay for their inputs with their sales revenues.

For their part, national and multinational agricultural input suppliers have also been increasingly engaged with growers. Across the cases, these suppleirs hold seminars to showcase new products, at times in local auditoriums, at times at local bars and restaurants. Each of these meetings provide forum for growers to meet, exchange information.

Consultants

The growth of these clusters has also been accompanied by an increase in the number of agronomists providing consulting services to growers. These consultants tend to have substantial production expertise and knowledge of markets. Although firms have always counted on consultants, these consultants were generally hired from outside the region. The difference now is that most consultants have either settled down in the fruit producing areas from elsewhere, or are from the clusters themselves, meaning they are better acquainted with local varieties and local conditions, as well as with the resources available to growers locally as they strive to upgrade. These consultants are often from

other states that move to the clusters to take advantage of the increasing number of growers. Others are former employees of larger firms, that either lose their jobs as these firms downsize or leave on their own to start their own consulting business or farm. They have turned out to be important conduits of information and drivers of dissemination across the clusters.

Like the input stores, these consultants also maintain tight relations with several multinational agricultural input providers. These multinationals often seek the consultants, some of whom travel abroad repeatedly in a given year, always funded by the multinationals. Sometimes companies hold roundtables with growers and consultants to discuss the performance of particular agricultural inputs or technical problems for which growers are seeking inputs.

Aside from passing information directly on to their clients, consultants contribute to a broader dissemination of technological information indirectly, as the information they pass on to their clients gets passed on to their clients' neighbors and acquaintences. Although consultants also prefer to work with larger growers, at least some consultants provide services for at least some small growers, as way of keeping in touch with that segement of growers, what they are producing, the problems they are facing, and the technologies they are adopting.[125]

Subcontracting and medium growers

Many medium growers have also managed to participate in these markets by engaging in subcontractual arrangements with large grower-exporters. With few exceptions in SC and grape growers in PJ, large firms increased their practice of subcontracting only in the mid 1990s, as they faced increased pressures for efficiency in light of growing competition and falling profit margins, while no longer having access to subsidized public credit.[126] Subcontracting enabled larger growers to maintain or even

[125] At least one consultant mentioned that working with smaller growers is the only way to test the parameters for a given technology. "The perfect execution by these smaller growers is what gives us consistent data, a lot more so than on the larger farms." That is, smaller growers have greater control of field operations than do larger growers who depend on hierarchal, less direct field operations.

[126] This "delay" reflects the unrealistically favorable economic environment surrounding these fruit clusters until the 1990s, where abundant cheap credit and secure demand assured high profit margins despite administrative inefficiencies.

expand their volumes, while reducing per unit costs by relaying production risks and labor costs to their suppliers. [127]

Although precise data on subcontracting is difficult to obtain, the rise in subcontracting is evident across the cases. In SC, the number of large firms subcontracting increased from two in the late 1980s to about seven today, including the largest firm in the sector, Fischer, which subcontracts about 25% of its production across five large to medium growers.

In PJ, the sequence of subcontracing differs between grapes and mangoes. Large grape growers began subcontracting in 1993 as their own production was insufficient in meeting European demands during Brazil's export window.[128] In the case of mangoes, the three largest firms began subcontracting in the late 1990s along with the newer firms that just established their pack houses in PJ, many of which pursuing a strategy based on subcontracting at least half of the mangoes they process and market from the medium growers in the irrigation projects.

Finally, the two lead firms in RN began subcontracting in 1994, reaching about 12% and 30% of their volume by 1997.[129] These firms subcontracted from two kinds of growers: the agronomist or agricultural technician who eventually became medium growers, including the Prodesianos and the nissei; and smallholders in the agrarian reform settlements that were just then beginning to produce melons collectively. In the former case, many medium growers used the opportunity to supply the large firms as a means of breaking into exports (JT, getting out from under). In the latter case, growers subsequently exported directly to European buyers with the assistance of World Vision. Subcontracting gave them the experience and also a positive reputation, since they had sold under M/F trusted brands.

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[127] According to Albuquerque (2001), labor costs up to 55% of total production costs for grapes in PJ, 18% for apples in SC, 10% for melons in RN, and 8% for mangos in PJ. An important component of this wage labor which motivates firms to subcontract are the *encargos sociais*. As a result, production by large firms can cost twice as much as that by medium growers. In the case of melons in RN, for example, production by the large firms in 1996 was between R$3,500-6,000 per hectare, for medium growers R$2,500-3,000, and small growers R$1,800-2,500 (EMBRAPA 1997). In the case of grapes in PJ, overall costs for smaller growers in 1993 were 45% lower than for larger growers (Collins 1995).

[128] See Collins (1995).

[129] Gomes (1999).

The two firms that first began subcontracting in the mid 1990s have since gone bankrupt and closed down, yet other firms have moved into the sector, each with its own subcontracting policy. Especially important has been the establishment of Nolem, the successor of Maisa, whose owners designed it to focus largely on marketing of subcontracted melons. Since its establishment in 1998, Nolem has subcontracted about half of the melons it processes and sells, totalling about 1400 ha from about 30 growers. It provides inputs equalling about 45% of the production costs upfront, and has a minimum base price for exports – if the market price falls below the established minimum price, Nolem splits the loss evenly with its suppliers. It also has an award system, through which it pays growers a premium for continuity with volume, quality, and punctuality.

Not all medium growers benefit from these contractual ties in the same way, of course, since large firms establish a variety of contracts. These range from annual contracts inclusive of inputs, technical assistance, soil analysis, harvesting, transportation, processing and marketing, with a minimum assured base price, to informal verbal arrangements limited to marketing. Nevertheless, the argument still holds that subcontractual ties with larger grower-exporters has sustained the participation of hundreds of medium growers in these fres fruit markets.

Central to my argument is the evidence that many medium growers have managed to use these contractual ties with larger firms as a springboard to establishing direct ties with buyers themselves.[130] This was typical for several medium growers in RN, who initially supplied the pioneering firms with melons, and subsequently, when contacted by a foreign buyer familiar with the quality of their melons, switched from subcontracting to direct source. The same was done by an association of medium mango growers in PJ. After having sourced one of the leading mango exporters for several years, this association is now establishing direct contacts with an importer in Rotterdam.

These findings contrast much of the in the literature on contract farming as to why subcontracting is often not a good alternative for smallholders. Under contract farming, medium growers commit to supplying a specified quantity and quality of fruit at a given price to the large grower-exporters in return for provision of credit, inputs, and technical

[130] Tendler (2001) makes this observation.

assistance. Thus, in principle, contract farming is a win-win situation: it reduces production and marketing risks to grower-exporters by ensuring a guaranteed supply that meet specific requirements, while medium growers have a secure market, along with credit and inputs for production.[131] In practice, however, contract farming tends to fail as a long lasting and developmental arrangement because of the difficulties in enforcing contracts, the unequal bargaining power between buyers and medium growers, monopsonistic behavior, and disruption of power relations, among other problems.[132]

What explains the more positive outcomes of the subcontractual ties across my cases? First, the majority of medium growers across my cases are agronomists or agricultural technicians, generally better educated and prepared to participate in these high-value markets than the smallholders considered in other studies. This does not invalidate my claim, however, since even these medium growers are many times smaller than the larger firms in each of the cases in terms of production, employment, and political clout.

Second, a major difference between these newer contractual arrangements and the earlier patterns of contract farming is the general context in which these subcontracts are taking place. Larger firms have increased their dependency on subcontracted production while at the same time having to assure the compliance of their suppliers to the final buyers. Larger firms are therefore more willing to engage with growers since the risks of noncompliance hinge on the grower-exporter.

The enduring strength of ethnic-based networks: the COTIA legacy

Of particular importance in explaining the resiliency of medium growers across my cases is COTIA: the now-extinct agricultural cooperative established by Japanese immigrants in Sao Paulo in 1927 to help immigrant families become economically active in Brazil through agricultural production.[133] As early as 1971, Carroll documents the "strongly cohesive force and economic behavior of the Japanese immigrants" behind COTIA.[134] COTIA spread its experience and opened production frontiers throughout

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[131] See Dirven (1996), Key and Runsten (1999), and Schejtman (1996).
[132] See Glover and Kusterer (1990) and Little and Watts (1994).
[133] See Marcovitch (1996) for a brief history of COTIA.
[134] Cavalcanti (1999) also notes the strong work ethics ("o trabalho sério") of the Japanese growers in PJ. Wells (1991, 1996), drawing from the experience of California agriculture, also notes the distinct economic

Brazil until 1994, when it collapsed because of an overextended bureaucracy and financial commitments. Despite its collapse, COTIA left Brazilian agriculture an inheritance of insurmountable experience in production, marketing, and a successful model of collective action, establishing a standard of production and marketing unmet by most other Brazilian medium growers.

From its headquarters in São Paulo, COTIA establishment of hundreds of agricultural colonies throughout Brazil, becoming the largest agricultural cooperative in Latin America, with 200 branch offices staffed by 22,000 employees and over 21,000 members.[135] It provided technical assistance and marketed crops produced by its members and from non-members through extensive channels with domestic supermarket chains, and a permanent office in Rotterdam for marketing agricultural products in Europe.[136]

Through its members, COTIA spread information on crop varieties and provided a model of planting techniques for many crops throughout Brazil. In the context of my three cases, COTIA turned out to play an important role in the development of each of the clusters by providing local growers a competent production and marketing network, as well as a model of collective action. Even following its closure, networks of former COTIA members continued playing an important role in the development of the fresh fruit industry through the formation of independent cooperatives in SC and PJ, and a marketing group in RN. These cooperatives produced at most 14% of total production in each cluster (see Table 11), yet their impacts on production technologies and crop varieties reached beyond the non-nissei communities in at least two ways:

First, COTIA growers were among the pioneers in producing each crop, proving the viability of these crops for small scale production. They were the first small scale apple producers in SC; the ones who introduced table grapes in PJ; and involved in the first field trials with melons in RN. Even without the helping hand of COTIA since 1994,

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behavior of Japanese growers. She compares the innovative behavior of Anglo, Japanese, and Mexican berry growers in California and argues that the Japanese stand out for their trust of the University of California's technical information, attention to detail, avoidance of indebtedness, preference to remain medium-sized, and preference for varieties that have already been tested.

[135] Staff and membership data from interview with directors of CAJ in Juazeiro.

[136] See Damiani (1999).

these growers have continued to excel in producing quality fruits that please domestic and foreign buyers.

And second, efforts by COTIA growers and by grower cooperatives made up of former COTIA members have generated positive spillovers to other non-nissei growers, including through the dissemination of public sector agricultural research, opening up of markets for crops produced by medium growers by proving to foreign buyers the quality of their production, and by providing a model of collective action.

Table 12. Participation of former COTIA growers across cases

Case	Cooperative and crop	No. of members	Production (ha)	Total prod. in cluster (ha)	Share of cooperative
Santa Catarina	SANJO - apples	78	900	13,046	7%
Petrolina-Juazeiro	CAJ - grapes	52	690	5,042	14%
Rio Grande do Norte	STA[a] - melons	5	550	6,243	9%

[a] STA is not a cooperative, but rather a marketing group through which members each have their own individual brands. Data for STA is for 1997, as is total area planted in RN.

COTIA left its legacy in SC through the *Cooperative Agrícola de São Joaquim* (SANJO), the most successful apple grower cooperative in terms of volume and quality of production. Interested in expanding into apple production, COTIA sent several scouts from Sao Paulo to Santa Catarina in the early 1960s to investigate the best region for apple production and in 1964 established a colony of six families from other parts of Brazil in São Joaquim, over a total of 560 hectares. COTIA growers arrived in São Joaquim with minimal capital and dilapidated machinery. In their favor, they had COTIA as guarantee for bank, access to well established COTIA marketing channels and brand name recognition outside Brazil, and an ethnic-based work ethic that enabled this group of growers to succeed together, even following the collapse of COTIA.

Just as important, COTIA growers in SC benefited from the SC state government's rising interest in promoting the production of apples. They obtained investment and working capital through PROFIT, and learned about apple production from the presence of JICA researchers and growers in SC who had already begun

experimenting with apple production.[137] Although there was no formal connection between COTIA and JICA, growers interacted informally. Especially important in terms of production technology, was the ongoing interaction between COTIA's agronomist in São Joaquim and the JICA apple expert, Shirozawa, who introduced the Fuji variety in the state.

Once COTIA went bankrupt in 1994, apple growers in São Joaquim organized themselves into a new cooperative named SANJO, setting the example to other medium growers ofthe advantages of working collectively. Already in the early 1990s, as COTIA deteriorated, growers in SC planned an alternative form of organizing independent of COTIA. They first established a marketing and transportation company in 1993 to substitute the COTIA services on which they had depended since first producing apples in 1974. In 1996, growers established their new cooperative to store, classify, package, market and distribute apples through a joint brand name. With the collapse of COTIA, the packing house and cold storages on which these growers depended were taken over by banks (these growers had paid for the investment cost of this infrastructure, for which COTIA was guarantor). As an alternative, growers jointly built a state of the art packing house and controlled atmosphere cold storage large enough to store all of their output. Today, SANJO has 78 members and produces about 37% of the apples produced in São Joaquim and 7% of total apple production in SC, making it the sixth largest apple producer in SC. It markets through many clients they "inherited" from COTIA as well as newer clients they have established themselves, including a direct buyer in Germany.

By the time CODEVASF began settling its projects in PJ in the 1970s, COTIA already had about two decades of producing, buying, and marketing a variety of quality fruits and vegetables in Sao Paulo, Parana, SC and elsewhere in Brazil. COTIA had such a good reputation in terms of the quality of its products that CODEVASF invited COTIA to establish a colony in one of the CODEVASF's earlierst irrigation projects in PJ, the Curaçá Project, cimpleted in 1978. COTIA then established a colony with 36 members across 1,927 hectares, and opened a branch office in Juazeiro to provide technical assistance and coordinate purchases.

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[137] Including a JICA colony in Curitibanos.

CODEVASF's strategy in inviting COTIA to its projects paid off: COTIA introduced melons and grapes the region, and provided a marketing channel to several firms growers, who subsequently established their own channels. COTIA growers in the Curaçá project first produced industrial tomato, as did most other growers motivated by CODEVASF and the presence of the tomato pulp processing firms that CODEVASF had also attracted to the region. COTIA growers in PJ also produced melons which COTIA had already been buying from other non-nissei growers in PJ and, in 1984, began growing table grapes, a crop they introduced in the region and which has since become one of the major fruit crops produced in and exported from PJ.[138] COTIA had already produced table grapes in Sao Paulo since the 1970s but, faced with high incidence of pests associated with rainfall in that state, COTIA turned to the possibility of irrigating grapes in the dry climate of PJ.

As for marketing channels, COTIA growers in PJ counted on COTIA's well established domestic and export channels. By the time growers began producing in PJ, COTIA had already been successfully exporting nissei-produced melons from Sao Paulo and apples from SC through its exporters in Sao Paulo and office in Rotterdam. As Damiani (1999) describes it, COTIA helped other growers in PJ break into exports by lending one of their export managers to the newly established PJ grower cooperative, VALEXPORT; providing contacts to buyers in Europe; and allowing the use of COTIA's office in the Netherlands. Moreover, COTIA also purchased melons and grapes from other growers, exporting them under their own brandname, and in the process teaching these other growers about the norms and standards of the export market.

In addition, the COTIA growers in PJ established the Brazilian Grape Marketing Board (BGMB) in 1992, a group within VALEXPORT focused on collective sales of 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 growers would harvest, and jointly contract trucks and ships to bring the fruit to the market," as well as jointly purchase inputs and packaging (Damiani 1999:120). The BGMB has continously exported about 80% of the table grapes exported from PJ and 70% of the Brazilian table grape exports.

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[138] See Damiani (1999).

As was the case in SC, growers in PJ also organized themselves into an independent cooperative once COTIA collapsed. The *Cooperative Agricola de Juazeiro* (CAJ) consists of 45 growers, each with an average of 10-12 hectares of grapes, and several also with 10 hectares of mango, or 5-6 hectares of ata/pina or passion fruit. The former COTIA growers formed CAJ by agreeing to pay whatever debts COTIA had associated with its operations in PJ, in turn for keeping the infrastructure in Juazeiro. CAJ established its own technical crew of four agronomists, has doubled its production and its storage infrastructure since 1994, and is overall more profitable. As one of its members explained, "COTIA was our mother. Whatever the grower wanted, it would provide him. When it disappeared, the grower felt unprotected and decided it had to improve its technical level. It was then that we learned to obtain higher returns."

COTIA's agricultural expertise also reached melon growers in RN. Although COTIA never established a colony in RN as it did in SC and PJ, it nevertheless influenced the melon industry through 1) the transfer of technology via a nissei consultant to the pioneering firm, 2) the subsequent move of several former COTIA growers from Sao Paulo and other states to the region, and 3) the establishment of COTIA-based marketing channels in Brazil and abroad.[139] Melon growers in RN, nissei and non-nissei alike, thus benefited from COTIA's extensive experience in production and marketing.

MAISA, the pioneering melon firm in Mossoro, contracted a COTIA-related nissei from Sao Paulo in 1978 to sharecrop several rows of melons on an experimental basis, where the firm and the grower split the returns evenly. The success of these early trials encouraged other firms and growers to adopt melon production. At least five other COTIA-related nissei from other states followed the firstcomer to RN, each helping the arrival of the subsequent movers by establishing sharecropping arrangements or by helping them find employment in one of the firms that were already producing melons. These growers had previously worked with a variety of crops, including tomatoes, cotton, peanuts, soy, beans, cucumbers, peppers, and, in some cases, melons (in Sao Paulo). Among them was an agronomist from the reknown agronomy school ESALQ (*Escola*

[139] I do not have an explanation as to why COTIA never established a colony in RN. I suspect it was because of its mixed experience with melons in PJ in the 1980s. Also, by the time melon production took off in RN in the early 1990s, COTIA had already begun its decline.

Superior de Agricultura Luis de Queiroz), who had spent nine years as researcher and extension worker for COTIA. Although COTIA did not carry out its own research, it drew from agricultural research centers throughout Brazil and transferred this information to COTIA members. This farmer moved to Mossoro when COTIA closed down to provide support to the growers who were already in RN producing melons and to whom he had provided support through COTIA. Upon moving to RN, he also started producing himself.

In addition, growers in RN benefitted from former COTIA marketing channels, as had been the case in SC and PJ. One of COTIA's melon exporting specialists moved to RN to coordinate the marketing of melons produced by growers who had previously marketed through COTIA. This specialist runs the RN office of a marketing firm established by former staff of COTIA's division of marketing, headquartered in Sao Paulo (STA). Along with the above mentioned agronomist, this marketing specialist coordinates the domestic and export sales of all the nissei growers in RN, providing technical assistance and quality control.

This chapter closes the analysis of how locally-embedded incentives and constraints shape how growers respond to collective good problems by focusing specifically on how medium growers have met the demands for quality, consistency, reliable supplies, and improved varieties. The next chapter summarizes the main argument and offers some insights into policy formulation.

CHAPTER 6. CONCLUSIONS

This dissertation analyzes how growers of fresh fruit in Santa Catarina (SC), Petrolina-Juazeiro (PJ), and Rio Grande do Norte (RN), Brazil, have resolved collective good kinds of problem associated with the rise of supermarkets and the global fruit trade. It set out to answer two questions: What institutional arrangements have growers used to resolve collective problems and what explains the differences in these arrangements in terms of what they achieve and whom they benefit?

This dissertation makes three basic points based on the main findings summarized in Table 13. First, the more effective growers' association and public-private collaborative efforts in helping growers obtain improved varieties, establish pest monitoring programs, and develop integrated production practices are in SC where the state government promoted a dual structure of production, established an institutional venue through which to engage with growers large and small, became a leading expert in apple research, and developed a well-structured, funded, and qualified agricultural extension service. Just as important, the apple growers' association, ABPM, has been well representative of its members, capable of voicing their needs, and supported by the industry's largest apple firms.

CODEVASF also molded a dual structure of production in PJ similar to that which ACARESC supported in SC, yet early state-grower relationship across these cases differed in important ways. In SC, the state government agency, ACARESC, coordinated the development of the apple industry, while the federal parastatal CODEVASF did so in PJ. ACARESC worked closely with the pioneering firm in early apple research in SC; CODEVASF, in turn, had to provide incentives for large firms to move to the region and begin production. ACARESC emphasized agricultural extension and research from early on, providing the basis for institutions that would sustain the sector's growth over time. CODEVASF also coordinated agricultural extension and research, but its main focus was heavy-duty irrigation infrastructure and tax incentives for colonization of its projects. And finally, ACARESC facilitated apple production by small growers alongside larger growers, while CODEVASF promoted a different mix of crops among larger growers and small and medium growers. These differences ultimately affected the formation and

outcomes of public-private partnerships and the possibility of medium and small growers of participating in the fresh fruit industry.

Second, the different arrangements growers have used to resolve collective good problems area also a function of the characteristics of their crops, especially production cycle (annual versus perennial) and production costs, and their markets. Growers of perennial crops (apples, mangos, and grapes) have more incentives to collaborate with each other than do growers of the annual crop (melons) because of the higher costs and risks involved with perennial crop production. As for markets, this dissertation provides an example of a domestic market (for apples) that, at least up to the mid 1990s, was more demanding than an export market (for melons).

The disincentives for inter-firm collaboration embedded in the comparatively "easier" production of melons thus helps the growth of the melon industry despite the absence of the kinds of collaborative institutions that have helped growers upgrade in the other cases. One could argue that the melon industry is really the success story among my cases because growers have managed to upgrade without the costly collective arrangements and public support present in the other cases. The evidence, however, reveals a comparatively more vulnerable sector: growers collectively failed to control the widespread infestation with white flies beginning around 1999 and to agree on the management of the water tables on which they depend; the pioneering firms have gone bankrupt; and RN has gradually lost its share in national melon production and exports.

And third, that medium growers have remained in the market reflects their ability to overcome the kinds of collective good problems affecting larger growers in addition to those associated with smaller scale production. Because of their small scale individually, medium growers have the additional challenge of pooling production and marketing, while also assuring consistency in volume and quality. While many medium growers have benefited from subcontractual ties to larger grower-exporters, this dissertation emphasizes how Japanese-Brazilian ethnic ties have been especially helpful in enabling groups of medium growers to weather the changing market environment and thrive in the fruit industry.

Table 13. Summary of findings

Case	Form of government support in 1970s-1980s	Nature of crop	Ethnic ties	Resulting collaborative arrangements
Santa Catarina	The state agricultural agency, ACARESC, learned from pioneering firm and promoted apple production by providing access to credit, agricultural extension and training, and highly rated apple research system. Thus created, from early on, institutional basis which continues supporting growers' upgrading efforts.	Perennial crop, with 3-4 years between planting and first harvest.	Pioneering small growers belonged to COTIA cooperative and later established independent cooperative (SANJO) that produces 7% of apples in SC.	Familiarity and enduring social ties between state researchers, extension workers, and growers facilitated greater public-private collaboration in 1990s that helped resolve collective action problems.
Petrolina-Juazeiro	A federal engineering-based parastatal, CODEVASF, created irrigation projects including the provision of infrastructure, land, credit, water, agricultural extension, and support in forming growers association. Supported dual structure of production based on different mix of crops.	Perennial crops, with 3-4 years between planting and first harvest.	COTIA growers introduced table grapes in projects and later established independent cooperative (CAJ) that produces 14% of grapes in PJ.	Crop-based groups (large mango growers via VALEXPORT, grape growers via BGMB and CAJ) have resolved collective action problems.
Rio Grande do Norte	No single government agency coordinated the development of the melon industry. Instead, development banks provided substantial subsidized credit to two large pioneering firms, which invested in in-house capabilities rather than those that could support broader grower base.	Annual crop, harvested as early as 60 days.	A Japanese immigrant participated in early melon trials and former members of COTIA established an independent marketing group that produced up to 9% of melons in RN.	Relative absence of collaborative institutions since problems of collective "inaction" generated by pioneering firms have persisted.

Interpreting the recent development of fruit production across these cases as a reflection of these locally-embedded factors suggests that 1) exports do not necessarily explain why growers upgrade, 2) public sector policies can generate incentives and disincentives for collaborative action, 3) "partnerships" are worth trying, but are difficult to generate and often entail exclusive benefits, and 4) medium growers are often more capable of participating in the markets for fresh fruits than that which is often assumed.

Why exports don't explain everything

The economic development literature rightly emphasizes the increasing importance of export-driven growth. Breaking into exports is rarely easy and, in most cases, brings firms face to face with world standards and best practices. Exports thus ultimately force firms to become more cost-competitive and quality-oriented. This

literature, however, tends to assume that export-based incentives are always positive by facilitating technology transfer and inducing greater competitiveness.

The experience of Brazilian fruit growers questions the assumption that exports are necessarily demanding of quality, or at least any more than what is demanded in the domestic market. In fact, the experience of melon growers in RN and apple growers in SC reflects just the opposite. Across the cases, melon growers were the first to export and have historically exported a greater share of their production than any of the other cases (growers have exported about 50% of output, compared to 35% for mangos, 11% of grapes, and 7% for apples). Yet melon growers had an exclusive four-month window to the European market for over a decade. This window allowed them to become an established supplier in Europe, but also "cursed" the industry by shielding it from the kinds of competitive pressures confronting other growers. Apple growers, in particular, from the very beginning confronted Brazilian imports of Argentine apples. As a result, the apple industry that grew out of an import substitution industrialization strategy was in the end more competitive than the export-oriented melon industry.

The public roots of collaborative (in)action

Whether or not growers collaborate reflect policy support in the 1970s and 1980s that molded the structure of production and, consequently, the relationships among growers and between growers and the state. This means that the state itself shaped growers' perspectives on and means for how they could resolve their problems – if by investing in and collaborating with local support institutions, or by focusing instead on strengthening in-house capabilities and ties with buyers and input suppliers.

Comparing the outcomes in RN versus SC and PJ is especially illustrative here. Fruit production RN differs from that in SC and PJ in the substantially different form of public sector support growers have historically received. In RN, public sector support was especially strong through the provision of highly subsidized credit to the pioneering firms until the early 1990s. The provision of abundant and highly subsidized venture and investment capital in the early years enabled these pioneering firms to test new varieties of melons and learn the best production practices for the local conditions, establish domestic and foreign export channels, and build a recognized name for locally produced melons.

But if easy credit to the pioneering firms facilitated the establishment of the melon industry in RN, it also imposed constraints on how this industry would grow. Public sector support in the form of a highly subsidized credit unattached to any kind of performance standard and given without question over at least a decade meant that these firms had the political clout to directly access and obtain government concessions independent and regardless of other growers in the industry. These firms had no incentives to lobby for government concessions that facilitate the entrance of other growers earlier on. On the contrary, anecdotal evidence suggests that they tried deterring the entrance of other growers to the market by resisting or blocking political support for credit and agricultural extension programs targeted at smaller growers.

Likewise, this early established dynamic between the pioneering firms and government agencies (including the Bank of Brazil, Bank of the Northeast, SUDENE) undermined the possibility of the establishment of grower-state ties that could benefit the cluster as a whole. Particularly with respect to agricultural research, for instance, the amount of public credit allocated to these firms allowed them each to establish in-house technical departments, hire consultants from other states and countries, and construct their own laboratories. Two large firms thus captured substantial public sector support (in the form of subsidized credit) and ultimately left little in the way of institution-building that could benefit growers as they contend with the new market environment.

On building partnerships that work

Despite the well-accepted notion of the state's importance in promoting innovation in agriculture and increasingly through partnerships with growers, the actual process leading to this greater public-private interaction is rarely analyzed nor are the conditions under which this public-private collaboration is more likely to occur or be constructive and inclusive. The case studies in this dissertation, especially that of SC, suggests two policy attributes that contribute to more effective public-private partnerships in what they accomplish and inclusive in whom they benefit.

First, more so than the other cases, public sector support in SC focused on developing quality, well-structured, and funded agricultural research and extension agencies. The state became a leading expert in apple research, earning growers' respect and lasting support. Especially during the 1970s and early 1980s, the SC state

government formed a highly trained group of researchers specializing on apple production, sought technical expertise and financial resources from industrialized country agencies with extensive experience in apple production. Just as impressive as its commitment to apple research was the state's well-structured and funded agricultural extension service. The state established extension offices throughout the apple producing areas, allowing for the high coverage especially during the 1970s of which growers still speak of today. The very approach of the SC state government in promoting apple production thus ushered the possibility of public-private partnerships from early on, welcoming growers to engage with state extension workers and, in the process, and earning growers' lasting respect.

And second, the state of SC from early on established venues to interact with both large and small growers by having research stations near Fraiburgo (large growers) and São Joaquim (small growers). This also meant that small (and later medium) growers had a voice within the public realm in spite of and independent from the larger growers in the industry.

Promises and perils of public-private partnerships

Consistent with the literature on partnerships, state-growers collaborations in research attained concrete and applicable results, including the development of improved apple (SC) and grape (PJ) varieties, integrated production practices in SC and PJ, pest and disease monitoring programs (fruit flies in PJ and RN and black spots in SC), and agricultural inputs that make apple harvests more uniform SC and that allow year-round mango harvests in PJ. These partnerships also provided the venue for greater interaction and mutual learning among growers and researchers. At the same time, my cases raise two important issues the literature on partnerships does not address: the exclusive nature of these partnerships, and their risk of undermining efforts the could benefit the entire cluster in the long run.

That public-private partnerships are a means of improving service delivery to growers assumes that user groups, in this case growers associations, are representative bodies, through which members collaborate in voicing and solving their problems. The problem is that some associations are better than others in representing their members and in promoting participation. Across these cases, ABPM is the most representative of

its cluster as reflected in its long lasting collaborative efforts and incorporation of small and medium growers, including in its Board of Directors. On the other extreme is PROFRUTAS in RN, which has been mainly a handmaiden of the large firms, bringing very few benefits to other growers, specially to small and medium growers.

Just as important, the new federal funding mechanisms that require public sector researchers to submit proposals in conjunction with growers associations naturally lead to a self-selection of growers that can benefit from this research and, in the process, exclude many others. Public sector researchers are more likely to seek endorsement from well-established associations, which have been around longer and are generally led by the largest firms (and therefore have greater political clout), than from the associations formed more recently by medium-sized growers. As a result, where these associations have traditionally benefited a few, new public-private partnerships are likely to remain exclusive.

Finally, a tendency emerges from my cases demonstrating how closer state-grower collaboration in research may ultimately undermine the long-term development of each cluster. Rising collaboration between public sector researchers and growers has been centered on problem-oriented research – immediate problems facing the growers for which relatively short-term research and experimentation may yield solutions. The problem, according to researchers at EPAGRI and CPATSA, is that this short-term, immediatist approach, undermines the public sector's capabilities to carry out basic longer-term research, much of which will ultimately be required as the basis for further improved technologies in the future as the problems facing growers become even more complex.

Listening to medium growers

While the literature tends to emphasize the many reasons why all but the largest growers should remain in the market, including access to resources, production and marketing knowledge, postharvest transport and marketing services, and expertise in the use of pesticides and other agricultural chemicals, medium growers across the cases analyzed in this study have accounted for as much as 30% to 60% of production. These growers have remained in the market largely because of increasing marketing

opportunities through subcontractual ties with larger growers, and by resourcefully organizing cooperatives and marketing groups.

This study also suggests that medium growers have at times benefited substantially from direct public sector support with agricultural research and extension (especially in SC), and at times survived despite relatively weak or absent public sector support in these respects (as in PJ and RN). In SC, the state's early commitment to agricultural research and extension (via ACARESC and EMPASC) targeted at small growers generated state-grower ties that have outlasted the government cutbacks and the merging of research and extension (in the creation EPAGRI) in the 1990s. Not only has the state government historically been committed to small grower development, but this commitment is now embedded in EPAGRI's research and experimental centers (especially that in Sao Joaquim) and its municipal-level offices.

Production by medium growers in PJ also resulted from direct government support, in this case through the parastatal CODEVASF. Yet the form in which CODEVASF provided that support led to a very different outcome: although it enabled hundreds of medium-sized growers to adopt fruit mango and grape production beginning in the mid 1990s, it was at the economic and social costs of high turnover rates among the original settlers of its irrigation projects.

CODEVASF's strategies led to comparatively less favorable outcomes for medium growers for at least two reasons. First, CODEVASF was first and foremost an engineering-based agency, focused on constructing massive irrigation and productive infrastructure along the entire San Fransisco River Valley. Its capabilities to work with small growers in no way resembled those of ACARESC's, a rural development agency with a mandate to provide agricultural extension, training, and credit to small growers. And second, medium growers in SC have produced apples alongside larger growers, while medium growers in PJ focused initially on different crops and only switched to fruits in the 1990s.

As a result of these differences, medium growers in SC have benefited from positive externalities associated with large grower production over the years, including continued investments in public agricultural research, establishment of disease monitoring systems, lobbying to include Brazilian apples in export marketing campaign,

and strengthened growers' association. In contrast, medium growers in PJ have not readily benefited from these kinds of large firm-generated externalities associated with collective goods. Instead, medium mango and grape growers in PJ have only in the 1990s established direct ties with CPATSA, as illustrated by its seedless grape research program and the implementation of integrated production practices among an association of medium mango growers. Why this attention to medium grower has taken so long despite their proven capabilities in the fruit industry remains a puzzle.

To conclude, growers in Brazil and elsewhere will increasingly face demands for quality and consistency, reliable supplies, improved varieties and norms and standards imposed by buyers and importing country governments. A better understanding of the formation and outcomes of how growers resolve collective good problems associated with these demands may help in the design of policies to further upgrade production and postharvesting technologies. This dissertation aims to be a step in this direction. In the least, it suggests that governments often have more margin for action than that which is often portrayed in helping growers farm for supermarkets.

APPENDICES

Appendix A. Municipal-level production (hectares planted) in SC, PJ, and RN, 1998-2002

	1998	1999	2000	2001	2002
Santa Catarina - apples					
Total state production	13905	13941	14593	15377	15907
Fraiburgo - SC	5800	5765	5765	5810	5940
Água Doce - SC	500	550	650	650	650
Lebon Régis - SC	985	980	980	1050	1130
Monte Carlo - SC	1150	1095	1141	1170	1170
São Joaquim - SC	2742	2780	2940	3080	3340
Bom Jardim da Serra - SC	520	580	653	724	849
Bom Retiro - SC	257	257	470	600	600
Urubici - SC	366	370	370	400	400
Total area	12320	12377	12969	13484	14079
Ave. annual share	0.88				
Ave. annual area planted	13046				
Petrolina-Juazeiro - mangos					
Total Pernambuco + Bahia	16822	18282	19952	21591	22872
Petrolina - PE	3989	5024	3800	3800	4620
Lagoa Grande - PE	-	210	44	50	60
Santa Maria da Boa Vista - PE	-	210	210	210	216
Juazeiro - BA	3740	3080	4627	5936	5940
Casa Nova - BA	782	652	716	716	716
Curaçá - BA	298	180	200	200	200
Sento Sé - BA	368	280	360	360	365
Total area	9177	9636	9957	11272	12117
Ave. annual share	0.52				
Ave. annual area planted	10432				
Petrolina-Juazeiro - grapes					
Total Pernambuco + Bahia	5141	5490	5184	6503	6097
Petrolina - PE	1400	2300	1900	2500	2040
Lagoa Grande - PE	950	950	428	570	600
Santa Maria da Boa Vista - PE	171	450	400	400	450
Juazeiro - BA	1540	756	1389	1993	1993
Casa Nova - BA	469	469	349	349	349
Curaçá - BA	100	100	160	100	100
Sento Sé - BA	50	100	150	150	150
Total area	4680	5125	4776	6062	5682
Ave. annual share	0.93				
Ave. annual area planted	5683				
Rio Grande do Norte					
Total state production	6437	4377	3724	6022	6771
Baraúna	1900	2076	2000	1500	3690
Mossoró	3250	1100	950	3756	2500
Total area	5150	3176	2950	5256	6190
Ave. annual share	0.82				
Ave. annual area planted	4544				

Source: IBGE, Municipal Agricultural Production

Appendix B. Share of production by grower size across the cases, selected years

Santa Catarina[a]					
	area planted (ha)	1985	1991	1996	
large	> 60	52%	65%	70%	
medium	6-60	28%	24%	19%	
small	< 6	20%	11%	11%	
Petrolina-Juazeiro[b]					
	area planted (ha)	1985	1988	1996	2002
large	> 200	19%	34%	39%	44%
medium	10-200	-	-	-	3%
small	< 10	81%	66%	61%	53%
Rio Grande do Norte[c]					
	area planted (ha)	1985	1990	1993	1997
leading	> 900	100%	75%	75%	47%
large	301-600		16%	19%	26%
medium	60-300		9%	6%	22%
small	< 50		0%	0%	5%

[a] Data for 1985 and 1996 from Santa Catarina census, as cited in Boeing (1998), data for 1991 from Hentske (1994). Original data was transformed from tons to area planted based on an average productivity of 17 tons/ha between 1988-1990, as cited in Boneti (1999). The cut-offs in tons are > 1000 tons, 100-1000 tons, and < 100 tons.

[b] Data for Senador Nilo Coelho Project, the largest among the six CODEVASF projects in Petrolina-Juazeiro, accounting for over 50% of PJ's irrigated area. Data for 1985 and 1988 from Miranda (1989), 1996 from Alves da Silva (1996), and 2002 from www.codevasf.gov.br/produtos/pro_senadornilocoelho.htm. The categories refer to CODEVASF's terminology of "empresas" (large) and "colonos" (small); medium growers refers to CODEVASF's recently created "lotes de tecnicos agricolas," which are project units designated for agricultural technicians or agronomists.

[c] Data from own fieldwork, as presented in Gomes (1998). This case has additional category for "leading" firms given the overwhelmingly dominance of the two largest firms in the sector. Also, the discontinuous ranges for area planted reflect the large difference in area between the leading and large firms, and a smaller difference between the area planted by the large firms and at least some of the medium growers.

Appendix C. Distribution of interviews by respondents and cases

	SC	PJ	RN	Total	Share
Large growers	10	7	22	39	18%
Medium and small growers	12	8	30	50	23%
Public sector researchers	6	7	15	28	13%
Other public sector technicians[a]	4	14	58	76	35%
Input suppliers	1	3	6	10	5%
Importers	0	4	3	7	3%
Federal level: Ministry and CNPq				6	3%
Total	33	43	134	216	100%

[a] Includes directors and other non-research technical staff from EPAGRI in SC; CPATSA, CODEVASF, USDA, Bank of the Northeast, and CEFET (Agronomy school) in PJ; and Bank of the Northeast (economics research office in Fortaleza and bank agency in Mossoro), and EMBRAPA Tropical Agroindustry (in Fortaleza) for RN.

Appendix D. Share of largest firms in each case

Case/Firm name	Production (ha)	Share of state production
Santa Catarina - apples[a]		
Fischer	3,600	26%
Agricola Fraiburgo	1,600	11%
Pomifrai	1,450	10%
Renar	1,100	8%
Agropel	1,000	7%
SANJO	900	6%
Total state production, 2002	14,079	
Share of largest firms (minus SANJO)		62%
Petrolina-Juazeiro - mangos[b]		
Fruitfort	380	3%
Ebraz	375	3%
Nova Fronteira	342	3%
Timbauba	300	2%
Agrobras	300	2%
Aguisa	280	2%
Agrodan	250	2%
Total state production, 2002	12,117	
Share of largest firms		18%
Petrolina-Juazeiro - grapes		
CAJ	690	12%
Fazenda Milano	320	6%
Timbauba	250	4%
Fruitmag	200	4%
Special Fruit	150	3%
Agropecuaria Vale das Uvas	140	2%
Agropecuaria Labrunier	130	2%
Logos Butia Agropecuaria	125	2%
Total state production	5,682	
Share of largest firms (minus CAJ)		23%
Rio Grande do Norte - melons[c]		
MAISA	2,000	32%
FRUNORTE	900	14%
Fazenda Sao Joao	550	9%
Santa Julia	500	8%
Transeuropa	300	5%
Total state production, 1997	6,243	
Share of largest firms		68%

[a] Data for 2000/2001, from fieldwork.

[b] Data from personal communication with VALEXPORT, August 2004, except for Fazenda Milano (grapes), obtained separately. Total state production refers to production in the states of Pernambuco (Petrolina) and Bahia (Juazeiro), as listed in Appendix A.

[c] Data from Gomes (1999). All but Transeuropa have since gone bankrupt. The new lead firm, Nolem, is a descendant of MAISA and currently produces 3,000 ha, or 60% of RN's total melon production (based on the more recent estimate of 5,012 ha planted in RN). This table presents the 1997 scenario for RN and not the 2002 (like the other cases) because it was these larger firms prominent in RN until the early 2000s that shaped the melon industry.

REFERENCES

ACARESC (1977). "Projeto de Fruticultura de Clima Temperado (PROFIT): Relatório 1970-1977." Secretaria de Agricultura e Abastecimento, Governo do Estado de Santa Catarina. Florianópolis: ACARESC.

Agland (1998). "Iniciative pelo Nordeste." Relatório Fase II. Agland Investment Services. Fortaleza, Ceará.

Albuquerque, Lessandro (2001). "The Current and Future Prospects of the Brazilian Fruit Suppliers to the EU: Opportunities, Challenges, and Sustainability." Report written for Capespan International.

Alston, Julian M., Philip G. Pardey, and Johannes Roseboom (1998). "Financing Agricultural Research: International Investment Patterns and Policy Perspectives." *World Development* 26(6):1057-1071.

Alves da Silva, Jose Maria, Alberto Martins Resende, and Carlos Arthur Barbosa da Silva (1996) "Avaliação dos Polos Agroindustriais do Semi-Árido Brasileiro: Condicionantes Críticos do Desenvolvimento do Polo Petrolina-Juazeiro.", Ministry of the Environment, Water Resources, and the Legal Amazon and the Arthur Bernardes Center of the Federal University of Viçosa: Brasilia.

Andrade, Luciara Maria de (1998). "Sustentabilidade Ambiental e Fruticultura no Nordeste Brasileiro: O Caso do Polo Açu/Mossoró." Masters thesis. Department of Geography, Federal University of Rio Grande do Norte. Mossoró.

Archibugi, Daniele, Jeremy Howells, and Jonathon Michie (1999). "Innovation Systems and Policy in a Global Economy." In Archibugi, Daniele, Jeremy Howells, and Jonathon Michie (editors), *Innovation Policy in a Global Economy*. Cambridge: Cambridge University Press.

Attwood, Donald, and B. Baviskar (1987). "Why Do Some Cooperatives Work But Not Others?" *Economic and Political Weekly Review of Agriculture* 22(26):A38-A55.

Barry, A.R. and W.R. Cline (1979). *Agrarian Structure and Productivity in Developing Countries*. Baltimore, MD: The Johns Hopkins University Press.

Barzelay, Michael (1991). "Managing Local Development: Lessons from Spain." *Policy Sciences* 24:271-190.

Beintema, Nienke M., Antonio Flavio Dias Avila, and Philip Pardey (2001). *Agricultural R&D in Brazil: Policy, Investments, and Institutional Profile*. Washington, D.C.: International Food Policy Research Institute. August.

Biggs, Stephen, and Grant Smith (1998). "Beyond Methodologies: Coalition-Building for Participatory Technology Development." *World Development* 26(2):239-248.

Binswanger, Hans P. and Miranda Elgin (1990). "Reflections on Land Reform and Farm Size." In C.K. Eicher and J.M. Staatz (Eds.), *Agricultural Development in the Third World*. Second Edition. Baltimore, MD: The Johns Hopkins University Press.

BNB/IICA (1997). "Programa de Apoio Creditício à Reorientação da Pequena e Média Unidade Produtiva Rural do Semi-Árido Nordestino (PRODESA): Avaliação Global e Proposta de Aperfeiçoamento." Fortaleza: Banco do Nordeste.

Boeing, Guido (1998). "Informe Conjuntural: Maçã." Florianópolis: Instituto CEPA.

Bonelli, Regis (2001). "Impactos Econômicos e Sociais de Longo Prazo da Expansão Agropecuária no Brasil: Revolução Invisível e Inclusão Social." Texto para Discussão No. 838. Rio de Janeiro: Instituto de Pesquisa Econômica Aplicada (IPEA).

Boneti, José Itamar da Silva, Jorge Dotti Cesa, José Luiz Petri, and Roque Hentschke (1999). *Cadeias Produtivas do Estado de Santa Catarina: Maçã*. Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina S.A. (EPAGRI). Florianópolis: EPAGRI.

Brockett, Charles D. (1997). "The Agro-Export Development Model in Central America: An Assessment of Recent Trends." Prepared for delivery at the 1997 meeting of the Latin American Studies Association, Guadalajara, Mexico, April 17-19.

Calvin, Linda, William Foster, Luis Solorzano, J. Daniel Mooney, Luis Flores, and Veronica Barrios (2002). "Response to a Food Safety Problem in Produce: A Case Study of a Cyclosporiasis Outbreak." In B. Krissoff, M. Bohman, and Julie Caswell (editors), *Global Food Trade and Consumer Demand for Quality*. New York: Kluwer Academic/Plenum.

Carraro, Antonio Fernando and Marcelo Mancuso da Cunha (1994). *Manual de Exportação de Frutas*. Brasilia: Instituto Interamericano de Cooperação para a Agricultura.

Carroll, Thomas F. (1971). "Peasant Cooperation in Latin America." In Worsley, Peter (editor), *Two Blades of Grass*. Manchester: Manchester University Press.

Carter, Michael R., Bradford Barnham, and Dina Mesbah (1996). "Agricultural Export Booms and Rural Poor in Chile, Guatemala, and Paraguay." *Latin American Research Review* 31(1):33-65.

Carvalho, José Márcio (1996). "Comercialização de Frutos de Qualidade: A Importância dos Tratamentos Pós-Colheita." Master's thesis. Department of Rural Business Administration. Federal University of Lavras. Lavras, Minas Gerais.

Carvalho, Otamar de (1988). *A Economia Política do Nordeste: Secas, Irrigação e Desenvolvimento*. Rio de Janeiro: Editora Campus.

Cavalcanti, Josefa Salete Barbosa (1999). "Globalização e Processos Sociais na Fruticultura de Exportação do Vale do São Francisco." In Cavalcanti, Josefa Salete Barbosa, org., *Globalização, Trabalho, e Meio Ambiente: Mudanças Socioeconômicas em Regiões Frutículas para Exportação*. Recife: Editora Universitária da Universidade Federal de Pernambuco.

CNPq (1995). "Programa Biotecnológico de Apoio à Competitividade Internacional da Agricultura Brasileira – BIOEX." Draft for discussion at Fruit Seminar. Conselho Nacional de Desenvolvimento Tecnológico e Científico. Brasília. July.

Collins, Jane L. (1995) "Farm Size and Non-traditional Exports: Determinants of Participation in World Markets." *World Development* 23(7):1103-1114.

Damiani, Octavio (1999). "Beyond Market Failures: Irrigation, the State, and Non-traditional Agriculture in Northeast Brazil." Ph.D. dissertation. Department of Urban Studies and Planning, Massachusetts Institute of Technology.

Dirven, Martine (1996). "Agroindustry and Small Scale Agriculture: A Comparative Synthesis of Different Experiences." Report LC/R.1663. Economic Commission for Latin America and the Caribbean. Santiago, Chile.

DISNC (1999). Caracterização socio-econômica dos produtores dos distritos de irrigação Senador Nilo Coelho (PE) e Maria Tereza (BA). Petrolina: Distrito de Irrigação Senador Nilo Coelho.

DISNC (2001). "Perímetro Senador Nilo Coelho." Petrolina: Distrito de Irrigação Senador Nilo Coelho.

Dolan, Catherine, and John Humphrey (2004). "Changing Governance Patterns in the Trade in Fresh Vegetables between Africa and the United Kingdom." *Environment and Planning A* 36(3):491-509.

Dotti Cesa, Jorge (1998). "Relação entre Qualidade e Preços na Produção de Maçãs dos Fruticultores da Cooperativa Regional Agropecuária Serrana Ltda. – COOPERSERRA." Graduate program in Business Administration of FURB/UNIPLAC (Universidade Regional de Blumenau/Universidade do Planalto Catarinense). São Joaquim. March.

Echeverría, Ruben G. (1998). "Agricultural Research Policy Issues in Latin America: An Overview." *World Development* 26(6):1103-1111.

Egan, Mary Lou, and Ashoka Mody (1992). "Buyer-Seller Links in Export Development." *World Development* 20(3):321-334.

ESAM/NEP (2000). "Produção Científica/Tecnológica: 10 Anos de Pesquisa em Pós-Colheita Junto ao Setor Produtivo." Núcleo de Estudos em Pós-Colheita, Escola Superior de Agricultura de Mossoró.

Evans, Peter (1996). "Government Action, Social Capital and Development: Reviewing the Evidence on Synergy." *World Development* 24(6):1119-1132.

Faiguenbaum, Sergio, Julio Berdegué, and Thomas Reardon (2002). "The Rapid Rise of Supermarkets in Chile: Effects on Dairy, Vegetable, and Beef Chains." *Development Policy Review* 20(4):459-471.

Farina, Elizabeth M. M. Q. (2002). "Consolidation, Multinationalisation, and Competition in the Supermarket and Processing Sectors in Brazil: Impacts on Horticulture and Dairy Products." *Development Policy Review* 20(4):317-334.

FIESC (2001). "Cultura da Maçã Brasileira." Federação da Indústria do Estado de Santa Catarina. Florianópolis: FIESC.

Fitzgerald, Deborah (1990). *The Business of Breeding: Hybrid Corn in Illinois, 1890-1940*. Ithaca and London: Cornell University Press.

Freitas, Gilvan Sidronio de (1978). "Incentivos Fiscais em Fruticultura de Clima Temperado." In *Anais do I Encontro Nacional de Fruticultura de Clima Temperado*, Florianópolis, March 6-10. Florianópolis: Santa Catarina State Secretary of Agriculture.

Gasques, José Garcia (2001). "Gastos Públicos na Agricultura." Texto para Discussão No. 782. Instituto de Pesquisa Econômica Aplicada. Brasilia: IPEA.

Gertler, Meric S., David A. Wolfe, and David Garkut (2000). "No Place Like Home? The Embeddedness of Innovation in a Regional Economy." *Review of International Political Economy* 7(4):688-718.

Gertler, Meric S., and David A. Wolfe (2002). *Innovation and Social Learning: Institutional Adaptation in an Era of Technological Change*. Basingstoke: Palgrave Macmillan.

Gibbon, Peter (2003). "Value-Chain Governance, Public Regulation and Entry Barriers in the Global Fresh Fruit and Vegetable Chain into the EU." *Development Policy Review* 21(5-6):615-625.

Globo Rural (1999). "Maçã, Frutos da Maturidade: Macieras catarinenses produzem a sua melhor safra." June, pp. 26-30.

Glover, D. and K. Kusterer (1990). *Small Farmers, Big Business: Contract Farming and Rural Development.* New York: St. Martin's Press.

Gomes da Silva, Aldenor (1992). *A Parceria na Agricultura Irrigada no Baixo Açu.* Centro de Ciências Humanas, Letras e Artes, Universidade Federal do Rio Grande do Norte. Natal, RN: UFRN.

Gomes da Silva, Aldenor (1999). "Trabalho e Tecnologia na Produção de Frutas Irrigadas no Rio Grande do Norte." In Cavalcanti, Josefa Salete Barbosa, org., *Globalização, Trabalho, e Meio Ambiente: Mudanças Socioeconômicas em Regiões Frutículas para Exportação.* Recife: Editora Universitária da Universidade Federal de Pernambuco.

Gomes, Raquel (1996). "Socioeconomic, Management, and Institutional Determinants of Technical Efficiency: The Case of Small Producers in Irrigated Agriculture in Northeast Brazil." Masters thesis. Department of Agricultural Economics, The University of Arizona.

Gomes, Raquel (1999). "Unexpected Growth and Unintended Spillovers: The Making of the Melon Industry in Mossoró-Assú, Northeast Brazil." First Year Doctoral Paper. Department of Urban Studies and Planning, Massachusetts Institute of Technology. February (Revised).

Granovetter, Mark S. (1973). "The Strength of Weak Ties." *American Journal of Sociology* 78(6):1360-1380.

Granovetter, Mark S. (1985). "Economic Action and Social Structure: The Problem of Embeddedness." *American Journal of Sociology* 91(November):481-510.

Hall, Andrew, Geoffrey Bocket, Sarah Taylor, Sivamohan, and Norman Clark. "Why Research Partnerships Really Matter: Innovation Theory, Institutional Arrangements and Implications for Developing New Technology for the Poor." *World Development* 29(5):783-797.

Hayami, Yujiro, and Vernon W. Ruttan (1985). *Agricultural Development: An International Perspective.* Baltimore: The Johns Hopkins University Press.

Henson, Spencer, and Rupert Loader (2001). "Barriers to Agricultural Exports from Developing Countries: The Role of Sanitary and Phytosanitary Requirements." *World Development* 29(1):85-102.

Hentske, Roque (1994). "Maçã: Estudo da situação catarinense frente ao MERCOSUL." Documentos No. 148. Secretaria de Estado da Agricultural e Abastecimento. Empresa de Pesquisa Agropecuária e Difusão de Tecnologia de Santa Catarina S.A. (EPAGRI).

Hirshman, Albert O. (1963). "Brazil's Northeast." In *Journeys Towards Progress: Studies of Economic Policy-Making in Latin America*. New York: The Twentieth Century Fund.

Homem de Melo, Fernando (1997). "Efeitos Negativos da Política Cambial sobre os Preços Agrícolas." *Preços Agrícolas* 11(August):24-26.

Humphrey, John, and Hubert Schmitz (2000). "Governance and Upgrading: Linking Industrial Cluster and Global Value Chain Research." Working Paper No. 120. Institute of Development Studies. Sussex: IDS.

Jarvis, Lovell S. (1994). "Changing Private and Public Roles in Technological Development: Lessons from the Chilean Fruit Sector." In Anderson, J.R., ed., *Agricultural Technology: Policy Issues for the International Community*. Wallingford: CAB International.

Kennedy, Lorraine (1999). "Cooperating for Survival: Tannery Pollution and Joint Action in the Palar Valley (India)." *World Development* 27(9):1673-1691.

Kenworthy, Lane (1997). "Civic Engagement, Social Capital, and Economic Cooperation." *American Behavioral Scientist* 40(5):645-656.

Kurtz, José Oscar (1999). "Maçã em Santa Catarina: A Participação da EPAGRI." Florianópolis: Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina (EPAGRI).

Kutcher, G.P. and P.L. Scandizzo (1981). *The Agricultural Economy of Northeast Brazil*. A World Bank Research Publication. Baltimore, MD: The Johns Hopkins University Press.

Langley, Suchada (coord.) (2000). "International Financial Crises and Agriculture." WRS-99-3. International Agriculture and Trade Reports. Situation and Outlook Series. Economic Research Service, US Department of Agriculture. Washington, DC. March.

Langley, Suchada, and Chris Bolling (1999). "Brazil's Financial Crisis & the Potential Aftershocks." *Agricultural Outlook*, AGO-259(March):9-11.

Little, P. and M. Watts (1994). *Living under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa*. Madison: University of Wisconsin Press.

Locke, Richard M. (1995). *Remaking the Italian Economy*. Ithaca and London: Cornell University Press.

Marcovitch, Jacques (1996). "Ascensão, Queda, e Esperança." Presesented at the Sixth International Seminar of the Programa de Estudod dos Negócios do Sistema Agroindustrial (PENSA). University of São Paulo.

Mellor, John W. (1966). *The Economics of Agricultural Development*. New York: Cornell University Press.

Merrill-Sands, Deborah, and Marie-Hélène Collion (1994). "Making the Farmers' Voice Count in Agricultural Research." *Quarterly Journal of Experimental Agriculture* 32(3):260-272.

Meyer-Stamer, Jörg, and Silene Seibel (2002). "Cluster, Value Chain and the Rise and Decline of Collective Action: The Cases of the Tile Industry in Santa Catarina, Brazil." Paper prepared for project "The Interaction of Global and Local Governance: Implications for Industrial Upgrading." August 2002 draft. (see www.ids.ac.uk/ids/global/vw.html).

Ministerio da Agricultura (2000). *Mapeamento da Fruticultura Brasileira*. Brasilia: Ministerio da Agricultura e do Abastecimento.

Miranda, Frederico Cristino (coordinator) (1989). "Project de Irrigação Vale do Massangano (Senador Nilo Coelho): Relatório de Avaliação Ex-Post." Brasília: Companhia de Desenvolvimento do Vale do São Francisco (CODEVASF).

Murray, Warwick E. (1999). "Local Responses to Global Restructuring in the Chilean Fruit Complex." *European Review of Latin American and Caribbean Studies* 66(June):19-38.

Nadvi, Khalid, and Hubert Schmitz (1999). "Clustering and Industrialization: Introduction" *World Development* 27 (9)

Nadvi, Khalid, and Sajid Kazmi (2001). "Global Standards and Local Responses." Paper for Workshop on "The Impact of Global and Local Governance on Industrial Upgrading." Brighton: Institute of Development Studies.

Olinger, Glauco (1996). *Ascensão e Decadência da Extensão Rural no Brasil*. Florianópolis, Santa Catarina: Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, S.A. (EPAGRI).

Page, Sheila, and Rachel Slater (2003). "Small Producer Participation in Global Food Systems: Policy Opportunities and Constraints." *Development Policy Review* 21(5-6):641-654.

Peres, Pierre Nicholas, and Sonia Aparecida Lemos Lacowicz (2001). "Contribuição do Setor da Maçã para a Receita Tributária do Município de Fraiburgo." Fraiburgo: Pomagri Frutas.

Perez-Aleman, Paola (2000). "Learning, Adjustment and Economic Development: Transforming Firms, The State and Associations in Chile." *World Development* 28(1).

Perry, Martin, Richard Le Heron, David J. Hayward, and Ian Cooper (1997). "Growing Discipline Through Total Quality Management in a New Zealand Horticulture Region." *Jornal of Rural Studies* 13(3):289-304.

Portugal, Alberto Duque, and Elísio Contini (1997). "O Público e o Privado na Pesquisa Agropecuária Brasileira." In *Resumo dos Anais do XXXV Congresso Brasileiro de Economia e Sociologia Rural.* Brasília: Sociedade Brasileira e Economia e Sociologia Rural.

Powell, Walter W. (1990). "Neither Market nor Hierarchy: Network Forms of Organization." *Research in Organizational Behavior* 12:295-336.

Pray, Carl E., and Dina Umali-Deininger (1998). "The Private Sector in Agricultural Research Systems: Will it Fill the Gap?" *World Development* 26(6):1127-1148.

PROFRUTAS (1996). "Ações Básicas para o Desenvolvimento da Agricultura Irrigada no Rio Grande do Norte." Mossoró, RN: PROFRUTAS.

Pyke, Frank, Giacomo Becattini, and Warner Sengenberger (editors) (1990). *Industrial Districts and Inter-firm Cooperation in Italy.* Geneva: International Institute for Labour Studies, ILO

Ragin, Charles (1994). *Constructing Social Research: The Unity and Diversity of Method.* Thousand Oaks, CA: Pine Forge Press.

Rauch, James E. (1996). "Trade and Search: Social Capital, Sogo Shosha, and Spillovers." NBER Working Paper Series No. 5618. National Bureau of Economic Research. June.

Raynolds, Laura (1994). "The Restructuring of Third World Agro-Exports: Changing Production Relations in the Dominican Republic." In P. McMichael (editor), *The Global Restructuring of Agro-Food Systems.* Ithaca, NY: Cornell University Press.

Reardon, Thomas, and Elizabeth Farina (2001). "The Rise of Food Quality and Safety Standards: Illustrations from Brazil." Presented at the International Food and Agribusiness Association's 2001 Food and Agribusiness Symposium, June 27, Sydney.

Reardon, Thomas, and Julio A. Berdegué (2002). "The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development." *Development Policy Review* 20(4)

Reardon, Thomas, C. Peter Timmer, and Julio A. Berdegue (2003). "The Rise of Supermarkets in Latin America and Asia: Implications for International Markets for Fruits and Vegetables." In Anita Regmi and Mark Gelhar (editors), *Global Markets for High Value Food Products*. USDA/ERS.

Reifschneider, Francisco J.B., and Uma Lele (1998). "Making Competitive Grants Programs of the National Agricultural Research System Work: Learning from the Brazilian Experience." A Joint EMBRAPA-World Bank ESDAR Paper. Paper prepared for a Workshop on the EMBRAPA Management Information System (MIS). Brasilia, May 24.

Rigolon, Francisco José Zagari, and Fabio Giambiagi (1999). "A Economia Brasileira: Panorama Geral." Departamento Econômico da Área de Planejamento, BNDES.

Rocha, J. (1996). Personal communication. Operations and Management Division, Senador Nilo Coelho Irrigation Perimeter District. Petrolina. February.

Rolling, N. (1982). "Alternative Approaches in Extension." In G.E. Jones and M.J. Rolls (editors), *Progress in Rural Extension and Community Development*. New York: John Wiley and Sons.

Santos, Lucy Woellner dos (1994). "Primórdios da Pesquisa com Maçã em Santa Catarina." *Agropecuária catarinense* 7(3): 20-22.

Sampaio, Yony (1999). "Investimentos Públicos e Privados em Agricultura Irrigada e Seus Impactos Sobre o Emprego e a Renda nos Pólos de Petrolina/Juazeiro e Norte de Minas Gerais." Fundação de Apoio ao Desenvolvimento da Universidade Federal de Pernambuco (FADE). Recife: UFPE.

Schmitz, Hubert (1995). "Small Shoemakers and Fordist Giants: Tale of a Supercluster." *World Development* 23(1):9-28.

Schmitz, Hubert (1999). "Global Competition and Local Cooperation: Success and Failure in the Sinos Valley, Brazil." *World Development* 27(5):1627-1650.

Sengenberger, Werner, and Frank Pyke (1992). "Industrial Districts and Local Economic Regeneration: Research and Policy Issues." In Sengenberger, Werner, and Frank Pyke (editors). *Industrial Districts and Local Economic Regeneration.*

Silva, Jose de Souza, and Murilo Xavier Flores (1993). "Strategic Management of Agricultural Research: The EMBRAPA Experience." *Public Administration and Development* 13:249-259.

Streek, Wolfgang (1992). *Social Institution and Economic Performance: Studies of Industrial Relations in Advanced Capitalist Economies.* London: Sage.

Tendler, Judith (1984). "The Well-Tempered Capitalist: Profiles from Bolivian Coops." *Journal of the Inter-American Foundation* 8(2):37-47.

Tendler, Judith (1993). "Tales of Dissemination in Small-Farm Agriculture: Lessons for Institution Builders." *World Development* 21(10):1567-1582.

Tendler, Judith (1993). *New Lessons from Old Projects: The Workings of Rural Development in Northeast Brazil.* Washington, D.C.: Operations and Evaluations Department, The World Bank.

Tendler, Judith (1997). "Small Firms and Large Buyers: Demand-Driven Public Procurement." In *Good Government in the Tropics.* Baltimore: The Johns Hopkins University Press.

Tendler, Judith (1999). "Thoughts for a research agenda for the meeting on public-private partnerships." Paper prepared for meeting at the University of Michigan, June 25.

Tendler, Judith (2001a). Comments on "Governance and Upgrading" paper for Workshop on "Local Upgrading in Global Chains." Unpublished paper. Department of Urban Studies and Planning, MIT. February 7.

Tendler, Judith (2001b). "Public-private collaborations: influence, politics, and upgrading." Comments on "Governance and Upgrading" paper, Part 2, for Workshop on "Local Upgrading in Global Chains." Department of Urban Studies and Planning, MIT. February 11.

Tendler, Judith (2001c). "Miscellaneous comments." Comments on "Governance and Upgrading" paper, Part 3, for Workshop on "Local Upgrading in Global Chains." Department of Urban Studies and Planning, MIT. February 12.

Tendler, Judith (2001d). "Miscellanea on global buyers." Comments on "Governance and Upgrading" paper, Part 4, for Workshop on "Local Upgrading in Global Chains." Department of Urban Studies and Planning, MIT. February 12.

Tendler, Judith (2001e). "Transforming Local Economies: Lessons from the Northeast Brazilian Experience." Prepared under the auspices of the MIT/Bank of Northeast Project. August 4.

Thrupp, Lori Ann (1994). "New Harvests, Old Problems: Feeding the Global Supermarket." NACLA Report on the Americas 23(3 Nov/Dec):22-27.

Unnevehr, Laurian (2001). "LDC Food Exports and Food Safety Standards in High Income Countries: What Role for the Public Sector in Overcome Barriers to Trade?" Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign.

VALEXPORT (2002). "VALEXPORT: Há 15 Anos Unindo Forças para o Desenvolvimento do Vale do São Francisco e da Fruticultura Brasileira." Petrolina.

Walters, Alejandro (1999). "Rebuilding Technologically Competitive Industries: Lessons from Chile's and Argentina's Wine Industry Restructuring." PhD Dissertation. Department of Urban Studies and Planning. Massachusetts Institute of Technology.

Watts, Michael, and David Goodman (1997). "Agrarian Questions: Global Appetite, Local Metabolism: Nature, Culture, and Industry in Fin-de-siècle Agro-Food Systems." In Goodman, David, and Michael Watts (editors). *Globalising Food: Agrarian Questions and Global Restructuring*. London and New York: Routledge.

Wells, Miriam (1991). "Ethnic Groups and Knowledge Systems in Agriculture." *Economic Development and Cultural Change* 39(4):739-771.

Wells, Miriam (1996). *Strawberry Fields: Politics, Class, and Work in California Agriculture*. Ithaca and London: Cornell University Press.

Whatmore, Sarah (1999). "Global Agro-Food Complexes and the Reshaping of Rural Europe." In Amin, Ash and Nigel Thrift (editors), *Globalization, Institutions, and Regional Development in Europe*. Oxford: Oxford University Press.

World Vision (2001). World Vision Brazil: Fair Trade Program Summary.